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Emotional reactivity and the overreport of somatic symptoms: Somatic sensitivity or negative reporting style?

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Abstract

Objective: The purpose of this study is to examine the role of emotional reactivity (ER) in symptom reporting and conceptualize somatizing processes as a signal detection task. Emotional reactivity has been theorized to influence symptom reporting through somatic sensitivity as well as via a negative reporting style. We assess the degree to which these two competing theories about the role of ER are accurate within the signal detection framework. **Methods:** We used a multimethod approach that included using both static and prospective self-reports as well as a signal detection task. **Results:** Results suggest that ER exerts its influence on somatization tendencies via a negatively biased reporting style and is not mediated by somatic sensitivity as suggested by the somatosensory amplification and the symptom perception hypothesis. **Conclusion:** Emotional reactivity has yet to be associated with objective measures of somatic sensitivity. Until such an association is found, it is likely that ER influences symptom reports via negatively biased reporting.

Keywords: Emotional reactivity; Signal detection; Somatic symptom reporting; Somatosensory amplification; Symptom perception; Somatization

Introduction

Theorists and researchers have consistently focused on emotionally reactive aspects of personality such as neuroticism (N [1]) and negative emotionality (NEM [2]) as predisposing factors in somatic symptom reporting (e.g., Refs. [3–6]). Indeed, emotional reactivity (ER) correlates with both retrospective [7–9] and daily symptom reports [5,6,8,9]. The strong relationship between ER and symptom reporting has also been found in experimental studies [10–12].

Explaining the relationship between ER and symptom reports

The symptom perception hypothesis [6] and somatosensory amplification [13–15] both suggest that emotionally reactive individuals are highly self-attentive and sensitive to bodily sensations. This sensitivity leads emotionally reactive individuals to overreport symptoms. However, although ER is associated with hypervigilance in bodily scanning and self-focused attention [6,11,12,16,17], most studies demonstrate no link between ER and somatic sensitivity [18–20].

Other theorists have suggested that emotionally reactive individuals have a negative self and other view and, therefore, have a negative reporting bias [3–5,9]. Supporting this contention is the finding that although ER is associated with symptom reports, it is not related to objective health status [5,21–23], health behaviors [6], or mortality [4,24], and may actually be health protective [6,25,26].

Emotional reactivity and negative reporting style

The evidence of an association between ER and negative reporting has accrued along three lines. First, it appears that ER negatively biases the encoding [8,27] and recall of experience [8,28,29]. Specifically, people who describe themselves as high in ER remember experiencing more

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physical symptoms [6,8] and negative mood [28] than they actually experienced (i.e., recall that based ratings are higher than daily ratings). Therefore, it appears that ER is associated with a tendency to magnify past negative experiences. Second, ER is associated with the *self-report* of negative emotions and life events (e.g., Refs. [5,30–32], high levels of distress [32,33], and daily hassles [5,34]). However, it appears that, relative to low emotionally reactive individuals, the potent negative experiences of high emotionally reactive individuals are better accounted for by their high self-reported negative reactivity to events, rather than the actual experiencing of more stressful events (as measured by checklists) over time [35]. Finally, research has demonstrated a negative correlation between ER and impression management [33,36–38], suggesting that high emotionally reactive individuals are not concerned about the impression they make on others, even when they believe others perceive them negatively [39].

Symptom reporting as a signal detection task

We propose that signal detection theory may provide an important heuristic from which to examine the role of ER in the symptom reporting process. Signal detection theory provides a mathematical analysis of an observer's sensitivity and reporting bias [40–42]. Sensitivity (A') has been defined as an observer's ability to correctly detect the presence or absence of a stimulus. Sensitivity varies as a function of a stimulus' probability of occurrence, intensity, and imminence [42]. The symptom perception hypothesis and somatosensory amplification suggest that emotionally reactive individuals are somatically sensitive and should perform accurately on signal detection tasks.

Response bias (B') is the extent to which the observer favors one response over another, independent of the base rate of the stimulus [41]. Response bias is influenced by the observer's beliefs about the base rates of the stimuli and the rater's goals when making judgments about a stimulus [40], particularly the perceived severity and consequences of a miss or false alarm [43]. It is our contention that emotionally reactive individuals are biased reporters.

Inaccuracy in signal detection tasks (i.e., misses and false alarms) is associated with costs [43,44]. If one is interested in reducing the costs of misses, he or she can substantially lower his or her decision criterion, thereby, causing most cues to exceed threshold (i.e., increase false alarms). Individuals with somatizing tendencies may consider the cost of missing the presence of a symptom (signal) particularly harmful. Therefore, emotionally reactive individuals may have a tendency to overreport the presence of somatic occurrences (signals), even when they do not objectively exist (i.e., "risky" reporting bias). Indeed, ER has been associated with a risky reporting [45–49]. Furthermore, ER is associated with a tendency to apprehensively and vigilantly scan the environment for signs of threat [50,51] and interpret ambiguous cues as threatening [33,52,53].

Hypotheses and predictions

We tested the hypotheses that (1) ER would be directly related to somatic symptom reports, but not to self-reported health behaviors [6], (2) ER would be negatively correlated with A' (i.e., insensitivity) and B' (i.e., risky response bias), but would remain a positive predictor of symptom reports after controlling for somatic sensitivity (A') and response bias (B'), and (3) the direct path between ER and symptom reporting would be best described as a negatively biased reporting style.

Method

Participants

A total of 131 participants (male, $N=33$; female, $N=98$) began the study. Sixty-seven participants (22 males, 45 females) dropped out of the study of their own accord (51%), leaving 64 (11 males, 53 females) participants completing the study.[1] The mean age was 19.7 years (range=17–25). The sample was largely European American. Participants leaving the study did not differ from those completing the study on any of the initial measures (Wilk's $\lambda=1.14$), $P<.40$. The dropout rate in this study was higher than those reported in three studies examining symptom reporting in university students [6,8,9]. In two of those studies, class grade was contingent on study completion [8,9], whereas participation in this study was voluntary. Watson and Pennebaker [6] required participants to complete approximately one half the number of days required in this study.

Measures

Screening

The screening measure used in the initial screening battery was the Somatization Screening Index (SSI [54]). The SSI is an 11-item scale asking respondents to indicate incidence of 11 common physical symptoms. The measure correctly identified 97.6% of community respondents who later received a clinical diagnosis of somatization disorder [54]. The measure demonstrated high internal consistency in the present study (Cronbach's $\alpha=.96$).

Retrospective symptom reports

The battery of retrospective symptom reports included the Somatization Subscale of the Symptom Checklist 90 (SCL-90 [55]) and the Illness Worry Scale (IWS [56]). In the present study, the SCL-90 subscale demonstrated

[1] The heartbeat detection data used in this study have been used in two previous publications [18,92], however the hypotheses under investigation were different than those in this paper.

moderate internal reliability (Cronbach's α=.75) as did the IWS (Cronbach's α=.61).

Emotional reactivity

Emotional reactivity was measured via the NEM Subscale of the Multidimensional Personality Questionnaire [2,32], which has demonstrated adequate test–retest reliability and internal consistency [2,6,32]. The NEM demonstrated high internal consistency (Cronbach's α=.85).

Retrospective reports of psychological distress

The Beck Depression Inventory (BDI [57]) and the Penn State Worry Questionnaire (PSWQ [58]) were used as indices of general distress. The BDI and PSWQ demonstrated high internal consistency (Cronbach's α=.86 and .94, respectively).

Impression management

The Balanced Inventory of Desirable Responding (BIDR [59]) is a 40-item scale of impression management, which demonstrated moderate internal consistency (Cronbach's α=.73).

Experience sampling measures

The symptom checklist [6,9] contained four subscales (i.e., depression, aches, gastrointestinal tract, upper respiratory). The scale demonstrated adequate reliability (Cronbach's α=.76) in the present study. However, the reliability for the four subscales was moderate; Depression (Cronbach's α=.50), Ache (Cronbach's α=.49), Gastrointestinal (Cronbach's α=.56), and Upper Respiratory (Cronbach's α=.49).

The Student Daily Hassles Scale (SDHS [60]) is a 37-item measure of hassles commonly encountered by university students. The measure includes test, relational, and time hassle subscales. All subscales demonstrated high internal consistency (Cronbach's α=.90 and above).

The Positive Affect Negative Affect Scale (PANAS-X [61]) is a 60-item measure of mood. The scale was modified by adding 28 additional mood terms to more fully sample affective experience [62]. Respondents indicate the extent to which the adjectives describe their current mood. Both the overall scale and subscales demonstrated high internal consistency (Cronbach's α=.90 to .96).

Retrospective measures

The daily symptom report, Daily Hassle Scale, and PANAS-X were all modified to allow respondents to retrospectively report symptoms, hassles, and moods over the course of the 60-day study. All retrospective scales and subscales were highly reliable.

Procedure

Sampling

Potential participants completed the SSI as part of a prescreening conducted with all undergraduate students enrolled in introductory psychology courses. Individuals who endorsed five or more somatic symptoms on the SSI and those who endorsed no somatic symptoms on the SSI were contacted via telephone and asked to participate in a longitudinal study examining emotion, stress, and health in university students. Sampling in this fashion ensured that we would recruit participants across a wide range of symptom reporting tendencies [54].

Brief interview and battery

Participants endorsing symptoms on the SSI were asked if these symptoms were the result of any medically diagnosed condition. The purpose of this inquiry was to determine if, in the absence of a medical examination, the symptoms were related to a chronic medical condition, particularly those that would cause vigilance of their cardiovascular system. None of the symptoms reported on the SSI were self-reported as the result of a medically diagnosed chronic condition. It is important to note, however, that although lay interpretations of common somatic symptoms are frequently accurate [63–65], they can also be inaccurate and be based on inappropriate illness schemas and beliefs [66], particularly when experiencing infrequent or unusual symptoms [67,68]. We asked only about common symptoms, however, increasing our confidence that these self-reports were generally accurate. All participants then completed an initial battery of measures.

Heartbeat detection task

After completing the brief interview and questionnaire battery, participants completed a heartbeat detection task [69]. The observer decided whether a tone was presented synchronously (or asynchronously) with his/her resting heartbeat (see Ref. [18] for a detailed description of the task).

Data analysis for the signal detection task

We calculated rates for "hits" (the probability of indicating a signal is present when it is actually present) and "false alarms" (the probability of indicating a signal is present when it is not actually present), as well as the number of total correct responses (hits+correct rejections) for each participant in order to compute indices of both sensitivity (A') and response bias (B') [70]. A' is a nonparametric measure of sensitivity that represents the area under the curve of the receiver operating characteristic (a plot of the hit rate as a function of the false alarm rate for an individual). It takes the "inflationary" effect of the false alarm rate on the hit rate into account and hence produces a "pure" measure of sensitivity [71]. Typical values for A'vary between 0.50 (indicating chance discrimination) and 1.00 (perfect discrimination). B' is a nonparametric measure of response bias that represents the natural logarithm of the ratio of the likelihood of obtaining a hit (i.e., the signal

Table 1
Correlations between ER, somatic sensitivity, and cross-sectional measures of somatic symptoms and distress

	1	2	3	4	5	6	7	8	9		Mean	S.D.
1. NEM	1.00										6.5	3.1
2. SSI	.16	1.00									4.9	3.1
3. SCL	.35**	.33**	1.00								18.2	4.7
4. DR.	.01	.25	.02	1.00							3.9	5.6
5. IWS	.42**	.32*	.38**	.08**	1.00						1.5	1.6
6. BDI	.32**	.30**	.55**	.05	.30*	.27*	1.00				6.6	5.3
7. PSWQ	.65**	.20*	.35**	.14	.48**	.41**	.28**	1.00			48.5	13.5
8. A′	−.02	−.17	.09	−.09	−.05	.02	−.01	−.12	1.00		.6	.2
9. B′	−.24	−.06	−.13	−.11	−.06	−.07	.08	−.05	.01	1.00	.07	.33

DR. = retrospective Dr. Visits.
Missing data deleted listwise.
* $P<.05$.
** $P<.01$.

likelihood) divided by the likelihood of a false alarm (i.e., the false alarm likelihood) (see Ref. [71] for a detailed discussion of the measurement of sensitivity and response bias). A B′ value of 0.00 indicated the absence of bias, with positive scores reflecting an increasingly cautious criterion (i.e., a tendency to indicate that a signal is not present), whereas a risky criterion is indicated with scores less than zero (i.e., a tendency to report that a signal is present).

Using the typical formulas for computing A′and B′(e.g., Ref. [70]), it became apparent that a number of participants ($n=46$) displayed less than chance performance (i.e., their false-positive rate exceeded their hit rate) on the heartbeat detection task. However, Aaronson and Watts [72] have shown that the application of traditional signal detection formulas to data from individuals who perform below chance level yields nonsensical values. Following Aaronson and Watts [72], we used their revised formulas for computing A′ and B′ in order to adjust the data from those 46 participants who performed at less than chance levels. These adjustments bring the initial values closer to chance levels.

Completion of daily measures

Participants completed the daily symptom report and Daily Hassles Report at the end of each day over 60 consecutive days, whereas the PANAS-X was completed in the morning, afternoon, and evening. Students placed completed measures in a box prior to class on Monday, Wednesday, and Friday of each week.

Final laboratory session

At the completion of the 60 days, each participant completed the retrospective measures and was debriefed.

Results

Correlations between ER and variables of interest

Table 1 presents the correlation coefficients for the measures used in the study. In general, these relationships were as predicted, although ER was not correlated with either somatic sensitivity (A′) or response bias (B′).

Emotional reactivity, somatic sensitivity (A′), and daily symptom reports

Because the daily symptom report data conformed to a multilevel data structure [73], we used hierarchical linear modeling (HLM [74]). Hierarchical linear modeling allows analysis of within-subject (i.e., daily symptom

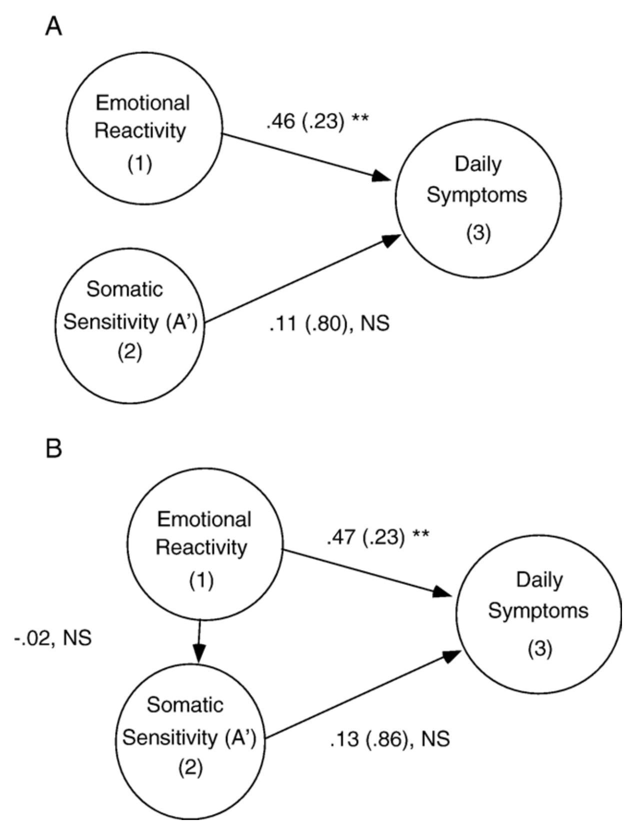

Fig. 1. The relationship of ER and somatic sensitivity to daily symptom reports (A) and the estimation of somatic sensitivity as a mediator in the symptom reporting process (B). Unstandardized coefficients are presented in parentheses. $*=P<.05$, $**=P<.01$, $t=P<.10$.

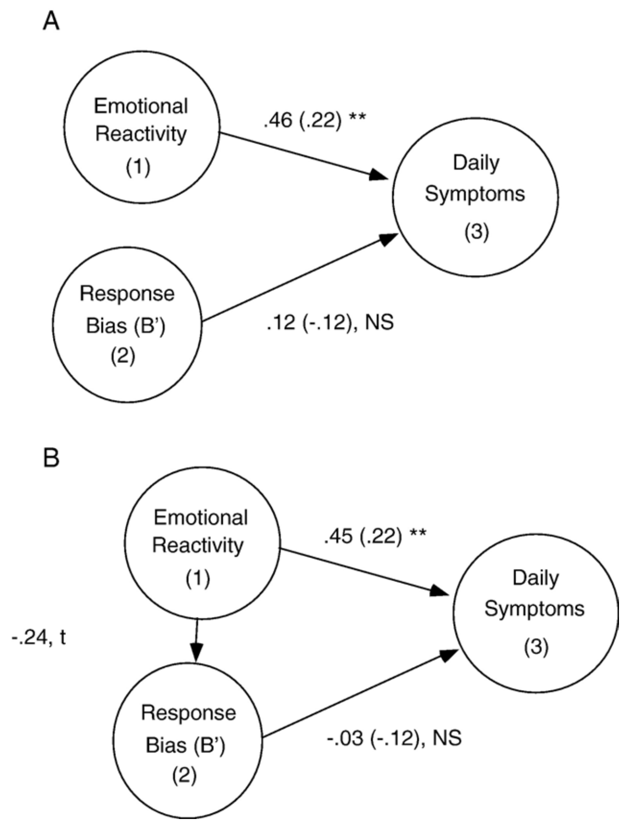

Fig. 2. The relationship of ER and response bias to daily symptom reports (A) and the estimation of response bias as a mediator in the symptom reporting process (B). Unstandardized coefficients are presented in parentheses. *= P<.05, **= P<.01, t= P<.10.

reports) and between-subject (i.e., ER, A′, B′) variation simultaneously, enabling one to model each source of variation. On average, participants reported 1.8 symptoms per day, and this was significantly different from zero (t= 9.22, P<.001).

As shown in Fig. 1A, ER was a significant predictor of daily symptom reports before including A′ as a potential mediating variable (r=.46, t=3.48, P<.01). A′ was not a significant predictor of daily symptom reports (r=.11, t=.83, P<.30). Therefore, ER continued to explain variance in daily symptom reports after controlling for A′ [$p31$=0.47 (.23), t=3.50, P<.01], accounting for approximately 16% of the variance. The same relationship held when using days when participants were not sick, as well as when using the number of correct responses as the index of somatic sensitivity.

Emotional reactivity and negative reporting style (B′)

We first operationalized negative reporting style as response bias (B′) and then examined whether B′ mediated the relationship between ER and daily symptom reports using HLM. As shown in Fig. 2A, ER was correlated with daily symptom reports before including B′ as a potential mediating variable (r=.46, t=3.48, P<.01). B′ was not correlated with daily symptom reports (r=.12, t=.19, P<.30) and, therefore, did not explain unique variance in symptom reporting. In Fig. 2B, ER remained a significant predictor of daily symptom reports after controlling for B′ [$p31$=0.45 (.22), t=3.31, P<.01]. Because ER and B′ were not correlated (r=−.24, P<.20), B′ did not mediate the relationship between ER and symptom reporting. Similar results were found when sick days were removed from the analysis.

Emotional reactivity and negative reporting style (distorted mood and hassles reports)

We next investigated whether the negatively biased reporting style associated with ER would mediate the relationship between ER and daily symptom reports. To conduct this analysis, we created discrepancy scores between the recall-based ratings and average daily ratings for the PANAS-X and retrospective hassles measures [28]. The discrepancies between recall ratings and daily ratings were calculated by subtracting the latter from the former. A negative number indicates that the participant recalled less

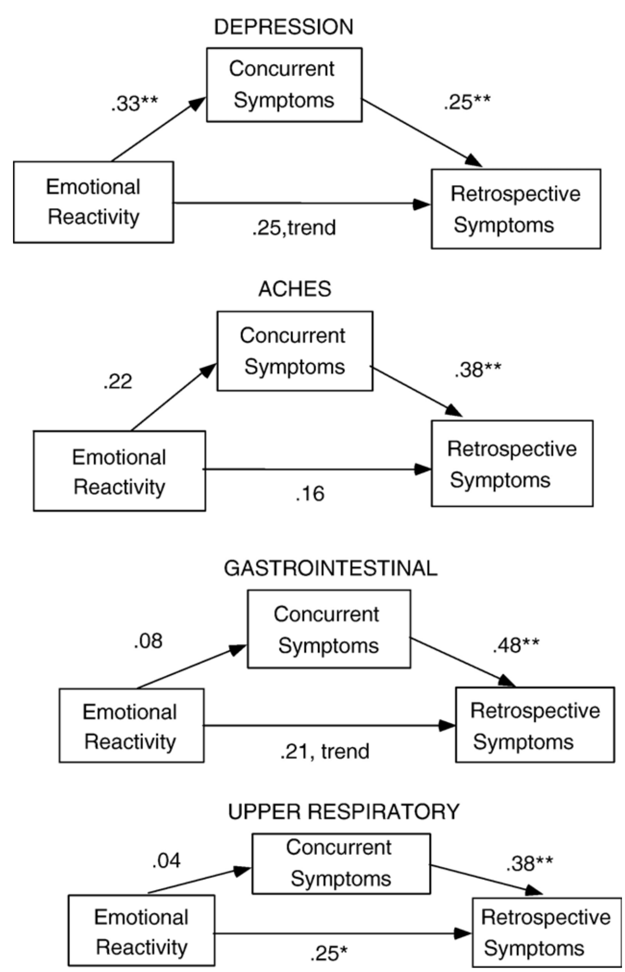

Fig. 3. Direct and indirect path of ER on concurrent and retrospective symptom reports.

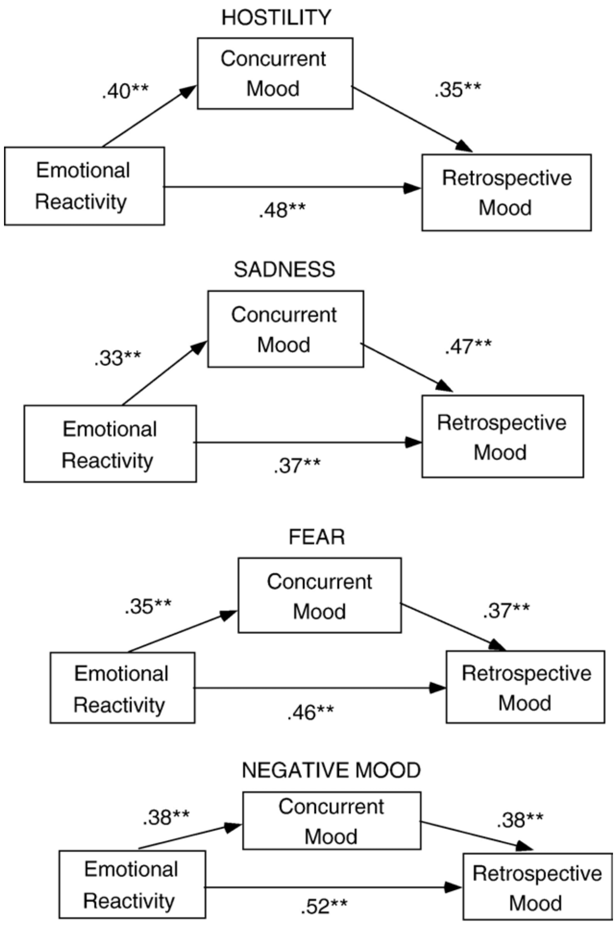

Fig. 4. Direct and indirect path of ER on concurrent and retrospective negative mood reports.

emotion or hassles than he or she reported on a daily basis, and a positive number indicates that the participant recalled more emotion or hassles than he or she reported on a daily basis. However, mean discrepancy scores did not significantly differ from zero for any emotion or hassle. Thus, neither mood nor hassles discrepancy scores mediated the relationship between ER and daily symptom reports.

We had predicted that ER would be associated with a tendency to retrospectively overreport somatic symptoms. Fig. 3 presents path diagrams for the four symptom dimensions. The paths (i.e., standardized betas) between concurrent symptoms and recalled symptoms were moderate for all symptom dimensions, suggesting that individuals who reported somatic symptoms on a daily basis tended to recall having those symptoms. The path from ER to concurrent depressives symptoms was moderate and significant. The paths between ER concurrent symptoms were insignificant for the other three symptom dimensions. This suggests that ER only influenced the daily report of somatic symptoms associated with depression.

The path from ER to recalled upper respiratory symptoms, controlling for concurrent respiratory symptoms, was moderate and significant (r=.25, P<.05). There was a trend for ER to explain variance in recall of the somatic depressive dimension (r=.25, P<.06), gastrointestinal dimension (r=.21, P<.06), and overall symptoms after controlling for overall concurrent symptoms (r=.16, P<.10). Emotional reactivity did not explain variance in retrospective aches after controlling for concurrent aches (r=.16, P<.20).

We compared the total predictive power of the indirect path to the direct path from ER to recalled symptoms [8]. As predicted, the direct path was larger than the indirect path for the depression (0.25 vs. 0.08), aches (0.16 vs. 0.08), gastrointestinal (0.21 vs. 0.04), and respiratory (0.25 vs. 0.02) dimensions, suggesting that ER directly influences symptom recall above and beyond that accounted for by concurrent symptom reports. However, the indirect path was larger than the direct path for recollection of overall symptom reports (0.26 vs. 0.16).

Emotional reactivity explained variance in retrospective mood reports above and beyond that accounted for by concurrent mood reports (see Fig. 4) for each mood dimension. As predicted, the direct path was also larger than the indirect path for all mood dimensions.

Fig. 5 demonstrates that ER explained variance in retrospective hassles reports above and beyond that accounted for by concurrent hassles reports for two of the three hassles dimensions (test, relational), but not for time. Also, as predicted, the direct path was greater than the indirect path for test and relational hassles. However, the predictive power of the indirect path was greater for time hassles.

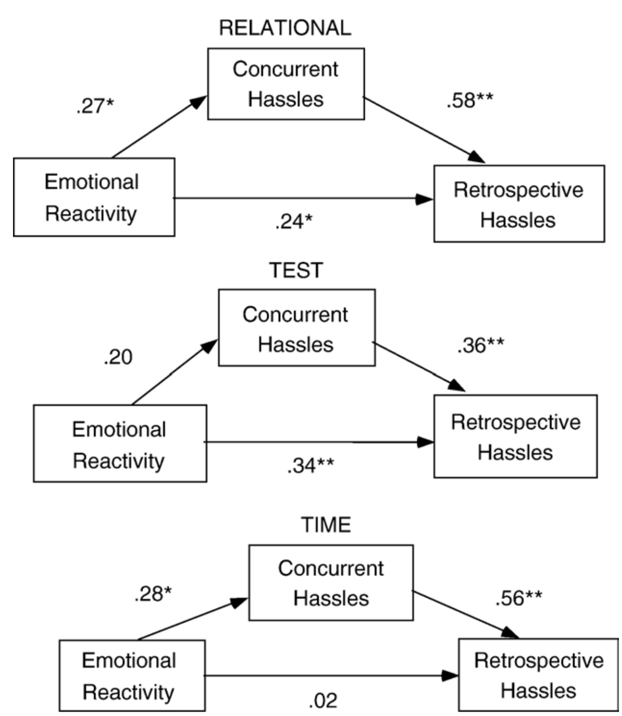

Fig. 5. Direct and indirect path of ER on concurrent and retrospective hassle reports using standardized betas.

Finally, as predicted, ER was negatively related to impression management ($r = -.26$, $P < .05$).

Discussion

This study used an elegant design, hierarchical modeling, and sophisticated statistical analyses to assess the role of ER in symptom reporting. We hypothesized that ER did not influence symptom reporting via somatic sensitivity as theorized in somatosensory amplification or the symptom perception hypothesis. Rather, we expected that ER's role in symptom reporting was due to its relationship to a negative reporting bias (e.g., a tendency to complain and to be unconcerned about social desirability). In support of our hypotheses, somatic sensitivity (A′) was not related to ER or somatic symptom reports. Emotional reactivity was directly related to static and prospective symptom reports, but not to the report of health behaviors (i.e., number of doctor visits) replicating previous findings.

Although we did not find a relationship between sensitivity (A′) and ER or somatic symptom reporting, there are some limitations associated with the use of heartbeat detection. The detection of resting heartbeats is a difficult task. There is some evidence that individuals are not particularly sensitive to their heartbeats [69,75–78]. Indeed, in our study, most participants performed the heartbeat detection task at worse than chance performance. Moreover, the assessment of cardioception is methodologically complex because they can tap differing psychophysical capacities, their conditions of administration can affect results, and they depend on the participants' ability to track external stimuli such as a tone or light [79]. The paradigm used in this study, however, did include a familiarization increasing the likelihood that subjects appropriately tracked the external tones. Adding to the complexity of assessing cardioception is the fact that completing a laboratory task in a well-controlled environment with no distractions does not capture complexities in bodily perception that are present in "real world." Somatizers are hypervigilant and have intense motivation to detect bodily symptoms [6,56,80]. Laboratory participants, although possibly hypervigilant during the task, likely do not have the same intensity of motivation as somatizers. To combat some of the limitations of heartbeat detection tasks, future studies might ask participants to detect their heartbeats after exertion and not while at rest [75], with some combination of sitting and reclining [75], after inducing affective arousal [78], or with substantial training [78]. Future studies might also consider using detection tasks using organ systems more easily detected and assessed, such as respiratory resistance detection [76] and tactile discrimination [81].

Despite the limitations of the heartbeat detection task, the results of our study must be added to a growing number of studies that have found no relationship between somatic sensitivity and ER. It is important to note that these studies have used various methodological approaches including self-report indices of somatic sensitivity (e.g., Refs. [79,82,83]) as well as somatic sensitivity measured via performance on objective tasks (e.g., Refs. [19,84]). In addition, the lack of connection between somatic sensitivity and ER has now been consistently demonstrated in studies examining autonomic responsiveness at rest and during stressor tasks [19,85], as well as in estimating individual resting heartbeats [20,86,87]. Moreover, even somatizing tendencies themselves are not related to objective measures of somatic sensitivity. Indeed, there is even some evidence that neurotic and somatizing tendencies are likely the result of defective somatic sensitivity [75,79,84]. Although not definitive, taken together, these studies cast doubt on the role of ER in somatic sensitivity.

The growing evidence of a lack of a connection between somatic sensitivity and symptom reporting has important theoretical implications. Widely accepted models of somatizing processes like the somatosensory amplification [14] and the symptom perception hypothesis [6] suggest a central role for somatic sensitivity in symptom reporting. Until a relationship between ER and somatic sensitivity is found and replicated, there is no reason to believe that somatic sensitivity contributes to symptom overreporting in emotionally reactive individuals.

The results of this study provided some limited, although contradictory, evidence that the negative reporting style associated with ER best explains the relationship between ER and symptom reporting. The strongest support for this contention lies in our replication and extension of Feldman Barrett's [28] and Larsen's [8] work examining the negatively distorting effects of ER on retrospective reports of daily experience. Specifically, we found that ER was associated with a negative recall bias for various dimensions of physical symptoms and mood. We extended previous findings to include retrospective recall of hassles. However, when using discrepancy scores as an index of bias, no such association emerged. Also, in support of our contention was the finding that ER was negatively associated with impression management.

We did not find any support for our conceptualization of symptom overreporting as a kind of risky response bias. Although there was a trend for B′ to be negatively correlated with ER (i.e., risky responding), B′ was not related to symptom reporting. This finding may reflect the strong likelihood that response bias in a signal detection task is not analogous to the kind of response bias that may be evidenced in somatizing behavior. There are several reasons for this possibility. In our heartbeat detection task, response bias was based on the base rate of synchronous and asynchronous presentations of heartbeat and tone (i.e., 50 synchronous and 50 asynchronous presentations). The experimental base rates established in our heartbeat detection task are not completely analogous to somatic symptom base rates that rarely remain constant, and change as a function of organ systems involved. It is also likely that the vigilance evidenced in somatizing individuals (i.e., being highly motivated to attend to all somatic signals in case they are symptoms of illness) is qualitatively different than the goals of participants doing a heartbeat detection task in a laboratory. Clearly, the urgency and vigilance of somatizing individuals is higher than that of experimental participants. Therefore, it is quite possible that individuals with diagnosed or subclinical levels of somatization would perform well on the heartbeat detection task.

Our finding that ER is negatively associated with impression management is consistent with theorists who have suggested that ER is associated with a tendency to complain [3,4,9]. Interestingly, it appears that emotionally reactive individuals are comfortable sharing their negative self-views with others. For example, individuals who anxiously monitor their bodies were more likely than individuals who did not monitor their bodies to want interpersonal attention, empathy, and demonstrations of concern from their physicians, even though their health was better than that of the nonmonitors [49]. Other studies have demonstrated that emotionally reactive individuals are not concerned with their social presentation [33,36,37]. These results suggest that although emotionally reactive individuals are attuned to external judgments made of them, they are not particularly concerned about communicating in a negative or complaining manner.

Study limitations

Fifty-one percent of the participants in this study dropped out. The level of attrition from the study calls into question the generalizability of our findings. This raises the possibility that our final sample represents particularly high functioning individuals. However, participants did not differ on any of the initial measures at the beginning of the study. Of course, it is possible that participants differed from those who dropped out on any number of theoretically relevant unmeasured variables (e.g., coping style, resilience). Moreover, lower-functioning students may have become more distressed as the semester progressed and dropped from the study. Although attrition is a serious limitation in this study, it is important to note that reliable and valid findings from longitudinal studies have been found even when there has been significant attrition [88]. Moreover, it must be noted that experience sampling studies such as ours often tax participants [89]. Indeed, a review of the debriefing interviews from our participants revealed that the daily ratings were perceived as onerous and challenging to complete and that remuneration was insufficient to the demands. Researchers interested in experience sampling must be creative in peaking student interest, use complex remuneration systems with incentives beyond basic cash or research credit, create and sustain a positive attitude on the part of the research team, and help cultivate good working relationships between research assistants and participants ([89], Feldman Barrett, personal communication).

Our study was also comprised almost entirely of European Americans, and cultural differences in somatizing tendencies have been found [90,91]. Furthermore, the use of university samples has been criticized in somatization research [13]. However, our sample demonstrated that there are a number of university students who report heightened levels of somatic distress. Moreover, using university students allows one to test theory, which is important in its own right. All of these issues limit the studies generalizability.

Our participants did not assess their somatic symptoms and hassles continuously throughout each day. Participants made only one symptom and hassle rating per day. Therefore, these reports were themselves given somewhat retrospectively. Obviously, these limited momentary ratings do not completely capture each participant's daily experience. Future experience sampling studies should take multiple symptom measures throughout the day and should consider using handheld recording devices that can increase compliance and accuracy of reports.

Finally, the correlational nature of this study makes it impossible to reach any conclusions about causation. Numerous unmeasured variables may mediate the role of ER in symptom reporting. Future research should test theories of symptom reporting using experimental or quasi-experimental studies.

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