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Health Anxiety, Cognitive Coping, and Emotion Regulation: A Latent Variable Approach

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Abstract
Background Health anxiety, the fear or conviction of suffering from a severe disorder, represents a dimensional and multifactorial construct consisting of cognitive, behavioral, affective, and perceptual components. It has recently been proposed that dysfunctional emotion regulation strategies contribute to health anxiety, but the empirical evidence for this claim is sparse.
Purpose The current research was aimed at broadly exploring and clarifying possible relationships between dimensions of health anxiety and cognitive coping and emotion regulation strategies.
Method In two studies with non-clinical samples ($n_{\text{study 1}}$= 172; $n_{\text{study 2}}$=242), health anxiety, cognitive coping, and emotion regulation strategies were assessed using multidimensional self-report measures. Functional (e.g., reappraisal) and dysfunctional (e.g., rumination) cognitive coping and emotion regulation strategies were differentiated.
Results Using structural equation modeling, the results of Study 1 revealed significant and consistent associations between the dimensions of health anxiety and dysfunctional coping and emotion regulation strategies. Study 2 replicated and extended the main findings of Study 1 by demonstrating that the associations between health anxiety and strategies of coping and emotion regulation were independent of the current level of depressive symptoms.
Conclusion Health anxiety was found to be associated with dysfunctional coping and emotion regulation strategies (e.g., suppression). The positive associations between behavioral dimensions of health anxiety (e.g., seeking reassurance) and dysfunctional coping strategies may suggest that behavioral dimensions of health anxiety serve as a compensatory strategy to overcome difficulties in cognitive coping.

Keywords Catastrophizing · Coping · Emotion regulation · Health anxiety · Hypochondriasis · Rumination

Introduction

Health anxiety and hypochondriasis are characterized by the fear or conviction of having a serious disease in the absence of confirmatory medical findings [1]. This fear or conviction is typically stimulated and maintained by minor bodily sensations (e.g., headache) that are interpreted in a catastrophic manner (e.g., having a brain tumor) [1]. Recent studies demonstrated that not only hypochondriasis but also sub-threshold variants of elevated health anxiety that are quite prevalent in the general population (about 6 %) are associated with clinically relevant impairment and distress [2]. This finding is also in line with recent taxometric studies demonstrating that health anxiety actually represents a dimensional construct with the most severe case of hypochondriasis only differing *quantitatively* but not *qualitatively* from less severe states of health anxiety [3, 4]. Besides high levels of distress and functional impairment, health anxiety is particularly associated with high health care usage [5]. Gaining a better understanding of the etiology and pathogenesis of health anxiety appears pivotal to promote ways to effectively treat this condition.

Because clinical observations suggest that health anxiety is often exacerbated in situations marked by high stress and elevated emotional arousal, health anxiety might be associated with deficits or maladaptive strategies of cognitive coping or

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emotion regulation in terms of effectively terminating negative affective states. Interestingly, the crucial role of emotion regulation deficits has so far mainly been investigated in the realm of anxiety and mood disorders [6–8]. A recent review summarized the pivotal role of alterations in emotion regulation strategies in the development and maintenance of anxiety disorders [9]. Emotion regulation strategies may modulate the immediate behavioral, physiological, and cognitive consequences of the fear response during re-encounters with the conditioned stimuli. In the long term, the inflexible, habitual use of dysfunctional emotion regulation strategies (e.g., expressive suppression) may result in functional impairments that are associated with anxiety disorders. These postulated processes of (dysfunctional) emotion regulation might not only be relevant to states of anxiety and dysphoria but also to health anxiety and hypochondriasis because contrary to the current controversial classification of hypochondriasis among the somatoform disorders [10, 11], it has been suggested that pathological health anxiety is actually more closely related to the spectrum of anxiety disorders [12, 13].

Up until now, only two studies have explicitly focused on the role of emotion regulation strategies in hypochondriasis and health anxiety [14, 15]. Fergus and Valentiner [14] found in a sample of students (N=503; M_{age}=19.1, SD_{age}=2.3 years; 68 % female) that the regulation strategies cognitive avoidance (β=.09) and reappraisal (β=−.11) are significant predictors of disease convictions. Marcus et al. [15] investigated the relationship between health anxiety and the regulation strategies of rumination and catastrophizing. In this study (N= 198 students; M_{age}=21.1, SD_{age}=4.1 years; 76 % female), a significant correlation (r=.24) between rumination and health anxiety was found. This association did not only result from the shared variance with negative affectivity because rumination was also directly related to health anxiety. The results also showed that catastrophizing ambiguous bodily symptoms (e.g., to interpret headache as a sign of a brain tumor) is directly associated with health anxiety (r=.19).

However, no previous study has yet considered the multidimensional model of health anxiety underlying cognitive-behavioral interventions with affective, cognitive, behavioral, and physiological aspects [16]. Marcus et al. [15] operationalized health anxiety with only one general score, and Fergus and Valentiner [14] distinguished the two dimensions: disease phobia and disease conviction. Additionally, the two prior studies examined only a small number of emotion regulation strategies. So, the present studies were designed to focus on this multidimensionality of health anxiety and on different coping and emotion regulation strategies, which might play a relevant role in health anxiety.

Regarding their consequences on emotional (e.g., dysfunctional emotion regulation resulting in increased negative affect [17, 18]) or cognitive processes (e.g., dysfunctional emotion regulation associated with reduced memory performance [19]), the regulation strategies can be divided into maladaptive coping or emotion regulation strategies (e.g., rumination, catastrophizing, self-blame, other-blame, and suppression) and adaptive coping or emotion regulation strategies (e.g., acceptance, positive refocusing, refocusing on planning, putting into perspective, and reappraisal) [20, 21]. Adaptive strategies (e.g., reappraisal and acceptance) showed mostly no or weak (negative) and inconsistent associations to psychological problems compared to maladaptive strategies (e.g., rumination and suppression) [22, 23]. Accordingly, we expected no significant associations between adaptive cognitive coping and emotion regulation strategies and the affective, behavioral, cognitive, and perceptual dimension of health anxiety.

In contrast, there are several empirical findings and clinical observations suggesting that associations between maladaptive regulation strategies and the four dimensions of health anxiety are rather likely: Clinical observations have shown that people with elevated health anxiety or hypochondriasis are repetitively and excessively preoccupied with illness worries or/and illness convictions, bodily symptoms, and the need for social support [1, 16]. So, we assumed positive correlations between rumination and all four dimensions of health anxiety (see hypotheses in Fig. 1).

Because a recent study showed a relationship between safety behaviors (including social support) and increased health anxiety, probably due to catastrophizing fostered by safety-related behaviors [24], we hypothesized that not only the catastrophic interpretation of bodily symptoms [15] but also catastrophizing in general the tendency to interpret an experience as particularly terrible [20] would be positively related to the affective, cognitive, behavioral, and perceptual components of health anxiety.

Two further maladaptive strategies, self-blame and blaming others, are also related to negative affect [25]. In particular, blaming yourself for an event or experience is positively correlated to anxiety and stress [25]. We therefore assumed that self-blame and other-blame are particularly associated with the affective dimension of health anxiety. Because the cognitive component of health anxiety also includes discrepancies between one's own illness convictions and the reactions of other people [26], we hypothesized that other-blame is positively related to the cognitive dimension.

An additional maladaptive strategy, emotional suppression, refers to the inhibition of ongoing emotion-expressive behavior such as facial expression [27]. While suppression could reduce the external signs of emotional states [27, 28], Gross and John [21] found a positive relationship between the habitual use of expressive suppression and the experience of negative emotions. In line with this, the counterproductive effect of suppression on anxiety was demonstrated in experimental studies with non-clinical [18, 29] and clinical samples [30]. We therefore expected a positive correlation between expressive suppression and the affective dimension of health

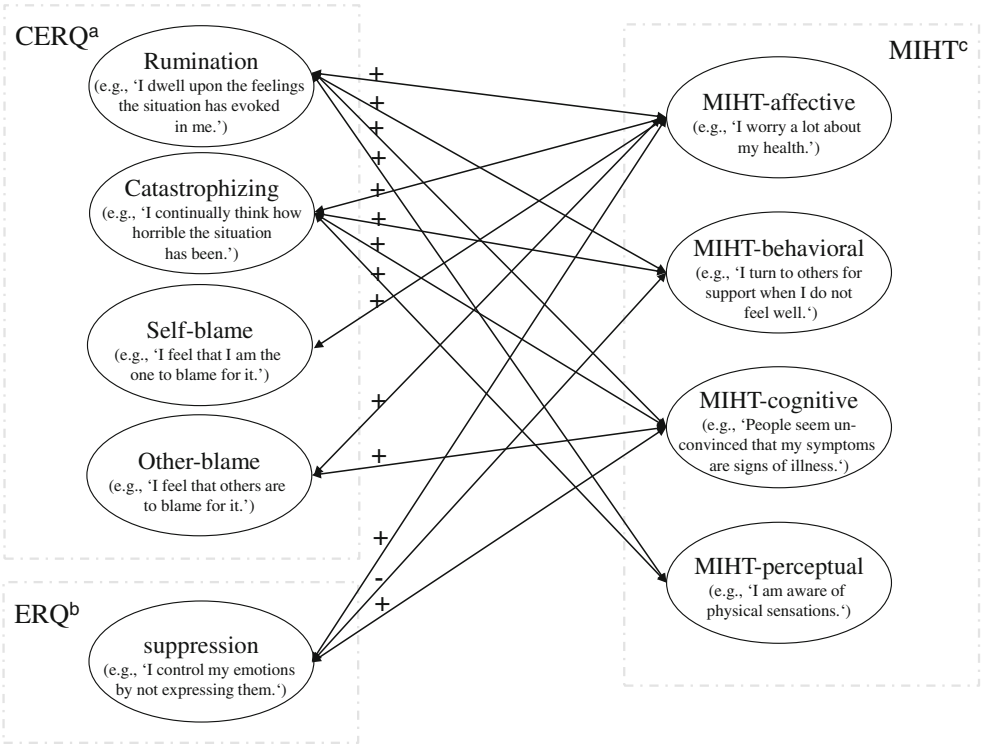

Fig. 1 The predicted positive (+) and negative (−) associations between maladaptive coping and emotion regulation strategies and the four dimensions of health anxiety (with sample items in *parentheses*). The used self-reports are (*a*) CERQ= Cognitive Emotion Regulation Questionnaire, (*b*) ERQ= Emotion Regulation Questionnaire, and (*c*) MIHT= Multidimensional Inventory of Hypochondriacal Traits

anxiety. Emotional suppression probably results in a discrepancy between inner feelings and outer expression and possible reactions of other people. Suppression is therefore probably positively related to the cognitive dimension of health anxiety as well. Whereas Gross and John [21] also found that individuals who habitually use suppression have less social support, people with hypochondriacal concerns tend to seek social support and medical reassurance [31]. For that reason, we expected a negative relationship between suppression and the behavioral dimension of health anxiety.

In general, we expected positive relationships between maladaptive coping and emotion regulation strategies and dimensions of health anxiety (our detailed hypotheses are summarized in Fig. 1). Because various coping and emotion regulation strategies are strongly related to depression [8, 32] and also health anxiety shows substantial overlap with depression [33], significant associations between cognitive coping and emotion regulation strategies and health anxiety could also result from the shared variance with depression. However, we assumed that the hypothesized relations should not only result from this shared variance (i.e., significant correlations should be observable, even when statistically controlling for the levels of depression; Study 2). Study 1 was designed to test the outlined hypotheses regarding significant associations between maladaptive coping and emotion regulation strategies and health anxiety. Study 2 aimed at replicating and extending the findings of Study 1 by statistically controlling for individual differences in depressive symptoms and by testing a possible mediating influence of depressive symptoms.

Study 1

Method

Participants and Procedure

In Study 1, a total of 172 participants (122 women; M_{age}= 26.23 years, SD_{age}=10.01 years) completed self-report measures on health anxiety and cognitive coping and emotion regulation strategies in an internet-administered test version. The participants were recruited at a German university and in online communities. A flyer about the study or an e-mail included the link to the online survey.

Measures

The Multidimensional Inventory of Hypochondriacal Traits (MIHT) The MIHT is a 31-item questionnaire for the dimensional assessment of health anxiety in the general population [26, 34]. The MIHT consists of the following four subscales: the affective subscale, including illness worries; the cognitive scale, which assesses illness convictions (that are not shared by others) and hypochondriacal alienation as a consequence; the behavioral subscale, which measures the tendency to seek social support; and the perceptual subscale, which focuses on bodily sensations [26, 34] and is closely related to the concept of somatosensory amplification [35]. Subjects are asked to "read each statement carefully" and to "use the following scale to rate each statement": 1="strongly disagree" to 5="strongly agree" [36]. The internal consistencies of the

subscales range from α=.75 to α=.89. Evidence for convergent validity has been provided through correlations with other established measures of health anxiety and discriminant validity through relationships with general assessments of psychopathology [34]. In these studies, the model fits for the MIHT were χ^2=609.68 (*df*=426, *p*<.01), CFI=.92, TLI=.92, and RMSEA=.05 (Study 1) and χ^2=659.48 (*df*=426, *p*<.01), CFI=.95, TLI=.95, and RMSEA=.05 (Study 2).

Cognitive Emotion Regulation Questionnaire (CERQ) The CERQ assesses cognitive coping strategies used after experiencing negative life events ("By the following questions you are asked to indicate what you generally think, when you experience negative or unpleasant events.") [20, 37]. This 36-item questionnaire consists of nine subscales: self-blame (e.g., "I feel that I am the one who is responsible for what has happened"), blaming others (e.g., "I feel that basically the cause lies with others"), acceptance (e.g., "I think that I must learn to live with it"), refocus on planning (e.g., "I think about how I can best cope with the situation"), positive refocusing (e.g., "I think of nicer things than what I have experienced"), rumination (e.g., "I am preoccupied with what I think and feel about what I have experienced"), positive reappraisal (e.g., "I think that the situation also has its positive sides"), putting into perspective (e.g., "I think that other people go through much worse experiences"), and catastrophizing (e.g., "I often think that what I have experienced is the worst that can happen to a person") [20, 37]. The CERQ uses a five-point scale (1="almost never" to 5="almost always"). Internal consistencies range from α=.75 to α=.87 and the test–retest correlation (1-year follow-up) from *r*=.48 to *r*=.65 [32]. In a German adaptation [37], Cronbach's α coefficients were $\alpha \geq$.73, except for the subscales acceptance (α=.60) and rumination (α=.66). The test–retest correlations (7-month follow-up) were found to be acceptable to good, with values ranging between *r*=.48 (positive refocusing) and *r*=.84 (catastrophizing) [37]. In our studies, the model fits for the CERQ were χ^2=906.83 (*df*=524, *p*<.01), CFI=.88, TLI=.86, and RMSEA=.07 (Study 1) and χ^2=1,028.54 (*df*=556, *p*<.01), CFI=.93, TLI=.91, and RMSEA=.06 (Study 2).

Emotion Regulation Questionnaire (ERQ) Because the CERQ does not include any suppression scale, we additionally used the ERQ [21, 38]. This questionnaire is a widely used self-report measure of individual differences in suppression (four items; e.g., "I control my emotions by not expressing them") and reappraisal (six items; e.g., "I control my emotions by changing the way I think about the situation I'm in") [21, 38]. The habitual use of both emotion regulation strategies ("We would like to ask you some questions about your emotional life, in particular, how you control [that is, regulate and manage] your emotions....") was measured on a seven-point scale (1="strongly disagree" to 7="strongly agree"). Cronbach's α coefficients range from α=.75 to α=.82 for reappraisal and from α=.68 to α=.76 for suppression [21]. In the current studies, the model fits for the ERQ were χ^2=119.23 (*df*=34, *p*<.01), CFI=.93, TLI=.91, and RMSEA=.12 (Study 1) and χ^2=183.08 (*df*=34, *p*<.01), CFI=.93, TLI=.91, and RMSEA=.14 (Study 2).

Statistical Analyses

The hypotheses regarding the associations between cognitive coping and emotion regulation strategies and health anxiety dimensions were examined by using a structural equation modeling (SEM) approach. The advantage of the SEM approach is that the latent structures of constructs are explicitly modeled and critically evaluated according to goodness of fit indices, and that relations between latent variables represent true score correlations that are independent of measurement error. The separate measurement models for the factors of the MIHT, ERQ, and CERQ were specified using the suggested structures in the original literature [20, 21, 26, 34]. Afterwards, we analyzed the standardized latent variable correlations between the dimensions of health anxiety (MIHT), dysfunctional and functional cognitive coping strategies (CERQ), and the ERQ dimensions reappraisal and suppression.

The analyses were performed using Mplus version 6 [39]. Mplus makes it possible to examine confirmatory models with categorical indicators modeled by a two-parameter normal-ogive IRT model and uses an integrated and generalized approach for measurement and structural models with latent variables [40]. The analyses of the measurement models were conducted with the robust mean and variance adjusted weighted least squares (WLSMV) procedure, which is insensitive to non-normal distributions. Because the WLSMV procedure is based on the tetrachoric correlation matrix and tetrachoric correlations have been observed to be biased with low cell frequencies [41], we collapsed rarely used response categories to obtain response frequencies of at least 5 % in each cell. The χ^2 test is sensitive to the sample size and the complexity of the model. Therefore, we used other descriptive fit measures for the evaluation of the model fit (e.g., [42]). As an absolute fit index, we chose the RMSEA (root mean square error of approximation). The CFI (comparative fit index) and the TLI (Tucker–Lewis index) are reported as incremental fit indices. It has been recommended [43] that the RMSEA should be smaller than .08 or .05 to indicate an acceptable or good fit. For the CFI and TLI, values greater than .95 can be considered as an adequate fit and values greater than .97 as a good fit. However, some researchers regard these cutoffs for the CFI and TLI as very restrictive. Particularly in trait research,

models with CFI values ≥.90 might be considered as acceptable [42].

Results

Means, standard deviations, and Cronbach's α coefficients of the four dimensions of health anxiety and the coping and emotion regulation strategies are shown in Table 1.

Model 1: Dimensions of Health Anxiety and Dysfunctional Cognitive Coping Strategies

The first model included the MIHT dimensions of health anxiety (affective, cognitive, behavioral, and perceptual) as well as the dysfunctional coping strategies of the CERQ (self-blame, rumination, catastrophizing, and other-blame). The fit indices (χ^2=1,266.15, *df*=1,004, $p<.01$; CFI=.92, TLI=.92, RMSEA=.04) indicated that the model is an acceptable to good representation of the data. The latent variable correlations between dimensions of health anxiety and dysfunctional coping strategies (CERQ) are presented in Table 2. As expected, the dimensions of health anxiety were positively related to rumination and catastrophizing. The strongest correlation (r=.47) was observed between affective health anxiety and rumination. Only the relationship between catastrophizing and the perceptual dimension of health anxiety was unexpectedly negative. The results showed, as expected, positive correlations between self-blame and the affective dimension of health anxiety, while other-blame was positively associated with the affective and cognitive dimension of health anxiety.

Model 2: Dimensions of Health Anxiety and Functional Cognitive Coping Strategies

In Model 2, we tested the hypothesis that there are no associations between functional coping strategies of the CERQ (acceptance, positive refocusing, refocusing on planning, positive reappraisal, and putting into perspective) and dimensions of health anxiety (MIHT). The corresponding model fit was acceptable to good (χ^2=1,400.83, *df*=1,137, $p<.01$; CFI=.92, TLI=.91, RMSEA=.04). Only a few significant correlations were observed. Positive refocusing was positively related to the behavioral factor of health anxiety, and refocusing on planning was positively associated with the affective and perceptual dimensions of health anxiety. The strategy of positive reappraisal was positively correlated with the perceptual dimension of health anxiety.

Table 1 Means (*M*), standard deviations (SD), and Cronbach's α of the dimensions of health anxiety and the measured coping and emotion regulation strategies for Studies 1 and 2

Measures (possible range)	Study 1 (n=172)			Study 2 (n=242)		
	M	SD	α	*M*	SD	α
Health anxiety dimensions						
MIHT						
Affective (7–35)	19.42	5.04	.79	16.17	5.56	.83
Behavioral (8–40)	24.26	5.22	.83	22.94	5.77	.80
Cognitive (7–35)	16.59	4.91	.85	12.90	5.53	.89
Perceptual (9–45)	28.81	4.64	.78	26.65	6.29	.83
Cognitive coping						
CERQ (each subscale, 4–20)						
Self-blame	10.00	3.16	.74	9.69	3.13	.74
Acceptance	11.80	3.16	.75	12.42	3.38	.76
Rumination	10.44	3.56	.77	9.85	3.39	.72
Positive refocusing	10.02	2.93	.75	10.15	3.64	.85
Refocusing on planning	11.83	2.80	.60	11.59	3.41	.73
Positive reappraisal	12.65	3.34	.78	12.51	3.93	.85
Putting into perspective	12.15	3.62	.80	12.56	3.88	.82
Catastrophizing	7.57	3.40	.81	6.84	2.89	.76
Other-blame	6.70	2.41	.82	6.45	2.30	.80
Emotion regulation						
ERQ						
Reappraisal (6–42)	4.39	0.99	.79	4.67	1.04	.80
Expressive suppression (4–28)	3.49	1.13	.71	3.40	1.21	.74
Depression						
PHQ-9 (0–27)				5.31	4.33	.84

MIHT Multidimensional Inventory of Hypochondriacal Traits, *CERQ* Cognitive Emotion Regulation Questionnaire, *ERQ* Emotion Regulation Questionnaire, *PHQ-9* depression scale of the Patient Health Questionnaire

Table 2 Standardized latent variable correlations between dimensions of health anxiety and coping and emotion regulation strategies in Study 1

	Health anxiety dimensions (MIHT)			
	Affective	Behavioral	Cognitive	Perceptual
Dysfunctional strategies (CERQ)				
Self-blame	.41**	.04	.20*	−.07
Rumination	.47**	.37**	.23**	.28**
Catastrophizing	.34**	.22*	.24**	−.17*
Other-blame	.37**	.34**	.25**	−.01
Functional strategies (CERQ)				
Acceptance	<.01	−.07	−.02	.07
Positive refocusing	<.01	.19*	−.14	.06
Refocusing on planning	.19*	.05	−.04	.36**
Positive reappraisal	−.02	.04	−.12	.31**
Putting into perspective	.01	.15	−.12	−.01
ERQ dimensions				
Reappraisal	−.06	.10	−.07	.22*
Expressive suppression	.07	−.44**	.27**	−.02

Model 1: dimensions of health anxiety and dysfunctional coping strategies, χ^2 =1,266.15, *df*=1,004, p<.01; CFI=.92, TLI=.92, RMSEA=.04. Model 2: dimensions of health anxiety and functional coping strategies, χ^2 =1,400.83, *df*=1,137, p<.01; CFI=.92, TLI=.91, RMSEA=.04 (item 20 of the subscale acceptance was excluded because it had a low factor loading of less than .03). Model 3: dimensions of health anxiety, reappraisal and expressive suppression, χ^2 =1,028.31, *df*=762, p<.01; CFI=.91, TLI=.90, RMSEA=.05

MIHT Multidimensional Inventory of Hypochondriacal Traits, *CERQ* Cognitive Emotion Regulation Questionnaire, *ERQ* Emotion Regulation Questionnaire

*p<.05; **p<.01

Model 3: Dimensions of Health Anxiety, Reappraisal, and Expressive Suppression

In Model 3, we tested associations between the dimensions of health anxiety (MIHT) and the two emotion regulation strategies of the ERQ: suppression and reappraisal. Again, the model fit was acceptable (χ^2=1,028.31, *df*=762, p<.01; CFI=.91, TLI=.90, RMSEA=.05). In account with our hypotheses, a greater habitual use of expressive suppression was associated with a lower extent of the behavioral dimension and a greater extent of the cognitive dimension of health anxiety. The emotion regulation strategy of reappraisal was only positively related to the perceptual scale of the MIHT.

Discussion

Study 1 confirmed our hypotheses regarding the relations between cognitive coping and emotion regulation strategies and health anxiety (except the links between catastrophizing and perceptual health anxiety and between suppression and affective health anxiety). Thereby, our results replicate and extend the findings of Marcus et al. [15]. While Marcus et al. [15] only used a total score of health anxiety, in the present data, more detailed associations were detected between different dimensions of health anxiety on the one hand, and rumination and catastrophizing on the other: Whereas rumination was generally positively associated with all four dimensions of health anxiety, the strategies of catastrophizing and blaming others were positively associated with the first three dimensions of health anxiety, but negatively or unrelated to the perceptual dimension, reflecting the somatosensory amplification construct [44]. This might suggest that the latter two strategies serve as "externalizing" strategies that turn one's attention away from bodily signals, as measured by the perceptual factor. Furthermore, in contrast to the study of Marcus et al. [15], we did not only examine catastrophizing of bodily sensations, but rather catastrophizing in a more general manner.

Probably, the use of these cognitive coping strategies, which we consider as dysfunctional, appears subjectively meaningful and beneficial. Especially via rumination, people attempt to understand the causes and consequences of events in order to avert further risks and disasters. However, in fact, rumination mostly appears dysfunctional. The thoughts remain abstract and maintain the preoccupation with problems because usually there is neither adequate problem solving nor emotional processing [45]. In the context of health anxiety, this self-focused and abstract rumination may play an important role because the strong self-focusing might increase the selective attention on bodily sensations (which is empirically mirrored in the positive association between rumination and the perceptual dimension of health anxiety), and the abstractness of thoughts could result in a deficit of alternatives to explain the experienced bodily symptoms.

The positive associations between the dimensions of health anxiety and the coping strategy of other-blame are worth a closer look: Blaming someone else clearly represents a form of external attribution. While internal factors are often considered as abnormal and pathological, external factors tend to be evaluated as normalizing [46]. For people with elevated health anxiety, blaming others may be beneficial at least in the short run because the external attribution has an alleviative effect on negative thoughts. However, blaming someone else can contribute to troubled social relations and the difficult physician–patient relationships that are often reported in the context of health anxiety [47]. The meaningful correlations between self-blame and health anxiety (particularly, affective health anxiety) fit well with previous studies on the relationship between self-blame and psychopathology, in particular anxiety and depression symptoms [25, 32].

In line with previous studies (e.g., [22, 23]), functional strategies showed no or fewer relations to psychological

problems. However, we found a few unexpectedly positive links, especially between reappraisal and the CERQ subscale refocusing on planning and the perceptual dimension of health anxiety. Possibly, paying attention to the body results in more information about the own well-being, which might, particularly in our relatively young and healthy sample, facilitate the revaluation or coping with an event or emotion. Nevertheless, in general, our study confirmed previous results that the use of dysfunctional emotion regulation strategies has greater importance in psychological disorders than the absence of functional strategies [48]. However, a recent study showed that functional strategies are negatively related to psychological problems, when there are higher values for dysfunctional strategies [49]. This indicates that adaptive strategies could be compensatory under certain circumstances (e.g., particular high levels of rumination).

Regarding suppression, as expected, the more people suppress their emotions, the less they tend to seek social support. This negative link between expressive suppression and the behavioral dimension of health anxiety is in accord with the findings of Gross and John [21], showing that the habitual use of expressive suppression is negatively associated with social support and close relationships, and positively with the avoidance of attachments. Consistent with our hypothesis, we found a positive link between expressive suppression and the cognitive dimension of health anxiety. However, we found no meaningful correlation between expressive suppression and the affective dimension. The behavioral and cognitive dimensions, like expressive suppression, may possibly refer to behavioral responses to the environment, while the affective and perceptual dimensions rather involve an inner engagement because these dimensions focus on worries and selective attention to bodily sensations.

A major shortcoming of Study 1 is that no measure of negative affect or depressive psychopathology was included. We are therefore unable to demonstrate that the associations between dysfunctional cognitive coping and emotion regulation strategies and dimensions of health anxiety did not only result from the shared variance with negative affect or depressive psychopathology. This problem was addressed in Study 2.

Study 2

The aims of the second study were to replicate the findings of Study 1 and to prove a possible influence of depressive symptoms on the documented associations by statistically controlling for individual levels of depression. First, we tested model fits and associations with depression as a covariate. Additionally, we used latent mediation analysis to test direct and indirect effects from cognitive coping and emotion regulation to health anxiety. Because we only observed few and weak associations between adaptive coping and emotion regulation strategies and health anxiety in Study 1, the second study exclusively focused on the dysfunctional cognitive coping strategies of the CERQ and the two ERQ dimensions of reappraisal and expressive suppression.

Method

Participants and Procedure

In Study 2, a total of 242 participants (169 women; M_{age}= 28.82 years, SD_{age}=12.07 years) completed self-report measures, of whom 116 participants (94 women; M_{age}= 29.90 years, SD_{age}=14.10 years) used a pencil-and-paper test version and 126 (75 women; M_{age}=27.76 years, SD_{age}= 9.63 years) an internet-administered version. The participants were mainly students at German universities who were recruited at the university campus and received course credits for their participation (paper-and-pencil sample) or were reached by mailing lists of their psychology departments (internet-administered version). Because a lot of research [50–52] showed that it is legitimate to summarize data from internet and paper-and-pencil samples, we merged these data for our calculations.

Measures

As in Study 1, dimensions of health anxiety were assessed with the MIHT. The CERQ and ERQ were used to measure cognitive coping and emotion regulation strategies.

The depression scale of the Patient Health Questionnaire (PHQ-9) [53] was used to measure the severity of common depressive symptoms based on DSM-IV. The nine items are rated with four categories (0="not at all" to 3="nearly every day") and have a good internal consistency of α=.89 [54]. In this study, the model fit for the PHQ-9 was χ^2=66.20 (df= 27, p<.001), CFI=.97, TLI=.95, and RMSEA=.08.

Statistical Analyses

In addition to the described analyses in Study 1, we statistically controlled the hypothesized relationships for the individual levels of depression (depression as a covariate) and conducted mediation analyses by specifying depression as a mediator between dysfunctional coping and emotion regulation and health anxiety. To test direct and indirect effects from coping and emotion regulation to health anxiety, we used path analysis in Mplus [39]. In this procedure, significant indirect effects indicate significant mediators. Common used tests (e.g., the Sobel test) focus on products of coefficients and rely on normal distribution assumption. However, because the products are often not normally distributed, MacKinnon et al. [55] recommended using the bias-corrected bootstrap method. Based on 10,000 bootstrap

samples (as recommended by Mallinckrodt et al. [56]), we evaluated the indirect effects using 95 % confidence intervals (CIs). The path analyses were computed with each of the (dysfunctional) regulation strategies and each of the health anxiety dimensions (e.g., testing, whether catastrophizing has a direct or/and an indirect effect on the cognitive dimension of health anxiety).

Results

Table 1 presents the means, standard deviations, and Cronbach's α coefficients for all measures.

Model 1: Dimensions of Health Anxiety and Dysfunctional Cognitive Coping Strategies

In Model 1, we tested the assumed associations between the dimensions of health anxiety (MIHT) and dysfunctional cognitive coping strategies (CERQ). The fit of the model containing the four dimensions of health anxiety and the four dysfunctional coping strategies was good to excellent (χ^2=1,247.58, *df*=1,002, *p*<.01; CFI=.96, TLI=.95, RMSEA=.03). When statistically controlling for individual levels of depression (by regressing the latent coping variables and latent health anxiety dimensions on depression), the fit indices remained unaltered (χ^2=1,278.95, *df*=1,041, *p*<.01; CFI=.96, TLI=.95, RMSEA=.03), indicating a very good model fit. The latent variable correlations between health anxiety and dysfunctional coping strategies, including the corresponding correlations after adding the level of depression as a covariate in parentheses, are presented in Table 3.

As expected and in line with the findings of Study 1, health anxiety was moderately positively related to rumination and catastrophizing. Even when statistically controlling for the level of depression, most of the correlations remained unaltered in their strengths. Regarding the cognitive coping strategies of other-blame and self-blame, we found significant relationships between other-blame and affective as well as cognitive health anxiety, but failed to find a significant correlation between self-blame and affective health anxiety.

Model 2: Dimensions of Health Anxiety, Reappraisal, and Expressive Suppression

In Model 2, we examined the anticipated associations between health anxiety and the emotion regulation strategies of the ERQ, reappraisal and expressive suppression (χ^2= 1,139.45, *df*=762, *p*<.01; CFI=.94, TLI=.93, RMSEA=.05). Controlling for the individual level of depression (as outlined in Model 1) hardly changed the model fit (χ^2=1,142.40, *df*= 797, *p*<.01; CFI=.94, TLI=.93, RMSEA=.04). As expected and in accord with Study 1, we found a negative association between expressive suppression and the behavioral dimension of health anxiety, and a positive link between expressive suppression and the cognitive dimension. These correlations remained stable and almost unaltered in their size after controlling for depression.

Mediation Analysis

To test the assumption that dysfunctional coping and emotion regulation is not only indirectly associated with health anxiety via depression, we evaluated the significance of

Table 3 Standardized latent variable correlations between dimensions of health anxiety and coping and emotion regulation strategies in Study 2 (corresponding correlations after adding the level of depression as a covariate in parentheses)

	Health anxiety dimensions (MIHT)			
	Affective	Behavioral	Cognitive	Perceptual
Dysfunctional strategies (CERQ)				
Self-blame	.14 (.00)	.11 (.07)	−.06 (−.25**)	.05 (.03)
Rumination	.27** (.22**)	.36** (.35**)	.08 (−.04)	.35** (.36**)
Catastrophizing	.36** (.31**)	.26** (.25*)	.27** (.15)	.08 (.07)
Other-blame	.22** (.19*)	.19* (.18)	.31** (.29**)	.15 (.15)
ERQ dimensions				
Reappraisal	.02 (.05)	−.04 (−.03)	−.07 (−.04)	.20** (.21**)
Expressive suppression	.18* (.14)	−.35** (−.38**)	.39** (.35**)	−.07 (−.09)

Model 1: dimensions of health anxiety and dysfunctional coping strategies, χ^2 =1,247.58, *df*=1,002, *p*<.01; CFI=.96, TLI=.95, RMSEA=.03 [item 28 (self-blame) and item 30 (rumination) were allowed to load on the factor "catastrophizing"]. Model 2: dimensions of health anxiety, reappraisal, and expressive suppression, χ^2 =1139.45, *df*=762, *p*<.01; CFI=.94, TLI=.93, RMSEA=.05

MIHT Multidimensional Inventory of Hypochondriacal Traits, *CERQ* Cognitive Emotion Regulation Questionnaire, *ERQ* Emotion Regulation Questionnaire

*p<.05; **p<.01

indirect and direct effects using mediation analyses. Merely for the cognitive MIHT scale, mediation analyses (with depression as a mediator) revealed significant indirect effects for the catastrophizing scale of the CERQ ($\beta_{standardized}$=.19, p<.001, 95 % CI=.09–.29) and for the suppression scale of the ERQ ($\beta_{standardized}$=.07, p<.05, 95 % CI=.01–.13),[1] indicating a significant mediating mechanism via depression for these scales. In contrast, only direct effects without indirect effects were observed for the relations between the affective MIHT scale and the cognitive coping strategies catastrophizing ($\beta_{standardized}$=.33, p<.01), rumination ($\beta_{standardized}$=.23, p<.05), and other-blame ($\beta_{standardized}$=.18, p<.05). For the behavioral MIHT scale, analyses revealed significant direct effects for catastrophizing ($\beta_{standardized}$=.28, p<.05), for rumination ($\beta_{standardized}$=.40, p<.01), and for suppression ($\beta_{standardized}$= −.42, p<.01). Furthermore, we found significant direct effects between the cognitive MIHT scale and other-blame ($\beta_{standardized}$=.26, p<.01) and between the perceptual MIHT scale and rumination ($\beta_{standardized}$=.39, p<.01).

Discussion

The results of Study 2 replicated the main findings of Study 1. By statistically controlling for individual levels of depression and by testing mediation models, Study 2 confirmed the hypothesis that the associations between different dysfunctional coping and emotion regulation strategies and dimensions of health anxiety did not only result from the shared variance with depression. Our findings are in line with the results presented by Marcus et al. [15], demonstrating that dysfunctional regulation strategies (e.g., rumination and catastrophizing) are not only indirectly (via negative affect) but also directly related to health anxiety. Noteworthy is the correlation between self-blame and the cognitive dimension of health anxiety because the direct effect is negative in direction, indicating that the more self-accusations people report, the fewer illness convictions they have. Probably, self-blaming might result in realizing more alternative explanations for, e.g., minor bodily symptoms (e.g., physical strain, body checking, or catastrophic beliefs).

General Discussion

The clinical and empirical observation that health anxiety and hypochondriasis co-occur with elevated states of negative affectivity suggests that dysfunctional coping and emotion regulation strategies might play a crucial role in the etiology and maintenance of health anxiety and hypochondriasis. The primary aim of the two studies was to test the assumed links between various coping and emotion regulation strategies and different dimensions of health anxiety.

In summary, the present results confirm substantial links between dysfunctional coping and emotion regulation strategies, especially rumination, catastrophizing, and other-blame and affective, cognitive, and behavioral dimensions of health anxiety. While expressive suppression was negatively related to the behavioral dimension, we found positive association between expressive suppression and the cognitive dimension of health anxiety, suggesting that the habitual suppression of one's affective states seems to be related to illness conviction and hypochondriacal alienation.

Because the behavioral dimension of health anxiety (e.g., the tendency to seek social support and medical reassurance) is one of the crucial components in cognitive-behavioral models of health anxiety and hypochondriasis (e.g., [16, 57]) and plays an important role in the maintenance of health anxiety, the associations between this dimension and coping strategies are worth a closer look. Both, Study 1 and Study 2, found medium-sized positive associations between rumination and the behavioral subscale of the MIHT (independent of the level of depression; mediation analysis showed only a direct effect; Study 2). Although the current cross-sectional design precludes definite causal interpretations, behavioral dimensions of health anxiety might serve to counteract ruminative tendencies. However, the positive nature of the associations suggests that this strategy is not successful in lowering illness worries. Such an interpretation of the association between rumination and behavioral dimensions of health anxiety is in line with Selby's emotional cascade theory [58], which states that ruminative thoughts increase negative affect and promote dysregulated behavioral responses in order to overcome negative affective states, at least in the short run.

Compared to other studies in the general population and in college students [20, 21, 26, 34], we found similar descriptive statistics of the measurements (see Table 1). Based on this, the findings were assumed to be valid for the general population. In future studies, it appears fruitful to further examine the association between multiple dimensions of health anxiety and coping and emotion regulation strategies in patients with full-blown hypochondriasis. If the reported associations prove true in patient samples, therapeutic approaches focusing on coping and emotion regulation strategies might be promising add-ons to existing successful cognitive-behavioral treatment approaches.

Limitations and Future Directions

It has to be acknowledged that in some cases, the fit indices did not indicate very good fits of the models (e.g., in case of

[1] Additionally, we found a direct effect ($\beta_{standardized}$=.32, p<.001) indicating a partial mediation.

the measurement models for the CERQ and the ERQ). However the RMSEA, one of the best-performing and most-used fit indices [42, 59, 60], was good to very good in most of the models (except for the ERQ model). Lower CFI values (<.95) may also result from an unfavorable proportion of the number of observations and the number of manifest variables within the model [61]. Furthermore, a critical CFI value of .95, indicating a good model fit [43], is difficult to achieve in trait models and is presumably too restrictive [42].

The question of the etiological relevance of cognitive coping and emotion regulation—i.e., whether dysfunctional coping and emotion regulation strategies result in the development of health anxiety and especially in dysfunctional behavior (e.g., excessive reassurance seeking) or vice versa—remains unanswered because the cross-sectional design of the present studies precludes conclusions about causality. Because neither Study 1 nor Study 2 included measures of trait anxiety, anxiety sensitivity, or negative affectivity, it is also not possible to determine how specific the reported associations between facets of health anxiety and strategies of coping and emotion regulation are. A further limitation concerns the exclusive use of self-reports. So, it would also be interesting to assess the links between coping and emotion regulation strategies and health anxiety by objective measures.

Conclusion

Our studies extend previous research on relations between coping and emotion regulation strategies and health anxiety by including a multidimensional concept of health anxiety and various coping and emotion regulation strategies. The current results showed significant and consistent associations between dysfunctional coping and emotion regulation strategies (particularly, rumination, catastrophizing, and other-blame) and dimensions of health anxiety (particularly, the affective, behavioral, and cognitive dimension). The results remained stable, even when statistically controlling for individual levels of depression. Mediation analysis further indicated that the described relations do not entirely result from the shared variance with depression. Interestingly, links between the behavioral dimension of health anxiety and dysfunctional cognitive coping suggest that behavioral aspects of health anxiety may serve to compensate for difficulties in cognitive coping. If it is possible to replicate these findings in clinical samples, therapeutic interventions focusing on cognitive coping and emotion regulation would be promising add-ons for current cognitive-behavioral approaches to health anxiety.

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