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Interplay of Concurrent Positive and Negative Interpersonal Events in the Prediction of Daily Negative Affect and Fatigue for Rheumatoid Arthritis Patients

P. H. Finan, M. A. Okun, D. Kruszewski, M. C. Davis, and A. J. Zautra
Arizona State University

H. Tennen
University of Connecticut School of Medicine

Objective: The purpose of this study was to examine the interaction of daily concurrent positive interpersonal events (PIE) and negative interpersonal events (NIE) on the daily experience of negative affect and fatigue in a sample of men and women with rheumatoid arthritis. Two hypotheses were made. The blunting hypothesis predicted that NIE would nullify the beneficial influence of PIE on outcome measures, and the buffering hypothesis predicted that PIE would offset the adverse influence of NIE. ***Design:*** Participants completed up to 30 consecutive daily diaries. Multilevel modeling was used to examine the day-to-day dependencies among study variables. ***Main Outcome Measures:*** The primary outcomes were daily negative affect and fatigue. ***Results:*** In support of the blunting hypothesis, on days when NIE were diminished, PIE were associated with a greater reduction in fatigue. In contrast, consistent with the buffering hypothesis, on days when PIE were elevated, NIE were associated with a lesser increase in negative affect. ***Conclusion:*** The examination of concurrent PIE and NIE provides a unique perspective on the role of interpersonal events in affective and physiological outcomes, beyond that which can be gained from the examination of either type of event in isolation.

Keywords: fatigue, negative affect, rheumatoid arthritis, interpersonal events, stress

Individuals with chronic pain report greater fatigue than the general population (Fishbain et al., 2003; Prins, van der Meer, & Bleijenberg, 2006), and a number of factors may be responsible. Several shared neurophysiological pathologies have been proposed that link pain and fatigue, including central nervous system sensitization (Clauw, 1995), immunological deficiencies (Cruess et al., 1999), sleep disturbance (Nicassio, Moxham, Schuman, & Gevirtz, 2002), and an overlapping neurobiological architecture between pain, fatigue, and psychopathological disorders (Afari & Buchwald, 2003). Recent research has suggested that interpersonal relations, manifested by everyday events involving kith and kin, may also play a role in determining the magnitude of fatigue experienced by those with chronic pain (Davis et al., 2008). Specifically, investigations of patients with rheumatoid arthritis (RA), osteoarthritis, and fibromyalgia have shown that positive interpersonal events (PIE) are associated with lower daily fatigue and negative interpersonal events (NIE) are associated with elevated daily fatigue (Parrish, Zautra, & Davis, 2008). This prior work invites further inquiry into the dynamic interplay between PIE and NIE in the prediction of fatigue among pain patients (Zautra, Affleck, Tennen, Reich, & Davis, 2005; Zautra, Smith, Affleck, & Tennen, 2001). In this investigation, we seek to advance our understanding of adaptation to chronic illness by examining the interaction of concurrent PIE and NIE on the daily experience of fatigue in a sample of men and women with RA, a chronic autoimmune disease characterized by inflammation of the synovial joints and chronic pain (Arnett et al., 1988). Furthermore, because previous tests of the joint effects of co-occurring PIE and NIE have focused on measures of negative affect as an outcome, we also included negative affect as a dependent variable.

Several cross-sectional studies have examined whether positive and negative social exchanges exert an interactive effect on psychological distress (Rook, 2003). This research has largely been cast as testing the hypothesis that the effect of stressful interpersonal events on psychological distress is buffered by positive social exchanges. However, the findings from those studies have been mixed, with some showing that PIE were more beneficial when there were few NIE and others showing that the benefits derived from PIE were greatest when NIE were prevalent (Okun & Keith, 1998).

Nezlek and Allen (2006) discovered a buffering effect of PIE on the relations between NIE and negative affect and depressogenic mood such that the within-person positive associations between NIE and the negative outcomes were weaker on days when participants reported a greater than average number of positive social and achievement events. More recently, Longua, DeHart, Tennen,

P. H. Finan, M. A. Okun, D. Kruszewski, M. C. Davis, and A. J. Zautra, Department of Psychology, Arizona State University; and H. Tennen, Department of Community Medicine and Health Care, University of Connecticut School of Medicine.

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Correspondence concerning this article should be addressed to P. H. Finan, Department of Psychology, Arizona State University, MC 1104, Tempe, AZ 85287. E-mail: patrick.finan@asu.edu

and Armeli (2009) extended those findings by examining the extent to which personality variables moderate the buffering effect of PIE on the relation between NIE and negative outcomes. Their analyses revealed that PIE buffered the harmful impact of NIE on negative affect for individuals low, but not high, in neuroticism. Extraverts also displayed the buffering interaction effect for negative affect.

An important limitation of these studies, however, is that the samples consisted of undergraduates. Thus, it is difficult to extrapolate whether the findings of buffering effects for negative affect generalize to a clinical outcome such as fatigue in clinical samples. Studies of the within-person associations between changes in PIE and changes in NIE on outcomes such as fatigue and affect have focused only on their independent effects (Gable, Reiss, & Elliot, 2000; Parrish et al., 2008) and thus have not investigated the possibility that both PIE and NIE jointly influence fatigue and negative affect.

Given the heterogeneity of the literature and the absence of evidence regarding the dynamic interplay of PIE and NIE in patients with RA, competing hypotheses can be generated regarding the form of the joint effect of NIE and PIE on fatigue and negative affect. On one hand, it can be predicted that NIE are stressful and would be associated with greater fatigue and negative affect unless buffered by the co-occurrence of PIE (Longua et al., 2009; Nezlek & Allen, 2006; Schuster, Kessler, & Aseltine, 1990). Thus, buffering represents a protective process. On the other hand, it can be hypothesized that PIE are associated with less fatigue and negative affect, but that these relations are blunted by the co-occurrence of NIE. For instance, Pagel, Erdly, and Becker (1987) found that as negative social exchanges increased, the relation between positive social exchanges and ratings of network satisfaction decreased. In this context, blunting is a harmful process in which the benefits of PIE are negated by NIE.

In this analysis, we used daily end-of-day measurements collected via paper diaries over the course of 30 days to test hypotheses regarding the interactive effect of daily deviations in PIE and daily deviations in NIE on fatigue. We tested two opposing hypotheses regarding the form of the joint effect of PIE and NIE on fatigue. According to the buffering hypothesis, the within-person positive association between daily elevations in NIE and fatigue will be weaker on days when PIE are high. The blunting hypothesis posits that the within-person inverse relation between daily elevations in PIE and fatigue will be less on days when NIE are high. Following Longua et al.'s (2009) report, we additionally tested these competing hypotheses with negative affect as an outcome. This decision was motivated by the desire to extend the existing knowledge base on how interpersonal events interact and how that interaction is associated with negative affect in a clinical sample of patients with RA. Finally, for both fatigue and negative affect, we tested whether individual differences in neuroticism and extraversion moderated the within-person interaction of PIE and NIE on fatigue and negative affect.

To contextualize the effects of interpersonal events, we provide descriptive statistics regarding the number of PIE and NIE that occur at work, with family members, with friends, and with spouses. We replicated our main analyses to ascertain the domains in which the effects of PIE and NIE were strongest. Finally, previous research has suggested that the main effects of PIE and NIE may carry over from one day to the next (Parrish et al., 2008). Therefore, we examined whether the joint effects of PIE and NIE on fatigue and negative affect observed in same-day analyses were observed in lagged analyses.

Method

Participants

The sample included 231 people with a physician-confirmed diagnosis of RA, 70 men and 161 women between the ages of 21 and 86 ($M = 55.3$, $SD = 13.3$). Participants were recruited from the greater Phoenix metropolitan area through solicitations at health fairs, the Phoenix Veterans Affairs Hospital, local doctors' offices, and the Arthritis Foundation. Participants were included in the study if they were not taking any cyclical estrogen replacement therapies, did not have lupus, and described themselves as having RA at screening and could obtain a written confirmation of their diagnosis from their rheumatologist. Five participants were excluded from analyses because of missing data (<10 diary days completed), resulting in a final sample of 226 included in the main analyses. The sample consisted primarily of Caucasians (90%). Approximately 40% of the participants reported that they had graduated from college, and 37% indicated that they were currently employed. The average annual household income of the sample was between $30,000 and $39,999.

Of the 226 participants in the current study, 90 were included in the Parrish et al. (2008) study. In the Parrish et al. study, participants were pooled from several studies to obtain a heterogeneous chronic pain sample of patients who met specific inclusionary criteria and who could be matched on a series of pain-related dimensions.

Procedure

The data presented in this article were drawn from a larger study aimed at investigating patients with RA using daily diary methods. All participants returned an informed consent form and a release of information form by mail. Once these forms were received, research assistants confirmed RA diagnosis with participants' physicians. Subsequently, participants were sent a set of 30 daily diaries and 30 stamped envelopes addressed to the research team. Participants were then contacted by a member of the research team by phone and provided with detailed instructions to aid in the completion and mailing of the diaries. They were instructed to complete one diary each night within 30 min of bedtime and to place the completed diary in the mail the next day.

Postmark verification was monitored to substantiate compliance with instructions. After completing and mailing diaries for 3 days, participants received a telephone call from a research staff member who asked whether they had any questions regarding the diaries and encouraged them to continue completing the diaries every evening for the remainder of the 30-day period. To ensure that diaries were completed and postmarked in succession each day, research assistants monitored the postmarks. When discrepancies were detected, participants were contacted immediately and urged to comply with the time-sensitive demands of the study. Analyses revealed that 97.3% of diaries were received with a verified postmark. Of that number, approximately 82.3% of diaries were

mailed on the morning after completion.[1] Participants were paid up to $90 for returning the initial questionnaire and completing the daily diaries.

Measures

Daily fatigue. A visual analog scale was used to assess daily fatigue. Patients were asked, "What number between 0 and 100 best describes your average level of fatigue today?" A 0 would mean *no fatigue* and a 100 would mean *fatigue as bad as it can be* (Jensen, Karoly, & Braver, 1986). Day-to-day test–retest reliabilities yielded a correlation of .71. This measure is an adaptation of the standard numeric rating scale commonly used to assess pain levels (Jensen et al., 1986). It has been used in other studies as a measure of fatigue in RA patients (Pollard, Choy, Gonzalez, Khoshaba, & Scott, 2006; Parrish et al., 2008) and has compared favorably to other multidimensional measures of fatigue in RA (Wolfe, 2004). Parrish et al. (2008) reported a correlation of −.59 between the 0–100 fatigue scale and the Vitality subscale of the SF-36 (Ware & Sherbourne, 1992) among patients with RA, demonstrating concurrent validity.

Daily negative affect. Negative affect was measured in the daily diary using items from the Negative Affect subscale of the Positive and Negative Affect Schedule (Watson, Clark, & Tellegen, 1988). Participants rated 10 standard mood adjectives for negative affect using a 5-point scale ranging from 1 (*very slightly or not at all*) to 5 (*extremely*). Day-to-day test–retest reliability yielded a correlation of .93.

Daily PIE and NIE. Interpersonal events were measured using an abridged version of the Inventory of Small Life Events for older adults (Zautra, Guarnaccia, & Reich, 1988). Participants were asked whether any of 30 PIE or 29 NIE occurred that day. Interpersonal events were categorized by those that occurred at work, with one's spouse, with family, and with friends. Sum scores for both PIE and NIE were computed for each day, across domains, yielding one score for each valence. To measure stability, test–retest reliabilities were computed across days to yield an average day-to-day correlation of .53 for PIE and .43 for NIE. As expected, PIE showed greater daily stability than NIE.

Neuroticism and extraversion. Neuroticism and extraversion were assessed using their respective subscales from the self-report version of the NEO Personality Inventory (Costa & McCrae, 1992). Items from both subscales were scored on a 5-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Reliability and validity data are provided in the NEO Personality Inventory—Revised manual (Costa & McCrae, 1992).

Data Analysis

Repeated daily measurements in our study resulted in a hierarchical nested data structure, with up to 30 observations nested within each participant. Multilevel modeling is optimal for such designs and was conducted for all analyses using SAS PROC MIXED (Littell, Henry, & Ammerman, 1998). The MIXED procedure is particularly useful when participants have varying amounts of missing data because it omits missing data points without omitting cases and uses maximum likelihood to estimate model fit when data points are unbalanced between participants. Overall, there were few missing data. Ninety-two percent of participants completed all 30 diaries, and 3.5% had 29 days of observations. Out of 6,780 possible observations (226 × 30), there were 6,343 observations of interpersonal events and fatigue and 6,308 observations of interpersonal events and negative affect. Thus, there were 437 and 472 missing data points (≈7%) for the primary fatigue and negative affect analyses, respectively. Missing data were assumed to be at random because no systematic mechanism for missingness was revealed in our review of the data.

Our data analytic strategy was twofold. First, we sought to characterize the Daily PIE × Daily NIE interaction on fatigue and determine whether individual differences in neuroticism and extraversion moderated those within-person dependencies. Second, we sought to replicate the effects presented Longua et al. (2009) by examining negative affect as the outcome and modeling the same within-person and cross-level interactions described earlier.

In deciding whether to model within-person variation (Level 1), between-person variation (Level 2), or both, researchers can either rely on existing theory or examine variance components for unconditional (null) models on the outcomes of interest. Longua et al.'s (2009) findings guided our decisions for the models involving negative affect as an outcome. Examination of the variance components for fatigue revealed that the within-person variance was 220.91 ($Z = 49.29$, $p < .0001$) and the between-person variance was 310.39 ($Z = 10.11$, $p < .0001$). The intraclass correlation for fatigue, which is calculated from the variance components, was .58, indicating that 42% of the variance can be explained by within-person variance. Given those findings, we found it appropriate to model both the within-person interaction of PIE and NIE and a between-person moderator (i.e., neuroticism and extraversion) of that interaction.

The Level 1 predictors, PIE and NIE, were modeled as within-person centered scores because this procedure allows for the interpretation of the intercept on the basis of the individual's mean on the independent variable of interest (Enders & Tofighi, 2007). For each observation, the participant's mean was subtracted from the daily score, yielding an index of within-person daily deviation. Centered scores are denoted in this article by the Greek letter Δ. As an example, if fatigue is the outcome and PIE is the predictor, by centering, we can interpret the intercept as the average value for fatigue when individuals are at their mean number of PIE.

The Level 1 equation was designed to answer the question of what happens to daily fatigue on days when an individual's (a) number of PIE is elevated, (b) number of NIE is elevated, and (c) number of both PIE and NIE are elevated. As an example, the daily influence of PIE and NIE on fatigue was assessed using this equation:

$$\text{Level 1:} y_{ij}\ (\text{Daily Fatigue}) = \beta_{0j} + \beta_{1j}(\Delta\text{PIE}) + \beta_{2j}(\Delta\text{NIE}) + \beta_{3j}(\Delta\text{PIE} \times \Delta\text{NIE}) + r_{ij}. \quad (1)$$

[1] This estimate reflects the actual number of diaries that were postmarked on the day subsequent to diary completion (58%), adjusted for the percentage of diaries completed on Saturday and postmarked on Monday (about one in seven, or 14.3%), as well as diaries postmarked late because of holiday, late drop-off at the mailbox, or postal service error (approximately 10%).

In this equation, there are *i* observations of fatigue for *j* individuals, β_{0j} yields an estimate of the average level of fatigue at the individual's mean PIE, β_{1j} is the coefficient for the influence of daily deviations in PIE on daily fatigue, β_{2j} is the coefficient for the influence of daily deviations in NIE on daily fatigue, β_{3j} is the coefficient for the within-person interaction of PIE and NIE on daily fatigue, and r_{ij} is the within-person error component.

At Level 2, the grand intercept and slopes are predicted by means of the within-person slopes, the individual difference moderator, and the relations between the slopes and the moderator for each person. A more detailed guide on how to model daily events within a multilevel framework can be found elsewhere (Nezlek, 2001).

The model specifications followed Singer's (1998) recommendations to identify the best-fitting model of the variances and covariances of the variables under study. The Level 1 predictors were modeled as random variables and were removed if they contributed to a worse fit. All models included a first-order autoregressive variance–covariance matrix to account for autocorrelation between observations.

Results

Descriptive Analyses

The means, standard deviations, and between-person correlations for study variables are presented in Table 1. Participants reported a moderate level of fatigue on average ($M = 32.77$, $SD = 22.98$). Participants reported more PIE ($M = 5.01$, $SD = 3.07$) than NIE ($M = 0.92$, $SD = 1.41$). Each day, participants reported an average of 1.42 ($SD = 0.82$) positive interpersonal work events, 0.33 ($SD = 0.51$) negative interpersonal work events, 2.16 ($SD = 1.04$) positive interpersonal spouse events, 0.46 ($SD = 0.46$) negative interpersonal spouse events, 1.69 ($SD = 1.07$) positive interpersonal family events, 0.20 ($SD = 0.28$) negative interpersonal family events, 1.42 ($SD = 0.82$) positive interpersonal friend events, and 0.24 ($SD = 0.28$) negative interpersonal friend events. The most frequently endorsed PIE items in each category were "Had an enjoyable conversation with a coworker" (26.8% of days), "Expressed love to a spouse/partner" (64.6% of days), "Visited with family members" (39.1% of days), and "Visited with friends" (34.4% of days). The most frequently endorsed NIE items in each category were "Criticized by your superior at work" (7.7% of days), "Criticized by spouse/partner" (10.6% of days), "Criticized or blamed for something by a family member" (3.8% of days), and "Met and unfriendly or rude person" (3.9% of days).

Within-person correlations between daily measures are provided in Table 2. Notably, daily deviations in PIE and NIE were not correlated ($r = .022$).

Cross-Sectional Daily Analyses: Fatigue as the Outcome

The best-fitting model included daily PIE as a random effect, and so it was retained as a random effect in all models. Daily elevations in PIE predicted diminished fatigue ($\beta = -.57$, $SE = .10$), $F(1, 6342) = 30.23$, $p < .0001$, and daily elevations in NIE predicted greater fatigue ($\beta = .570$, $SE = .16$), $F(1, 6342) = 13.09$, $p < .001$. Interpretation of the beta weights indicates that a 1-unit increase in PIE was associated with a 0.57-unit decrease in fatigue, whereas a 1-unit increase in NIE was associated with a 0.57 unit increase in fatigue. The interaction between PIE and NIE was also significant ($\beta = .14$, $SE = .06$), $F(1, 6342) = 5.69$, $p < .05$. Pseudo-R^2 for the interaction was .03, indicating that the interaction term accounted for approximately 3% of the explainable variance in fatigue. Neither neuroticism ($p = .15$) nor extraversion ($p = .95$) moderated the interaction, and thus they were removed from the final model. The results of the multilevel model are summarized in Table 3, and the interaction effect is plotted in Figure 1. The primary model was subsequently rerun separately for each interpersonal domain to determine which domain or domains influenced the overall interaction effect. The interaction of work-related PIE and NIE was significant, $F(1, 3582) = 4.10$, $p < .05$, as was the interaction of family-related PIE and NIE, $F(1, 6175) = 7.50$, $p < .01$. The interaction was not significant for interpersonal spouse events ($p = .15$) and interpersonal friend events ($p = .63$).

By dichotomizing PIE and NIE into the top and bottom third of responses for graphical purposes, we can see that fatigue was elevated on days when either few PIE were reported or many NIE were reported. Fatigue was reduced only on days when many PIE were coupled with few NIE. Consistent with the blunting hypothesis, the form of the interaction effect shows that the reduction in fatigue associated with days with many PIE was diminished when participants concurrently experienced many NIE.

Table 1
Descriptives and Between-Person Correlations of Study Variables

Study variables	*M*	*SD*	1	2	3	4	5	6
1. Fatigue	32.77	22.98	—	.35**	.03	.12	.26**	−.10
2. Negative affect	1.32	0.35		—	.08	.46**	.44**	−.17*
3. PIE	5.01	3.07			—	.37**	−.05	.21**
4. NIE	0.92	1.41				—	.20**	−.09
5. Neuroticism	2.61	0.67					—	−.38**
6. Extraversion	3.28	0.55						—

Note. Between-person correlations for the daily variables (fatigue, negative affect, PIE, NIE) were conducted at their mean level, averaged across diary days. PIE = positive interpersonal events; NIE = negative interpersonal events.
* $p < .05$. ** $p < .01$.

Table 2
Within-Person Correlations of Daily Variables

Daily variables	1	2	3	4
1. Fatigue (n = 6,594)	—	.22**	−.07**	.06**
2. Negative affect (n = 6,558)		—	−.07**	.33**
3. PIE (n = 6,633)			—	.02
4. NIE (n = 6,633)				—

Note. Within-person correlations of daily variables were conducted with the within-person centered variables. The n is provided with each variable name to show the number of data points observed for each variable. The significance of the correlations should be interpreted cautiously given our large sample size. PIE = positive interpersonal events; NIE = negative interpersonal events.
** $p < .01$.

Cross-Sectional Daily Analyses: Negative Affect as the Outcome

As with the fatigue analyses, the best-fitting model included PIE as a random effect.[2] Daily elevations in PIE were associated with diminished negative affect ($\beta = -.01$, $SE = .002$), $F(1, 6307) = 32.41$, $p < .0001$, and daily elevations in NIE were associated with elevated negative affect ($\beta = .1$, $SE = .004$), $F(1, 6307) = 800.70$, $p < .0001$. The interaction of PIE and NIE was also significant ($\beta = -.004$, $SE = .002$), $F(1, 6307) = 9.51$, $p < .01$. Pseudo-R^2 for the interaction was .13, indicating that the interaction term accounted for approximately 13% of the explainable variance in negative affect. Neither neuroticism ($p = .31$) nor extraversion ($p = .74$) moderated the interaction, and they were thus eliminated from the final model. The results of this multilevel model are summarized in Table 4, and the interaction is presented graphically in Figure 2. Again, to disentangle the interaction effect by interpersonal domain, the model was rerun separately for each domain. The interaction of friend-related PIE and NIE was significant, $F(1, 6164) = 5.51$, $p < .05$, whereas a trend for significance was observed for the interaction of work-related PIE and NIE, $F(1, 3570) = 3.17$, $p = .08$. The interaction was not significant for interpersonal spouse ($p = .16$) and family ($p = .12$) events.

As can be seen in Figure 2, the slope from low to high NIE is steeper on days when PIE are diminished than on days when PIE are elevated, relative to each person's mean. Consistent with the buffering hypothesis, the form of the interaction effect indicates that on days when NIE were elevated, patients with RA experienced less negative affect if PIE were also elevated.

We performed a post hoc analysis in which we examined the interaction of PIE and NIE on positive affect. This model was not part of our a priori hypotheses but was included because of the high concurrent validity between the positive affect measure and both the negative affect and fatigue measures. A trend toward a significant interaction emerged ($\beta = -.004$, $SE = .002$), $F(1, 6322) = 3.12$, $p = .08$, suggesting that NIE blunted the beneficial impact of PIE on positive affect.

Lagged Analyses for Fatigue

To test the temporal ordering of the interaction of PIE and NIE on fatigue, the model was run predicting next-day fatigue from current-day PIE and NIE. Current-day fatigue was used as a control variable in place of an autoregressive error structure. The interaction was not significant, $F(1, 6204) = .68$, $p = .41$. However, consistent with Parrish et al.'s (2008) finding with a reduced sample, both PIE ($\beta = .42$, $SE = .09$), $F(1, 6204) = 19.51$, $p < .0001$, and NIE ($\beta = .56$, $SE = .17$), $F(1, 6204) = 10.98$, $p < .001$, predicted greater next-day fatigue.

Lagged Analyses for Negative Affect

To test the temporal ordering of the interaction of PIE and NIE on negative affect, another lagged model was tested. Again, the interaction was not significant, $F(1, 6151) = 1.34$, $p = .25$. A main effect was not observed for PIE on next-day negative affect, $F(1, 6151) = 2.69$, $p = .10$, but NIE were found to predict diminished next-day negative affect, $\beta = -.010$ ($SE = .004$), $F(1, 6151) = 4.83$, $p < .05$.

Lagged Analyses for Positive Affect

After our post hoc analysis of the interaction of interpersonal events on positive affect, we tested a lagged model to evaluate the temporal ordering of effects. The interaction was not significant, $F(1, 6180) = 0.62$, $p = .43$. Main effects were observed for both PIE ($\beta = -.01$, $SE = .003$), $F(1, 6180) = 9.74$, $p < .01$, and NIE ($\beta = .02$, $SE = .007$), $F(1, 6180) = 9.78$, $p < .01$, such that positive affect was diminished when preceded by days when either PIE or NIE were elevated.

Discussion

The current study examined the joint effects of PIE and NIE on the fatigue and negative affect ratings of people with RA. Previous daily diary studies of individuals with RA have focused on the independent effects of increases and decreases in PIE and NIE on clinical outcomes such as fatigue. For example, Parrish et al. (2008) demonstrated that days without PIE and days with NIE each contributed to elevated ratings of fatigue. Our analyses were based on the notion that the co-occurrence of PIE and NIE jointly influence daily fatigue and negative affect, in addition to their independent effects. Contrary to the buffering hypothesis, which posits that PIE would offset the adverse influence of NIE on fatigue and in accord with the blunting hypothesis, we found that NIE dampened the beneficial influence of PIE on fatigue. This effect was observed primarily in the work and family interpersonal domains and did not extend to the friend and spouse interpersonal domains. A trend for the blunting effect was also found with positive affect, but this fell short of statistical significance.

Two influences are apparent from these analyses. Low PIE was associated with high fatigue regardless of the level of NIE. Days of high PIE could lower fatigue, but only if they were not also accompanied by high NIE. High NIE served as the spoiler in our findings, blunting the benefit derived from PIE. The data appear to provide some support for the arguments offered by Baumeister,

[2] We chose not to include positive affect as a covariate for these models. If positive affect would have been included, we would have been examining the interaction between PIE and NIE on negative affect, equating participants on positive affect. In such an analysis, the effects of PIE on negative affect may have been masked.

Table 3
Multilevel Regression of PIE and NIE Predicting Fatigue

Covariance parameter estimates	Participant	β	*SE*	*Z*	*p*
		Random effects			
Intercept	ID	307.68	30.47	10.10	<.0001
ΔPIE × Intercept	ID	−3.64	1.87	−1.94	.05
ΔPIE	ID	0.86	0.21	4.16	<.0001
Residual	ID	214.59	4.43	48.45	<.0001
Predictor terms	**β**	***SE***	***df***	***T***	***p***
		Fixed effects			
Intercept	26.11	4.58	223	5.70	<.0001
ΔPIE	−0.57	0.10	6342	−5.50	<.0001
ΔNIE	0.57	0.16	6342	3.62	<.001
ΔPIE × ΔNIE	0.14	0.06	6342	2.39	<.05

Note. Complete statistics for the final multilevel model. PIE = positive interpersonal events; ΔPIE = within-person centered PIE; NIE = negative interpersonal events; ΔNIE = within-person centered NIE.

Bratlavsky, Finkenauer, and Vohs (2001), who suggested that when pitted against each other, negative experiences trump positive ones However, in the current study, the absence of NIE alone was not sufficient to lower daily fatigue. Participants reported less fatigue on days when both NIE were low and PIE were high.

Interestingly, we did find support for the buffering hypothesis when negative affect was used as the outcome, occurring primarily in the friends and work interpersonal domains. The low PIE–low NIE cell appears to be the key to understanding the difference between the forms of the interaction effects on fatigue and negative affect. Fatigue is elevated on days when both PIE and NIE are low compared with days when PIE are high and NIE are low. The benefit of PIE for fatigue, then, diminishes as NIE increase, creating a blunting effect. Negative affect, however, appears to be less affected by PIE than NIE, as evidenced by the similarity of negative affect ratings on days when either a high or a low number of PIE co-occur with a low number of NIE. The benefit of PIE for negative affect is most apparent as NIE increase, creating a buffering effect. In the context of these results, a heuristic helps distinguish between blunting and buffering effects: Blunting occurs when the beneficial effect of something good is diminished by something bad, and buffering occurs when the inimical effect of something bad is diminished by something good. The important message here is that the examination of PIE or NIE in isolation yields an incomplete and potentially misleading picture of how daily interpersonal events affect same-day fatigue.

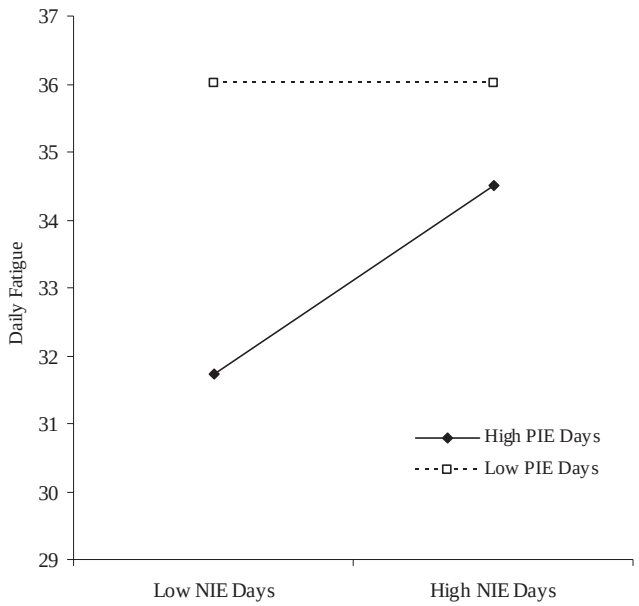

Figure 1. The interaction of changes in positive interpersonal events (PIE) and changes in negative interpersonal events (NIE) in the prediction of daily fatigue. Slopes for the figure were generated by dichotomizing positive and negative interpersonal event days into the top and bottom thirds of responses. Note that the slopes in this graph were generated for visual purposes, and the significance of the interaction was determined by the beta estimate for the continuous within-person interaction.

We speculate that the blunting effect may occur for fatigue because the physical and emotional activation that results from the co-occurrence of high levels of PIE and NIE may simply exhaust patients with RA to the point to which they cannot fully experience the vitality provided by PIE. Clearly, this effect should be explored in the general population and other chronic pain groups to determine the extent to which disease-specific energy depletion may have factored into the observed effects. The buffering effect on negative affect may be explained by the dynamic model of affect (DMA; Zautra et al., 2001). Under conditions of relative calm, positive and negative affect are generally independent (Zautra et al., 2001). Consistent with this notion, our results indicate that in the absence of NIE, negative affect is not differentially influenced by varying numbers of PIE. Thus, on days when NIE are minimal, the positive affect that presumably is derived from PIE appears to have little impact on the level of negative affect. The DMA holds, however, that conditions of adversity yield a more bipolar relation between positive and negative affect (Reich, Zautra, & Davis, 2003). In accord with the tenets of the DMA, on days when NIE are high relative to a person's mean, negative affect is differentially influenced by high versus low PIE. Thus, it is reasonable to

Table 4
Multilevel Regression PIE and NIE Predicting Negative Affect

Covariance parameter estimates	Participant	β	*SE*	*Z*	*p*
		Random effects			
Intercept	I. D.	0.11	0.01	9.97	<.0001
ΔPIE × Intercept	I. D.	−0.001	0.0007	−1.67	.10
ΔPIE	I. D.	0.0003	0.00009	2.89	<.01
Residual	I. D.	.12	.002	50.00	<.0001
Predictor terms	**β**	***SE***	***df***	***T***	***p***
		Fixed effects			
Intercept	1.32	.02	224	56.87	<.0001
ΔPIE	−0.01	.002	6307	−5.69	<.0001
ΔNIE	0.10	.004	6307	28.30	<.0001
ΔPIE × ΔNIE	−0.004	.001	6307	−3.08	<.01

Note. Complete statistics for the final multilevel model. PIE = positive interpersonal events; ΔPIE = within-person centered PIE; NIE = negative interpersonal events; ΔNIE = within-person centered NIE.

conjecture that the positive affect presumably derived from PIE becomes more strongly coupled to negative affect as NIE increase.

Contrary to Longua et al.'s (2009) findings, neither neuroticism nor extraversion moderated the PIE × NIE interaction for either fatigue or negative affect. One possible explanation for this null finding is that for adults with RA, as opposed to healthy college students, the dynamic interplay of interpersonal events is driven more by disease-related individual difference variables than by general personality factors. It is also possible that interpersonal events may serve as mediators between personality features and clinical outcomes such as fatigue and negative affect. In a separate study of women with RA and osteoarthritis, Smith and Zautra (2008) found that personality features associated with vulnerability and resilience, respectively, were associated with the frequency of negative and positive interpersonal exchanges. Thus, neuroticism and extraversion, or factors associated with them, may predispose individuals to experience more interpersonal events, which, in turn, influence their fatigue and negative affect. Such a mediational model should be explored to explicate the between-person variance in the joint effects of PIE and NIE on fatigue and negative affect.

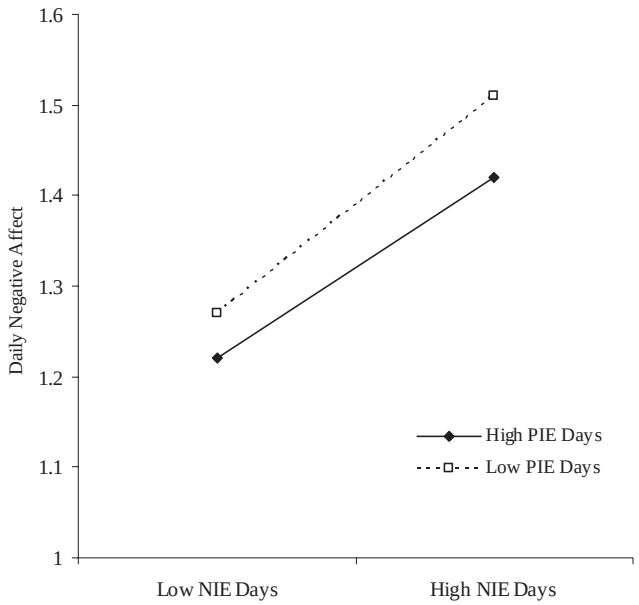

Figure 2. The interaction of changes in positive interpersonal events (PIE) and changes in negative interpersonal events (NIE) in the prediction of daily negative affect. Slopes for the figure were generated by dichotomizing positive and negative interpersonal event days into the top and bottom thirds of responses. Note that the slopes in this graph were generated for visual purposes, and the significance of the interaction was determined by the beta estimate for the continuous within-person interaction.

Our lagged analyses suggested that the co-occurrence of PIE and NIE did not explain next-day fatigue and negative affect. Main effects revealed that fatigue and positive affect were both diminished when preceded by days in which interpersonal events of either valence were elevated, whereas negative affect was diminished when preceded by days in which NIE were elevated. This pattern of findings appears at first blush to be counterintuitive and requires further exploration. It is possible that the next-day reduction in negative affective intensity is a compensatory reaction to the elevated affective engagement associated with the interpersonal interactions on the preceding day. Under this view, the diminished negative affect, positive affect, and fatigue on the next day after a day when many PIE and NIE occur would reflect a restorative process intended to promote homeostatic balance. Clearly, this is a speculative explanation for surprising results and requires empirical testing.

As noted earlier, using a sample that included 90 participants included in the current study, Parrish et al. (2008) reported a lagged effect of PIE on next-day fatigue. Our findings, then, extend those analyses in several unique ways. First, we included more than twice as many participants ($N = 226$ overall, or 136 new participants), providing a more powerful test of the lagged PIE effect on fatigue. Second, we examined both negative and positive affect as next-day outcomes, finding lagged effects for both variables. Third, we tested for the interaction of PIE and NIE on

next-day outcomes. Overall, this set of analyses revealed a pattern of elevated fatigue and diminished affective intensity that carries over from days in which either PIE or NIE are elevated. That the interaction of PIE and NIE does not carry over to next-day fatigue and affective outcomes suggests that the model was underpowered to detect the lagged influence of such a small effect. Before conclusions can be drawn about the temporal ordering of the interactive effects of PIE and NIE, data should be collected from a larger sample to provide adequate power.

We additionally examined the main and interactive effects of interpersonal events in four domains: work, spouse, family, and friends. The interaction between PIE and NIE on fatigue was not apparent when examined specifically within the spouse and friend domains, and the interaction on negative affect was not apparent within the spouse and family domains. We note that the interactions were not observed for spouses and tended to be observed for workers. A statistical explanation for the lack of interaction effects in the spousal domain is that half of our sample did not have a spouse and thus our statistical power to detect interaction effects in this domain was substantially reduced. Perhaps interaction effects were observed for both negative affect and fatigue in the work domain because interpersonal events with coworkers and supervisors were less predictable than interpersonal events with spouses, family members, and friends.

Clinical Implications

The findings of the present study may have clinical implications for the treatment of patients with disorders that may be influenced by interpersonal events. The scheduling of positive experiences is a common prescription of behavioral therapy (Needles & Abramson, 1990), and positive affect has been shown to promote resilient responding among chronic pain patients (Zautra, Johnson, & Davis, 2005). However, the benefit of pleasant daily social events may not be realized unless attention is also given to interpersonal relationships that lead to conflict and any possible iatrogenic effects on the social world of patients trying to bolster their positive experiences. Thus, our findings provide support for behavioral monitoring of the co-occurrence of PIE and NIE. Moreover, cognitive therapeutic techniques, which teach adaptive appraisal strategies for relevant interpersonal events, may also be informed by these findings. For example, appraisal of NIE may differ depending on whether it occurred in the context of PIE and whether an individual has a history of fatigue or affective reactivity to interpersonal events. Our Interpersonal Event $\times$ Domain findings suggest that cognitive–behavioral therapy focused on monitoring and appraisal of PIE and NIE may be effective in group, family, and couples therapy contexts.

Prior two-dimensional investigations of event–affect relations have shown that the absence of interpersonal discord does not raise positive emotion (Zautra et al., 2001), but here the results show that the presence of discord can negate the value of concurrent positive experiences on fatigue. The lack of within-person correlation between daily PIE and NIE in the present study ($r = .02$) suggests that clinicians should monitor the occurrence of both types of events rather than assuming the presence or absence of one type of event given the other. If NIE undermine the benefits of PIE, then patients with RA who follow a therapeutic regimen of increasing engagement in PIE may not experience a concomitant reduction in fatigue. Over time, this could result in a withdrawal from interpersonal activity altogether. Such a coping strategy may be useful in the short term, but the resulting social isolation is maladaptive in the long term. Ultimately, if a similar pattern of blunting for fatigue and buffering for negative affect is found in other clinical samples, the results would be informative for clinicians charged with the task of negotiating the Faustian bargain of elevated fatigue for reduced negative affect.

Any potential clinical extrapolation of the present results should come with the caveat that only 3% of the explainable variance in fatigue was accounted for by the interaction of PIE and NIE. The same interaction accounted for a larger proportion of explainable variance, 13%, in negative affect. One reason for this discrepancy could be that fatigue in RA is more directly influenced by disease factors than by interpersonal context, whereas interpersonal context has direct implications for the affective experience. Nonetheless, even very small effects detected in microlongitudinal studies such as this one may have more important long-term implications because they are experienced day after day, perhaps compounding over time.

Limitations and Directions for Future Research

We found considerable between-person variance in fatigue suggesting that Level 2 variables may explain individual differences in the observed interaction. Future efforts should explore potential moderating variables related to both physical and psychosocial well-being for patients with RA to account for the between-person variance in fatigue and negative affect. For example, Rook (2003) found that self-esteem predicted reactivity to negative social exchanges. Because individuals with high self-esteem are able to deflect negative social exchanges, negative social exchanges may negate the benefits associated with the occurrence of positive social exchanges only among individuals with low self-esteem.

The degree of fatigue reported by patients with RA in this study is somewhat less than what has been reported in studies of older and, perhaps, sicker patients (Belza, Henke, Yelin, Epstein, & Gillis, 1993; Pollard et al., 2006). Thus, the current findings may not be generalizable to RA patients in all age groups and at every level of illness severity and duration. Although the variance in interpersonal events may diminish as illness increases, studies of the relations of interpersonal events with fatigue and affect may be warranted in other chronically ill populations whose adaptation is likely to be affected by interpersonal experiences (Manne et al., 2008).

In the current study, despite our finding that the signs of the beta weights for the blunting and buffering effects were opposite, and the graphical depictions of these effects, we cannot rule out the possibility that the base-rate differential between PIE and NIE may have influenced the directions of the interaction effects reported. Another important limitation is that despite the considerable flexibility of multilevel designs, the within-person associations reported here are still cross-sectional at the level of day. Moreover, there was no evidence that the joint effects of PIE and NIE carried over from one day to the next. Thus, we cannot conclude that the interaction of events causally affected fatigue or negative affect. In fact, it is plausible to speculate that a bidirectional relation between our predictors and outcomes may have existed. To address this issue, it would be useful to employ experimental designs in which

interventions are targeted to (a) increase the frequency of occurrence of PIE and (b) reduce negative affect. By using intervention designs that treat both interpersonal events and affect–physical symptoms as independent variables, researchers will be able to assess whether PIE exert an impact on clinical outcomes and whether affective states and physical symptoms influence the quantity and valence of interpersonal events.

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