Cancer-related fatigue in a couples’ context
Müller, Fabiola

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Daily co-rumination mediates the maladaptive effect of spouse catastrophizing on cancer patient’s fatigue

Fabiola Müller, Mariët Hagedoorn, Emily C. Soriano, Ellen Stephenson, Ans Smink, Christiaan Hoff, Anita DeLongis, Jean-Philippe Laurenceau, Marrit A. Tuinman
Abstract

Objective: Fatigue is a prevalent symptom among post-treatment cancer patients. Patients’ catastrophizing thoughts about their fatigue are known to worsen fatigue. Spouses may also engage in catastrophizing about patient fatigue, contributing to increases in fatigue. However, the pathway through which catastrophizing influences symptoms is poorly understood. The current study hypothesized that patient and spouse catastrophizing translate into worse fatigue through co-rumination—extensively talking about fatigue-related worries (H1). Co-rumination, while maladaptive for patients’ symptoms, was predicted to foster couples’ relationship satisfaction (H2).

Method: Dutch post-treatment colorectal cancer patients (Mean age (SD) = 64.3(10.2), 66.3% male) and their spouses (n = 101 dyads) completed daily diaries for 14 days. Patients and spouses reported on their catastrophizing about the patients’ fatigue, co-rumination, and their momentary relationship satisfaction. Patients also reported on their momentary fatigue severity. Multilevel structural equation modelling was applied to test within-person actor- and partner-effects between catastrophizing, co-rumination and fatigue (H1) and co-rumination and relationship satisfaction (H2) while controlling for previous levels of the outcome.

Results: While patient catastrophizing was only directly related to patient fatigue ($b = 0.52$, 95% Credibility Interval [CI] [0.09, 0.95]), as expected, the effect of spouse catastrophizing on patient fatigue was mediated through co-rumination ($b = 0.32$, 95% CI [0.07, 0.60]). Patient- and spouse-reported co-rumination were unrelated to both dyad members’ relationship satisfaction.

Conclusions: Co-rumination emerged as a dyadic pathway that explained how spouse cognitions translate into worse patient fatigue. Reducing patient and spouse catastrophizing and fostering adaptive dyadic communication could be targets for interventions aiming to relieve fatigue in post-treatment cancer patients.

Keywords: cancer-related fatigue, catastrophizing, co-rumination, intensive longitudinal design, relationship satisfaction
What is the public health significance of this article?
Fatigue is a distressing symptom many cancer patients experience. Patients’ catastrophizing thoughts about their fatigue (e.g., ‘I cannot bear the fatigue any longer’) are known to maintain fatigue after treatment completion. This study indicates that spouses of cancer patients also catastrophize about the patients’ fatigue, which further exacerbates fatigue through couples’ co-rumination—extensively talking about fatigue-related worries. Findings suggest that interventions targeting patient and spouse catastrophizing and fostering adaptive communication could relieve the fatigue burden in the growing group of patients treated for cancer.
Background

Fatigue is a distressing symptom experienced by the majority of cancer patients, and for some patients, fatigue persists even long after treatment has been completed (Abrahams et al., 2016; Husson et al., 2015; Jones et al., 2016). Evidence suggests that maladaptive cognitions and behaviors perpetuate fatigue after treatment completion (e.g., Donovan, Small, Andrykowski, Munster, & Jacobsen, 2007; Goedendorp, Gielissen, Verhagen, & Bleijenberg, 2013). The current diary study investigates a dyadic cognitive-behavioral pathway to further our understanding of the mechanism through which catastrophizing cognitions exacerbate symptoms. We argue that cognitions of both members of a couple may influence the experience of fatigue following cancer through joint ruminative conversations. Moreover, such maladaptive ruminative communications may be sustained as they might foster both couple members’ relationship satisfaction. This study contributes to identifying potential targets for cancer-related fatigue interventions in dyads.

Catastrophizing, defined as a set of maladaptive cognitions that is characterized by focusing on negative thoughts and feelings about a symptom (Severeijns, Vlaeyen, & van den Hout, 2004), has consistently been identified as a major risk factor for the perpetuation of fatigue after completion of cancer treatment. That is, several longitudinal studies (Goedendorp et al., 2013; Lukkahatai & Saligan, 2013) and our recent diary study (Müller et al., 2018) demonstrated that patient catastrophizing predicts higher levels of cancer-related fatigue. In these studies, only patients’ catastrophizing about their own fatigue has been investigated. However, fatigue is a highly distressing and often persistent symptom that can fundamentally disrupt several domains of daily life (Donovan, McGinty, & Jacobsen, 2013; Jones et al., 2016). As such, patients’ spouses also are affected by, and may thus catastrophize about, patients’ fatigue. There is some evidence from studies on coping with chronic pain that spouses also catastrophize about patients’ symptoms (Cano, Leonard, & Franz, 2005; Leonard & Cano, 2006). While limited by their cross-sectional design, these studies suggest that patients whose spouses show higher level of catastrophizing experience worse pain outcomes. However, the pathway through which maladaptive cognitions of spouses might translate into worse patient outcomes is poorly understood.

A possible pathway through which patient and spouse catastrophizing might translate into worsened fatigue is co-rumination, a dyadic process in which
problems (i.e., fatigue) get repeatedly and extensively discussed whilst focusing on negative thoughts and feelings (Rose, 2002). According to the *interpersonal emotion regulation model* (Zaki & Williams, 2013), individuals might turn to their spouses in an effort to regulate the negative emotions that are evoked by their catastrophizing thoughts (Holtzman & DeLongis, 2007; Müller et al., 2018). Alternatively, as suggested by Sullivan’s *communal coping model* (Sullivan, Tripp, & Santor, 2000; Sullivan, 2012), catastrophizing individuals may communicate their symptoms to their spouse to elicit support. In line with both models, individuals who tend to focus extensively on negative emotions or cognitions were found to be more likely to seek social support (Nolen-Hoeksema & Davis, 1999) and engage in strategies to effectively communicate their symptoms to others (Sullivan, Adams, & Sullivan, 2004). This indicates that individuals who catastrophize, both patients and spouses, are likely to turn to each other for support, which might result in co-ruminative conversations about fatigue. Engaging in co-rumination, however, has been associated with adverse symptom developments in the long-term (Rose, Carlson, & Waller, 2007; Stone, Hankin, Gibb, & Abela, 2011), as well as within days (White & Shih, 2012). Although existing studies have focused primarily on investigating symptoms of depression and anxiety in young community samples, these studies strongly suggest the potential maladaptive effect of extensively discussing negative thoughts and feelings within the dyad. Similarly, a couple’s co-rumination about fatigue is expected to increase fatigue. Hence, the first aim of our study was to investigate whether co-rumination mediates the maladaptive effect of patient and spouse catastrophizing on patient fatigue severity thus offering an explanation for how spouse catastrophizing translates into worse patient outcomes.

Although co-rumination might be maladaptive for a patient’s fatigue, as a dyadic process, it may be beneficial for the couple’s relationship. An important component of Rose’s co-rumination construct is that discussing problems within a dyad comes with an adjustment trade-off (Rose, 2002; Rose et al., 2007). That is, while co-rumination can worsen symptoms, it might foster *relationship satisfaction*. Several studies found that co-rumination fosters an individual’s satisfaction with the relationship in which the co-rumination occurred (Calmes & Roberts, 2008; Waller & Rose, 2010). This positive effect of co-rumination on the relationship is possibly due to its conceptual overlap with self-disclosure (Rose, 2002; Waller & Rose, 2010). In line with the intimacy model (Reis & Shaver, 1988), self-
disclosure appears to benefit close relationships by fostering feelings of intimacy (Laurenceau, Barrett, & Pietromonaco, 1998; Manne, Ostroff, et al., 2004). Similarly, discussing fatigue-related worries as a couple might, while worsening fatigue, simultaneously enhance the couple’s relationship satisfaction. So far, many studies investigated changes in relationship satisfaction of only one individual involved in the co-rumination process. Yet, as co-rumination is a dyadic process, both spouses’ relationship satisfaction might benefit from the mutual self-disclosure inherent to co-rumination. Gaining insight into the potential relationship enhancing effect of co-rumination for both members of the couple can increase our understanding of why this process might be sustained despite its presumed association with worsened fatigue. Therefore, the second aim of this study was to investigate whether co-rumination is related to increases in relationship satisfaction in both members of the couple.

In short, we expected daily co-rumination to mediate the link between patient and spouse catastrophizing and increased patient fatigue (H1). Daily co-rumination was also expected to be associated with increases in both couple members’ relationship satisfaction (H2). A dyadic diary method was applied, which provides ecologically valid data and allows a focus on identifying within-person effects (Bolger, Davis, & Rafaeli, 2003; Heron & Smyth, 2010). The Actor-Partner Interdependence Model (APIM; Kenny, Kashy, & Cook, 2006; Kenny, 1996) and its extension the Actor-Partner Interdependence Mediation Model (APIMeM; Ledermann & Bodenmann, 2006; Ledermann, Macho, & Kenny, 2011) provide a framework for studying the proposed hypotheses. The APIM framework accounts for the fundamental characteristic of intimate relationships—interdependence—that dyad members’ cognitions and behaviors are interrelated and that one dyad member’s cognitions and behaviors can influence his/her own outcome (i.e., actor-effect) as well as the other dyad member’s outcome (i.e., partner-effect). Figure 1 displays the models assessed.
Co-rumination mediates between catastrophizing and fatigue

Figure 1. Model predicting (a) patient fatigue, hypothesis 1 and (b) patient and spouse relationship satisfaction, hypothesis 2.

Note. Unstandardized regression coefficients are reported. Actor-effects are represented by solid lines and partner-effects by dashed lines; error covariances are represented by curved double-headed arrows and correlated error variances are depicted in circles; * indicates parameters for which 95% CIs do not include 0. Italic a, b, c indicate the paths of the (mediation) model. Subscript: the first letter indicates the role (P, patient; S, spouse) and the second letter indicates the effect (A, actor-effect; P, partner-effect), e.g., $a_{pp}$ a-path patient partner-effect. The heavy lines represent the significant mediational pathway, model (a).
Chapter 6

Methods

Participants

Patients treated for colorectal cancer were recruited from four hospitals located in the Netherlands. A nurse invited patients and their spouses during the patients’ follow-up visits or they were mailed a letter inviting them to participate in the study. Patients were eligible if they (1) completed cancer treatment at least 6 months previously, (2) were not terminally ill, (3) were married or cohabiting for at least 1 year, and (4) scored at least a 1 on average fatigue during the previous week (0 ‘no fatigue’ to 10 ‘as fatigued as I could be’) during the telephone screening. Couples were excluded from participation if one or both spouses were (1) younger than 18 years, (2) not able to understand Dutch, (3) cognitively impaired, or (4) diagnosed with chronic fatigue syndrome or fibromyalgia.

Six hundred and seven patients were potentially eligible for participation, of which 569 received study information, consent forms, and prepaid envelopes. The main reason for not providing study information was patients’ lack of interest (55%). After reviewing demographic and clinical characteristics of interested patients, 88 appeared to be not eligible. After informed consent was signed, both spouses of eligible and interested couples (n = 185) were mailed a baseline questionnaire. Couples were considered eligible for the diary component of the study if a patient’s baseline data met the cut-off score for elevated fatigue on (1) the Checklist Individual Strength (Knoop, Bleijenberg, Gielissen, van Der Meer, & White, 2007; Vercoulen et al., 1994), or (2) the Fatigue Symptom Inventory (Donovan, Jacobsen, Small, Munster, & Andrykowski, 2008; Hann et al., 1998), or (3) if patients indicated that they experienced fatigue at least 2 days during the previous week. Out of the 137 invited couples, 36 did not agree to participate in the diary component of the study, mainly due to lack of interest (39%). The final sample consisted of 101 post-treatment colorectal cancer patients and their spouses of which two were same-sex couples. These patients did not differ significantly from patients who did not agree to participate in the diary component (n = 36) on any of the study-relevant variables. Descriptive statistics for the sample characteristics and the within-person variables can be found in Tables 1 and 2.

According to Dutch law regarding medical research involving human subjects (WMO), a waiver for ethical assessment was provided by the Medical Ethical
Co-rumination mediates between catastrophizing and fatigue

Committee of the Medical University of Groningen (METc 2013/158). The study was conducted according to the declaration of Helsinki.

Table 1
Sample characteristics

<table>
<thead>
<tr>
<th></th>
<th>Patients</th>
<th>Spouses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n = 101</td>
<td>n = 101</td>
</tr>
<tr>
<td>Demographics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age, years (SD)</td>
<td>64.3 (10.2)</td>
<td>63.2 (11.2)</td>
</tr>
<tr>
<td>Gender, male</td>
<td>67 (66.3%)</td>
<td>34 (33.7%)</td>
</tr>
<tr>
<td>Relationship duration, years (SD)</td>
<td>37.7 (13.4)</td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low (primary school/LBO)</td>
<td>37 (36.6%)</td>
<td>28 (27.7%)</td>
</tr>
<tr>
<td>Medium (high school/MBO)</td>
<td>59 (58.4%)</td>
<td>70 (69.3%)</td>
</tr>
<tr>
<td>High (college/university)</td>
<td>5 (5%)</td>
<td>3 (3%)</td>
</tr>
<tr>
<td>Clinical characteristics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cancer site, colon</td>
<td>63 (62.4%)</td>
<td>.</td>
</tr>
<tr>
<td>Prognosis, good</td>
<td>78 (77.2%)</td>
<td>.</td>
</tr>
<tr>
<td>Treatment, surgery only</td>
<td>45 (44.6%)</td>
<td>.</td>
</tr>
<tr>
<td>Stoma, yes</td>
<td>50 (49.5%)</td>
<td>.</td>
</tr>
<tr>
<td>Time since diagnosis, months (SD)</td>
<td>17 (9)</td>
<td>.</td>
</tr>
<tr>
<td>Time since treatment, months (SD)</td>
<td>13 (8)</td>
<td>.</td>
</tr>
</tbody>
</table>

Note. Values represent n and %, unless otherwise indicated.
Table 2

*Descriptive statistics and bivariate correlations of the diary variables*

<table>
<thead>
<tr>
<th>Diary variables</th>
<th>Mean (SD)</th>
<th>ICC</th>
<th>Reliability</th>
<th>Number of observations&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Correlations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>R&lt;sub&gt;U&lt;/sub&gt;</td>
<td>R&lt;sub&gt;KF&lt;/sub&gt;</td>
<td>1</td>
</tr>
<tr>
<td>1 Catastrophizing, patient</td>
<td>0.35 (0.27)</td>
<td>0.77</td>
<td>0.76</td>
<td>0.996</td>
<td>1409</td>
</tr>
<tr>
<td>2 Catastrophizing, spouse</td>
<td>0.46 (0.31)</td>
<td>0.75</td>
<td>0.73</td>
<td>0.996</td>
<td>1400</td>
</tr>
<tr>
<td>3 Co-rumination, patient</td>
<td>0.37 (0.44)</td>
<td>0.60</td>
<td>0.78</td>
<td>0.99</td>
<td>1313</td>
</tr>
<tr>
<td>4 Co-rumination, spouse</td>
<td>0.50 (0.50)</td>
<td>0.56</td>
<td>0.77</td>
<td>0.99</td>
<td>1287</td>
</tr>
<tr>
<td>5 Fatigue severity&lt;sup&gt;a&lt;/sup&gt;, patient</td>
<td>4.38 (1.94)</td>
<td>0.56</td>
<td>.</td>
<td>.</td>
<td>1398</td>
</tr>
<tr>
<td>6 Relationship satisfaction&lt;sup&gt;a&lt;/sup&gt;, patient</td>
<td>8.87 (0.72)</td>
<td>0.77</td>
<td>.</td>
<td>.</td>
<td>1384</td>
</tr>
<tr>
<td>7 Relationship satisfaction&lt;sup&gt;a&lt;/sup&gt;, spouse</td>
<td>8.73 (0.73)</td>
<td>0.78</td>
<td>.</td>
<td>.</td>
<td>1360</td>
</tr>
</tbody>
</table>

Note. SD, Standard Deviation, at the within-person level; ICC, Intraclass correlation; Reliability coefficients were calculated as proposed by Cranford et al. (2006) and Shrout and Lane (2012). The within-person reliability coefficient, R<sub>U</sub>, reflects whether there are reliable within-person differences in change over time. The between-person reliability coefficient, R<sub>KF</sub>, reflects the reliability of the between-person diary average, calculated across persons and times. As the values are averaged across all assessments (K = 42 for catastrophizing, K = 14 for co-rumination), high values of > 0.9 are common. Within-person correlations are displayed below the diagonal, and between-person correlations are displayed above the diagonal. <sup>a</sup> as measured in the evening; <sup>b</sup> maximum number of observations = 1414 (14 days x 101 participants); * p < .05; ** p < .01; *** p < .001
Procedure
Diary data were collected between September 2014 and July 2016 within a larger longitudinal study investigating dyadic coping with cancer (Müller et al., in press; Müller et al., 2018). The research assistant visited couples at their homes to provide instructions for the diary procedure. Each spouse of the couple received an electronic tablet on which the diary assessments were completed 3 times daily for 14 consecutive days. Participants received a reminder signal to fill in each assessment, which was adapted to their daily routines, i.e., approximately 1 hour after waking (morning assessment), 1 hour after lunch (noon assessment) and 1 hour prior to going to bed (evening assessment). Couples were instructed to respond to the assessments independently and without discussing their answers. All participants completed the diary component and the adherence to the protocol was high: Of the total number of 1414 diary days (101 couples x 14 days), 10/12 morning assessments, 15/23 noon assessments, and 16/15 evening assessments were missing across patients and spouses respectively. On days spouses indicated not having had spent time together, items on co-rumination were precluded (105 diary days, 7%). Rather than excluding these diary assessments a priori, these were retained to make use of all available data for analysis.

Measures
Demographic and clinical variables. Gender, age, relationship duration, occupational status, and cancer-related variables were assessed by self-report in the baseline questionnaire. Cancer site was dichotomized into a carcinoma located in (1) the colon versus (2) the rectum, or anus. Treatment was dichotomized into (1) surgery only versus (2) surgery and additional treatment (chemotherapy and/or radiotherapy). Patients with a permanent or temporary stoma were categorized as having a stoma. The cancer stage was dichotomized into (1) good prognosis (i.e., stage I and stage II) versus (2) poor prognosis (i.e., stage III and stage IV).

Catastrophizing. Three times daily, patients and their spouses reported on their own catastrophizing about the patients’ fatigue during the hours preceding the assessment. Three items adapted from the Pain Catastrophizing Scale (Sullivan, Michael, Bishop, & Pivik, 1995) were used, each representing one of the 3 subscales, i.e., rumination, magnification, and helplessness (e.g., patient: ‘Tonight, I worried about my fatigue’; spouse: ‘Since rising, I was anxious my partner’s fatigue...’).
would become worse'; patient: ‘Since this afternoon, I thought I could not bear the fatigue any longer’). Responses ranged from 0 (‘not at all’) to 4 (‘extremely’). For each assessment, mean scores were calculated, which were then aggregated across the day to represent patients’ and spouses’ average level of catastrophizing during the day. Higher mean scores indicate higher levels of catastrophizing.

**Co-rumination.** Every evening, patients and spouses responded to three items to assess their perceived co-rumination during the day. Items were developed based on the Co-Rumination Questionnaire (Rose, 2002; e.g., patient: ‘Today, my partner and I spent a lot of time discussing my fatigue’; spouse: ‘Today, my partner and I talked about the negative aspects of his/her fatigue’; patient: ‘Today, my partner and I talked about how annoying my fatigue is’) with responses ranging from 0 (‘not at all’) to 4 (‘very much’). Higher mean scores represent higher levels of co-rumination.

**Fatigue.** Three times daily, patients reported on their momentary level of fatigue with 1 item (‘How fatigued do you feel right now?’). Responses ranged from 0 (‘not at all’) to 10 (‘as fatigued as I could be’). Fatigue as reported in the evening was used as outcome, while fatigue as reported in the morning was used as a covariate. Fatigue as assessed at noon has not been used in the current analysis.

**Relationship satisfaction.** Every morning and evening, patients and spouses reported on their momentary relationship satisfaction with 1 item (i.e., ‘How satisfied are you with your relationship right now?’). Responses ranged from 0 (‘not at all satisfied’) to 10 (‘extremely satisfied’). Assessments in the evening were used as outcome while controlling for the morning value.

**Statistical analyses**
The data for the present study contain two sources of nonindependence, that is, nesting of (a) observations within participants (level 1) and (b) participants within couples (level 2). Multilevel Structural Equation Modeling [MSEM] allows taking the nested data structure into account, fitting multiple outcomes simultaneously (i.e., mediation, actor- and partner-effects), and accommodating random effects (Ledermann & Kenny, 2017; Preacher, Zyphur, & Zhang, 2010).

In preparation for the analyses, data were restructured to the dyadic format with rows comprising repeated daily assessments for each couple and separate variable columns for patient and spouse variables (Laurenceau & Bolger, 2012). The
dyad was considered as the unit of analyses and dyad members were considered to be distinguishable by their role (i.e., patient, spouse). Variables were person-mean centered, that is, each participant’s mean score across the diary period was calculated and subtracted from his/her raw daily scores. Therefore, the 0-point for the centered variables represents each participant’s own average level of the variable over the diary period. As our hypotheses focus specifically on within-person associations, between-person effects were not included (Preacher et al., 2010). Following the example provided by Bolger and Laurenceau (2013, p. 183), the predictor, mediator, and outcome variables were all person-mean centered in order to investigate pure within-person effects. Due to substantial model complexity and to prevent convergence problems (Preacher et al., 2010), only theoretically relevant random effects were estimated, which were the hypothesized actor- and partner-effects, but not control variables or the direct paths in the mediation model (H1).

To predict within-person change in the outcomes (fatigue, relationship satisfaction) and mediator (co-rumination) over time, we controlled for their values at the previous time point. Evening fatigue and relationship satisfaction were modeled controlling for their morning values (t). Co-rumination was assessed only in the evening, hence, we controlled for co-rumination at the previous day (t-1). Furthermore, diary time was included as covariate (with 0 representing the first day of the 14-day diary period), and covariances between patient and spouse predictor variables, and covariances between error terms of their outcomes and the mediator were estimated. Actor- and partner-effects in the model predicting relationship satisfaction (H2) were constrained to be equal across patients and spouses to overcome convergence problems.

Bayesian estimation was used which enables estimation of complex multilevel (mediation) models and generates Credibility Intervals [CI], which can be interpreted intuitively as the probability that the population parameter is within the bounds of the given interval (Gelman & Hill, 2007; Yuan & MacKinnon, 2009). Analyses were run in Mplus (version 8) using its default non-informative priors (see Muthén & Muthén, 1998-2017, p. 775), which is expected to lead to similar results as those derived with a frequentist approach (Yuan & MacKinnon, 2009). Posterior distributions were obtained using Markov chain Monte Carlo [MCMC], Gibbs sampling with 10000 iterations. Ninety five percent CI’s are reported to indicate whether estimates were statistically significant. Effects are notated as follows:
Italic letters \((a, b, c)\) indicate the paths of the (mediation) model. The first letter of the subscript indicates the role (P, patient; S, spouse) and the second letter indicates the effect (A, actor-effect; P, partner-effect), e.g., \(a_{pp}\), a-path patient partner-effect, which shows the unstandardized regression coefficient for patient catastrophizing predicting spouse co-rumination (H1). For significant effects, also standardized multilevel fixed effects are reported based on the relationship between X and Y in terms of within-person SD-units, controlling for the included covariates. These standardized effects were calculated by multiplying the unstandardized regression coefficient (see Table 3) by the quotient of the within-person SD (see Table 2) of the predictor variable divided by the within-person SD of the outcome variable, that is \(b_{xy} (SD_x / SD_y)\).

**Results**

**The mediating effect of co-rumination between catastrophizing and patient fatigue**

Estimates of the mediation model predicting patient fatigue are summarized in Table 3a and Figure 1a. Both patient and spouse catastrophizing positively predicted their own (actor-effects, \(a_{pa} = 0.41, 95\%\ CI\ [0.21, 0.59]\), standardized effect = 0.25; \(a_{sa} = 0.51, 95\%\ CI\ [0.35, 0.67]\), standardized effect = 0.32) and each other’s perception of co-rumination (partner-effects, \(a_{pp} = 0.23, 95\%\ CI\ [0.05, 0.40]\), standardized effect = 0.12; \(a_{sp} = 0.18, 95\%\ CI\ [0.06, 0.31]\), standardized effect = 0.13). In turn, both patient and spouse co-rumination predicted increases in patients’ daily fatigue (\(b_{pa} = 0.50, 95\%\ CI\ [0.10, 0.93]\), standardized effect = 0.11; \(b_{sp} = 0.65, 95\%\ CI\ [0.35, 0.96]\), standardized effect = 0.17). Tests of the indirect effects [IE] provided partial support for our hypothesis for the mediating effect of co-rumination. Specifically, spouse co-rumination significantly mediated the effect of spouse catastrophizing on patients’ increases in fatigue (IE\(_{sp1}\) = 0.32, 95% CI [0.07, 0.60], depicted with heavy lines in Figure 1a). This mediated effect explained 59.4% of the total effect [TE] from spouse catastrophizing on patient fatigue (TE\(_{s}\) = 0.54, 95% [0.12, 0.96]). The remaining mediating effects did not reach statistical significance.
Co-rumination mediates between catastrophizing and fatigue

Table 3
Effects of the model predicting (a) patient fatigue (hypothesis 1) and (b) patient and spouse relationship satisfaction (hypothesis 2)

(a) Outcome patient fatigue

<table>
<thead>
<tr>
<th>Paths</th>
<th>Fixed effects</th>
<th>Random effects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate (SD) 95% CI</td>
<td>Estimate (SD) 95% CI</td>
</tr>
<tr>
<td>Direct effects</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a paths (X_{ca} → M_{co})</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient actor-effect (a_{pa})</td>
<td>0.41 (0.10) [0.21, 0.59]</td>
<td>0.44 (0.13) [0.26, 0.75]</td>
</tr>
<tr>
<td>Spouse actor-effect (a_{sa})</td>
<td>0.51 (0.08) [0.35, 0.67]</td>
<td>0.30 (0.10) [0.16, 0.53]</td>
</tr>
<tr>
<td>Patient partner-effect (a_{pp})</td>
<td>0.23 (0.09) [0.05, 0.40]</td>
<td>0.28 (0.11) [0.13, 0.55]</td>
</tr>
<tr>
<td>Spouse partner-effect (a_{sp})</td>
<td>0.18 (0.06) [0.06, 0.31]</td>
<td>0.14 (0.06) [0.06, 0.30]</td>
</tr>
<tr>
<td>b paths (M_{co} → Y_{f})</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient actor-effect (b_{pa})</td>
<td>0.50 (0.21) [0.10, 0.93]</td>
<td>1.11 (0.57) [0.40, 2.60]</td>
</tr>
<tr>
<td>Spouse partner-effect (b_{sp})</td>
<td>0.65 (0.15) [0.35, 0.96]</td>
<td>0.41 (0.23) [0.13, 1.01]</td>
</tr>
<tr>
<td>c' paths (X_{ca} → Y_{f})</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient actor-effect (c'_{pa})</td>
<td>0.52 (0.22) [0.09, 0.95]</td>
<td>. .</td>
</tr>
<tr>
<td>Spouse partner-effect (c'_{sp})</td>
<td>0.07 (0.18) [-0.29, 0.42]</td>
<td>. .</td>
</tr>
<tr>
<td>Indirect effects</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indirect actor-effect</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient indirect actor-effect, IE_{pa} : (a_{pa} * b_{pa})</td>
<td>0.15 (0.18) [-0.20, 0.54]</td>
<td>. .</td>
</tr>
<tr>
<td>Indirect partner-effect</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient, partner-partner, IE_{pp} : (a_{pp} * b_{sp})</td>
<td>0.09 (0.12) [-0.15, 0.33]</td>
<td>. .</td>
</tr>
<tr>
<td>Spouse, actor-partner, IE_{sp1} : (a_{sa} * b_{sp})</td>
<td>0.32 (0.13) [0.07, 0.60]</td>
<td>. .</td>
</tr>
<tr>
<td>Spouse, partner-partner, IE_{sp2} : (a_{sp} * b_{pa})</td>
<td>0.15 (0.12) [-0.06, 0.41]</td>
<td>. .</td>
</tr>
</tbody>
</table>
### Chapter 6

Table 3 (continued)

(a) Outcome patient fatigue

<table>
<thead>
<tr>
<th>Paths</th>
<th>Fixed effects</th>
<th>Random effects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate (SD)</td>
<td>95% CI</td>
</tr>
<tr>
<td>Total effects</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient, TE&lt;sub&gt;p&lt;/sub&gt;: ((a_{PA} \times b_{PA}) + (a_{PP} \times b_{SP}) + (c_{PA}))</td>
<td>0.77 (0.26)</td>
<td>[0.24, 1.27]</td>
</tr>
<tr>
<td>Spouse, TE&lt;sub&gt;s&lt;/sub&gt;: ((a_{SA} \times b_{SP}) + (a_{SP} \times b_{PA}) + (c_{SP}))</td>
<td>0.54 (0.22)</td>
<td>[0.12, 0.96]</td>
</tr>
</tbody>
</table>

Model statistics: PSR = 1.005

(b) Outcome patient and spouse relationship satisfaction

<table>
<thead>
<tr>
<th>Paths</th>
<th>Fixed effects</th>
<th>Random effects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate (SD)</td>
<td>95% CI</td>
</tr>
<tr>
<td>Actor-effect ((X_{Co} \rightarrow Y_{R})^{a})</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient actor-effect ((a_{PA}))</td>
<td>0.05 (0.07)</td>
<td>[-0.09, 0.18]</td>
</tr>
<tr>
<td>Spouse actor-effect ((a_{SA}))</td>
<td>0.05 (0.07)</td>
<td>[-0.09, 0.18]</td>
</tr>
<tr>
<td>Partner-effect ((X_{Co} \rightarrow Y_{R})^{b})</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient partner-effect ((a_{PP}))</td>
<td>-0.03 (0.05)</td>
<td>[-0.13, 0.07]</td>
</tr>
<tr>
<td>Spouse partner-effect ((a_{SP}))</td>
<td>-0.03 (0.05)</td>
<td>[-0.13, 0.07]</td>
</tr>
</tbody>
</table>

Model statistics: PSR = 1.001

Note. Unstandardized regression coefficients are reported. Ca, Catastrophizing; Co, Co-rumination; F, Fatigue; R, Relationship satisfaction; CI, Credibility interval; IE, Indirect Effect; TE, Total Effect; *Patient and spouse actor-effects were constraint to be equal; b Patient and spouse partner-effects were constraint to be equal; PSR, Potential Scale Reduction: a value close to 1 indicates good model convergence (10000 iterations; Gelman & Rubin, 1992). Indirect effects were calculated by multiplying the a- and b-path and adding their respective covariance.
The association of co-rumination with patient and spouse relationship satisfaction

Estimates of the model predicting patient and spouse relationship satisfaction are summarized in Table 3b and Figure 1b. Our second hypothesis was not supported. Neither patient nor spouse co-rumination were significantly associated with patient or spouse relationship satisfaction, respectively (actor-effects, constrained to be equal, $a_{PA}/a_{SA} = 0.05, 95\% \text{ CI } [-0.09, 0.18]$). Also, the partner-effects were not significant, indicating that patient co-rumination was not associated with spouse relationship satisfaction and vice versa (partner-effects, constrained to be equal, $a_{PP}/a_{SP} = -0.03, 95\% \text{ CI } [-0.13, 0.07]$).

Conclusions

This dyadic daily diary study of post-treatment cancer patients and their spouses provided evidence for a dyadic cognitive-behavioral pathway through which negative cognitions can translate into worse symptom outcomes. Co-rumination, as reported by the spouse, mediated the association between spouse catastrophizing and patient fatigue. Co-rumination, while maladaptive for patient fatigue, was not found to foster the couple’s daily relationship satisfaction.

We found patient and spouse catastrophizing to positively predict patient- and spouse-reported co-rumination. Spouse co-rumination in turn, predicted increases in patient fatigue throughout the day. This is an exciting finding as it suggests a dyadic pathway through which spouses’ maladaptive cognitions can exert their negative effect on patients’ symptoms. This result provides additional evidence for previous findings that spouses also catastrophize about patient symptoms (Cano et al., 2005; Leonard & Cano, 2006) and provides an explanation for how spouse catastrophizing translates into worse patient symptoms. In line with earlier research, patient catastrophizing was directly associated with increases in patient fatigue (e.g., Goedendorp et al., 2013). Even though patients’ catastrophizing did contribute to couples’ co-rumination, it did not mediate the maladaptive effect of their catastrophizing on their own fatigue. This indicates that, for patients, the maladaptive effect of their catastrophizing thoughts might be a mainly intrapersonal process, which is likely driven by increased negative affect (Müller et al., 2018). For spouses, however, catastrophizing was associated with patient fatigue only through co-rumination indicating an interpersonal, dyadic pathway through which spouse cognitions contribute to worse patient fatigue. That
is, spouse cognitions can contribute to worse patient fatigue when it leads to couples’ co-rumination. Interestingly, only co-rumination as reported by the spouse, but not as reported by the patient, mediated the effect between spouse catastrophizing and patient fatigue. Spouses reported higher levels of co-rumination than did patients, which might be due to a gender effect. That is, most spouses in our sample were female, who, among younger populations, have been found to report more co-rumination than do men (Spendelow, Simonds, & Avery, 2017). Further, our finding highlights that co-rumination is rooted in both dyad members’ catastrophizing thoughts. This is an important finding as it stresses that only assessing patient cognitions may provide an incomplete picture of maladaptive cognitions that form a risk for patient’s adverse symptom developments.

We did not find the expected association between co-rumination and increases in patient nor spouse relationship satisfaction. This was unexpected, as co-rumination has consistently been found to benefit the relationship in young samples (Calmes & Roberts, 2008; Rose, 2002; Rose et al., 2007; Rose, Schwartz-Mette, Glick, Smith, & Luebbe, 2014). Unlike most co-rumination studies, our sample consisted of romantic couples. The couples had a long average relationship duration (37.7 years) and reported high levels of daily relationship satisfaction (average > 8 on a 0-10 scale). It might be that in stable relationships, co-rumination does not fulfill the same positive function as in relationships that are still developing, i.e., among adolescents. Importantly, the random effect variances of the non-significant fixed effects (see Table 3) indicate that for some patients and spouses, co-rumination is predictive of greater relationship satisfaction while for others, it is predictive of lower relationship satisfaction. Differences in patients’ and spouses’ ability to be responsive during their conversations might explain the heterogeneity in the association between co-rumination and relationship satisfaction. While co-rumination appears to have some overlap with self-disclosure (Rose, 2002; Waller & Rose, 2010), also assessing whether spouses feel understood, validated and cared for (i.e., partner responsiveness) during their arising conversations might be necessary to understand when disclosure is adaptive for couples’ relationships (Laurenceau et al., 1998; Laurenceau, Barrett, & Rovine, 2005). In some couples, the extensive negative focus of their ruminative conversations might prevent responsive partner interactions (Horn & Maercker, 2016) and hence impede, as opposed to foster, relationship satisfaction.
To the best of our knowledge, this is the first study to apply the concept of co-rumination to the cancer and fatigue literature. However, other researchers, mainly in the field of pain, have recognized that interactions within dyads might contribute to the development of chronic symptoms (e.g., Fordyce, 1976; Sullivan, 2012). Importantly, Cano and Goubert’s (2017) recently defined concept of emotional disclosure of pain-related distress appears to be closely related to co-rumination. The concept is similar to co-rumination as both include communicating one’s negative thoughts and feelings about a symptom. Emotional disclosure of pain-related distress differs from co-rumination as only the latter includes a dyadic component in which both members of the couple are assumed to respond and engage in a ruminative conversation. Our results suggest that when emotional disclosure is rooted in catastrophizing, co-rumination might occur, which in turn is related to adverse symptom outcomes. Hence, assessing someone’s motives to disclose feelings and worries (e.g., catastrophizing) and the resulting dyadic conversation (e.g., co-rumination) might help us understand some of the mixed findings on the adaptiveness of sharing concerns for patients’ adjustment (see Hagedoorn et al. (2011) for an overview).

The strengths of this study are reflected in its dyadic and daily diary design that provided unique insights into dyadic interactions as they naturally occur in daily life. Applying the APIM framework allowed us to study intrapersonal (actor-effects) and interpersonal (partner-effects) associations between the concepts of interest while taking the couple members’ interdependence into account. Importantly, we extended previous literature by investigating a dyadic cognitive-behavioral pathway that explains how catastrophizing thoughts can translate into symptom outcomes. Co-rumination appears to be a compelling process for understanding symptom development in couples as it links cognitions, partner communications, and their influence on symptom severity.

The results of this study should be interpreted in light of some limitations. First, co-rumination was assessed only once daily, every evening retrospectively for the entire day, to account for the possibility that spouses would not spend the entire day together or would not engage in conversations about fatigue several times daily. Thus, the three daily catastrophizing assessments were aggregated across the day to analyze the associations at the day-level. This design choice made it difficult to disentangle the temporal order of the effects investigated. However, we controlled for the mediator assessed at the previous day and the outcome variables as assessed in the morning,
which suggested that catastrophizing predicts an increase in co-rumination, which in turn predicts an increase in fatigue across the day. Second, the levels of catastrophizing and co-rumination were rather low in our sample, which might be due to the fact that cancer patients with the most severe fatigue complaints were underrepresented in our study. This might lead to an underestimation of effects. Further, while the demographic and clinical characteristics of the patients in our study are comparable to those of a large population-based study among post-treatment colorectal cancer patients in the Netherlands (van Putten et al., 2016), our findings may not be generalizable to couples that are less satisfied with their relationship as those included in the current study.

Lastly, the indirect effects in the model predicting patient fatigue were calculated by multiplying the a- and b-paths of the model, assuming that the variables are normally distributed. The distribution of the mediator co-rumination, however, resembles a count distribution. Bayesian estimation, however, is less sensitive to non-normally distributed parameters, including the skewed distributions of indirect effects (Van de Schoot et al., 2014).

Our findings have some important theoretical and clinical implications. Of theoretical relevance, spouse cognitions and the nature of the dyadic conversation seem to play a predictive role in patient’s symptom development that should not be overlooked. That is, spouse cognitions can contribute to patient’s fatigue through couple’s co-rumination. Hence, researchers should extend their research focus from the patient to the dyad to capture both dyad members’ cognitions as both might be a risk factor for patients’ adverse symptom outcomes. Relatedly, researchers investigating dyadic coping need to more broadly define and operationalize the constructs they assess in future work. While openly sharing cancer-related concerns is often assumed to be beneficial for patient adjustment (e.g., Cordova, Cunningham, Carlson, & Andrykowski, 2001), our results suggest that solely assessing disclosure does not suffice when assessing its adaptiveness for patients’ symptom development. The resulting dyadic communication should also be assessed. That is, simply assessing patients’ or spouses’ attempts to communicate their fatigue-related worries without assessing the nature of the arising dyadic conversation might lead researchers to faulty conclusions about the adaptiveness of disclosing.

Of clinical relevance, patients at risk for long-term fatigue might be overlooked in clinical practice, as they appear to have supportive spouses with whom they can share their fatigue-related concerns. Adversely, these seemingly supportive communi-
Co-rumination mediates between catastrophizing and fatigue

cations can worsen fatigue. Furthermore, fostering the couple’s communication about their cancer experience has been a common treatment goal in couple-based interventions. As noted by Badr (2017), this is however a rather nonspecific goal as we currently lack knowledge on which communication patterns are (mal-)adaptive. Our results fill part of this knowledge gap by showing that couple’s ruminative conversations are maladaptive for patient’s symptom development while, at least in the current study, do not benefit the couple’s relationship. Hence, co-rumination should be prevented. However, simply discouraging fatigue-related conversations might be maladaptive as refraining from expressing one’s worries (i.e., protective buffering) has been found to be related to increased distress and less relationship satisfaction in couple’s coping with cancer (Hagedoorn et al., 2000; Regan et al., 2015). Instead, cognitive-behavior therapy for fatigued cancer patients (e.g., Bleijenberg, Gielissen, Bazelmans, Berends, & Verhagen, 2004) might be extended to target both dyad member’s catastrophizing thoughts. Additionally, couples might be trained to replace co-rumination with communication strategies that have been found to benefit patients’, spouses’ and couples’ adjustment to cancer (i.e., mutual constructive communication; Badr & Carmack Taylor, 2009; Manne, Badr, Zaider, Nelson, & Kissane, 2010; Manne et al., 2006) and couples should be encouraged to engage in activities, as this has been found to benefit patients’ functioning as well as their relationship satisfaction (Müller et al., in press).

In conclusion, this dyadic diary study indicates that daily co-rumination mediates the effect of spouses’ catastrophizing cognitions on cancer patients’ fatigue severity. This finding suggests that spouse cognitions and dyadic ruminative conversations contribute to patients’ adverse symptom development. Targeting both dyad members’ negative cognitions and fostering adaptive dyadic interactions might help relieve fatigue in the growing group of patients treated for cancer.

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Conflict of interest

The authors declare that they have no conflict of interest.
Chapter 6

References


Co-rumination mediates between catastrophizing and fatigue


Chapter 6


156
Co-rumination mediates between catastrophizing and fatigue


