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Original

The Role of Perseverative Cognition for Both Mental and Somatic Disorders in a Naturalistic Psychiatric Patient Sample / Appel, J.E., Vrijsen, J.N., Marchetti, I., Becker, E.S., Collard, R.M., van Eijndhoven, P., Schene, A.H., Tendolkar, I. - In: PSYCHOSOMATIC MEDICINE. - ISSN 0033-3174. - 83:9(2021), pp. 1058-1066. [10.1097/PSY.0000000000001003]

Availability:

This version is available at: 11368/3011622 since: 2022-03-06T18:12:16Z

Publisher:

Published

DOI:10.1097/PSY.0000000000001003

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The Role of Perseverative Cognition for Both Mental and Somatic Disorders in a Naturalistic Psychiatric Patient Sample

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ABSTRACT

Objective: Perseverative cognition (PC) is the repeated or long-term activation of the cognitive representation of psychological stressors and is associated with prolonged stress including somatic and mental consequences. Hence, PC might represent a cognitive process linking mental and somatic pathology, but current research on this link is limited by investigating healthy samples, markers of somatic disease, and single disorders. The present study explored the importance of PC for different mental and somatic disorders in psychiatric patients.

Methods: Data from 260 naturalistic psychiatric outpatients were used. Psychiatric diagnoses were based on structured clinical interviews. Somatic diseases were assessed using a well-validated questionnaire and were clustered into (cardio)vascular and immune/endocrine diseases. PC was operationalized using the Perseverative Thinking Questionnaire (PTQ).

Results: Multiple regression complemented with relative importance analyses showed that the PTQ total and subscale scores were associated with the presence of mood disorders, addiction, and anxiety. Unexpectedly, no relatively important associations were found between the PTQ and autism spectrum disorder, attention-deficit/hyperactivity disorder, or somatic disease.

Conclusions: Our data complement previous work linking PC to stress-related mental disorders but question its immediate role in neurodevelopmental and somatic disorders. Targeting PC in the treatment of mood disorders and perhaps also in addiction seems promising.

Key words: psychiatric disorder, somatic disorder, perseverative cognition, repetitive negative thinking, stress response.

Comorbidity among mental disorders is the commonality, not the exception. Nearly half of the individuals presenting with one mental disorder also meet the *Diagnostic and Statistical Manual of Mental Disorders* (DSM) diagnostic criteria for at least one other mental disorder (1). Besides, mental disorders also show high comorbidity with somatic pathology, such as cardiovascular diseases, and also allergies, rheumatoid arthritis, and diabetes (2–5). Such comorbidity is associated with unfavorable outcomes for the individual, such as low quality of life (6) and mortality (7), as well as high levels of health care utilization (8). Investigating psychological factors that contribute to the comorbidity between mental and somatic disorders can inform us about possible targets for intervention.

Research has delineated perseverative cognition (PC)—“the repeated or chronic activation of the cognitive representation of one or more psychological stressors” (9, p. 114)—as involved in the development of both mental and somatic disorders. PC describes the common feature of processes like worry and rumination to uphold the representation of the stressor. Therefore, PC is

often examined by using measures of repetitive negative thinking, which describes a thinking style that is characterized by being repetitive, intrusive, and difficult to disengage from. Its effects are perceived both as being unproductive and as capturing mental capacity (10). According to the PC hypothesis (PCH; (9)), the maintained representation of the stressor prolongs the psychological and physiological stress response. In the long run, this stress response has negative consequences, specifically mental and somatic health problems (11). The emergence of perseverative processes, according to Verkuil et al. (11), happens automatically and universally. Every stimulus that might indicate danger triggers a stress response, which is only inhibited upon the perception of safety. Hence, the absence of a stress response is thought to be a

ADHD = attention-deficit/hyperactivity disorder, ASD = autism spectrum disorder, CIs = confidence intervals, DSM = *Diagnostic and Statistical Manual of Mental Disorders*, PC = perseverative cognition, PCH = perseverative cognition hypothesis, PTQ = Perseverative Thinking Questionnaire, RI = relative importance

Received for publication November 20, 2020; revision received March 1, 2021.

result of inhibitory activity, whereas the (prolonged) stress response (e.g., PC) is regarded as the inability to switch from disinhibition back to inhibition or, in other words, the inability to perceive safety (12,13).

In addition to the transdiagnostic relevance of PC as well as its contribution to various disorders by prolongation of the stress response, PC can also have disorder-specific consequences. Worry is an element of many theories on anxiety disorders (14) and may prolong a perseverative loop. For example, the contrast avoidance theory of generalized anxiety disorder (15) proposes that individuals with generalized anxiety disorder are especially sensitive to severe shifts in emotional experience. To deal with this vulnerability, they use worry to produce a constant condition of stress, which lowers the likelihood of unexpected negative emotionality (16). In depression, rumination is regarded as an important process upholding biased information processing, which both triggers and maintains depressive episodes (e.g., cognitive model of depression; (17)). Its characteristic repetitive focus on depressive symptoms simultaneously leads to an extended stress reaction (9). PC likewise is hypothesized to play a central role in the development of and relapse into alcohol dependence. Initially, alcohol use might serve as a way to cope with the heightened stress and negative affect caused by PC (e.g., attention allocation model; (18)), a connection that after some time can result in habitual drinking in response to PC. In addition, stress sensitivity gets heightened by time, and relapse can itself become a stressor maintaining the disorder (see integrated biopsychosocial model of addiction; (19)). With regard to autism spectrum disorder (ASD), individuals' cognitive rigidity might leave them caught up in potentially stressful cognitions and thus heighten their level of PC as well as symptoms of anxiety and depression (20). Also, attention-deficit/hyperactivity disorder (ADHD), and in particular its inattentive symptoms, is characterized by executive function difficulties (21), potentially prolonging repetitive cognitions. In support, executive dysfunction has been associated with both worry (22) and rumination (23). Finally, for somatic diseases, PC is thought to prolong psychophysiological stress responses, which causes the dysregulation of different biological systems and in the long run somatic disease ((9); see also allostatic load; (24)). In addition, rumination seems to be related to health-risk behaviors that are hypothesized to further perpetuate the stress response (25). After the development of somatic disease, disease-related worries and disease-specific deficits might further elevate level of PC. As an example, diabetes is associated with cognitive difficulties such as reduced cognitive flexibility and psychomotor activity (26), conceivably implicated in perseverative cognitive processes.

There is much support for the PCH in the field of mental health. For instance, PC is not only associated with the severity of depression and anxiety, but also with their level of comorbidity (27,28). Moreover, across mental disorders, PC seems to mediate the association between the anxiety and depressive disorders and their symptom severity (29), and it predicts both the maintenance and relapse of these disorders (28). PC is also implicated in other mental disorders (30). For instance, rumination as an important factor of PC has been related to addiction and may even predict alcohol abuse (31–34). With respect to neurodevelopmental disorders, both ASD and ADHD have been associated with high levels of PC (35–38). Hence, PC has been described as a transdiagnostic construct that may contribute to the development and severity of multiple mental disorders (30,39,40).

Also, in the field of somatic health, we find evidence for the importance of PC. PC has been found to impact upon immune, endocrine, and cardiovascular responses to stress, although longitudinal approaches are missing (for reviews, see Refs. (12,41)). To provide a brief overview, research in laboratory and naturalistic settings relates PC to elevated levels of inflammatory markers (42), amplified cortisol secretion (43), and reduced heart rate variability (44,45). Likewise, PC predicts the severity of subjective health complaints, such as fatigue and back pain (46). There is little research on the link between PC and objective health outcomes. As far as we found, PC has only been linked to physician-diagnosed heart problems so far (e.g., hypertension, fatal and non-fatal coronary heart disease) (47). Summarizing, there is evidence for the role of PC in several mental disorders, and it has been associated with markers of somatic disease. Playing a crucial role in the stress response, PC might help explain the high comorbidity between mental and somatic disorders.

However, until now, the potential role of PC in the comorbidity between mental and somatic disorders has received relatively little attention. The studies that have been conducted indicate that PC might indeed link mental to somatic morbidity. In one study in college students, PC mediated the relationship between depressive and perceived somatic symptoms (e.g., nausea, dizziness) (48). Furthermore, PC was found to be a concurrent predictor of college students' posttraumatic stress symptoms, general mental health, and physical symptoms and sensations (49). These first results on the role of PC in both mental and somatic symptoms are compelling. However, an exploration of the role of PC as a potential common psychological pathway in the comorbidity between clinical disorders is lacking, as studies mostly focused on only a single mental disorder or on subjective health outcomes. The ecological validity and consequently the generalizability and clinical relevance of the findings is limited, necessitating research that assesses multiple and more objectively assessed mental and somatic disorders in a clinical sample.

The present study sought to explore the importance of PC for mental and somatic disorders in a naturalistic outpatient cohort of patients presenting with different mental disorders (mood disorders, anxiety, addiction, ASD, ADHD) and with different somatic diseases (immune-endocrine, cardiovascular). First, we aimed to replicate previous findings concerning subjective health outcomes by demonstrating that level of PC is associated with a worse subjective evaluation of one's health status (e.g., (49)). Next, we sought to examine the unique shared variances of the different mental and comorbid somatic disorders with PC. Mental disorders were classified by a mental health professional based on structured clinical interviews. In line with other Dutch cohort studies (e.g., (50)), somatic disorders were classified using the Statistics Netherlands questionnaire (CBS questionnaire; Centraal Bureau voor de Statistiek, see www.cbs.nl). PC was measured with the Perseverative Thinking Questionnaire (PTQ; (10)).

Based on previous literature, we expected PC to be associated with all included mental and somatic disorders. The previous literature does not enable formulation of specific hypotheses about the exact strength of these associations, although there is most consistent evidence for the association of PC with anxiety and mood disorders. If we find that PC is indeed associated with most included disorders, that would support the generalization of the PCH to clinical disorders and would help to generate more specific hypotheses about the comorbidities wherein PC is most strongly implicated. In

addition, it would provide information on which treatments would benefit from a focus on PC.

METHOD

Participants

This study is part of the MIND-Set study, which aims at measuring integrated novel dimensions in a variety of mental disorders. The study is executed at the outpatient unit of the psychiatric department of the Radboud University Medical Center (Radboudumc), Nijmegen, the Netherlands. The department is specialized in the diagnosis and treatment of comorbidity of neurodevelopmental and stress-related disorders in adults, with specific attention for combined psychiatric and somatic pathology. Patients were eligible if they were 18 years or older and were diagnosed with one or more psychiatric disorders (mood disorder, anxiety, addiction, ASD, ADHD). Exclusion criteria were a current psychosis, sensorimotor handicaps, a full-scale IQ estimate <70, inadequate command of the Dutch language, or being mentally incompetent to sign an informed consent form. The study was approved by the Ethical Review Board of the Radboudumc.

Procedure

The total study consisted of an online preassessment and three consecutive sessions, two of which are important for the current analysis. In the preassessment, patients filled out online questionnaires about demographics, symptoms, and functioning. The first session consisted of a face-to-face clinical appointment encompassing standardized diagnostic interviews as well as the Statistics Netherlands questionnaire on somatic diseases (CBS questionnaire; Centraal Bureau voor de Statistiek, see www.cbs.nl). During the second session, patients were asked to complete another set of questionnaires, including the PTQ. The time difference between the intake session and the second session was on average 28.38 days (standard deviation = 26.62 days; six missings).

Measures

Sociodemographics

Information on age, gender identification, educational level, marital status, and ethnic background was obtained.

Psychiatric Diagnoses

The Structured Clinical Interview for *DSM-IV* Axis I Disorders (51) was used to diagnose mood and anxiety disorders and to exclude psychotic disorders. The Measurements in the Addictions for Triage and Evaluation and criminality (52) was applied to diagnose addiction disorders according to *DSM-IV*.

ADHD and ASD were assessed in a two-step procedure. The World Health Organization Adult ADHD Self-Report Scale—short version was administered for ADHD screening (53). When the screening was positive (six items, cutoff >3), the Diagnostic Interview for ADHD in adults (54) was conducted in the next step. For screening on ASD, the Autism-spectrum Quotient (55) was used. When a patient scored positive (50 items, cutoff >25), the Dutch interview for the diagnosis of ASD in adults (56) was administered subsequently. Both the Diagnostic Interview for ADHD in adults and the Dutch Interview for the Diagnosis of ASD in adults were completed in the presence of a partner and/or family member of the patient to be able to retrospectively and collaterally ascertain information on a broad range of symptoms in childhood and adulthood.

For the current analyses, we used the clusters of disorders of the *DSM-IV*, namely, mood disorders, anxiety disorders, addiction, ASD, and ADHD. All categories were scored as *present* (1; i.e., one or more diagnosed disorders in that category) or *absent* (0; i.e., no diagnosed disorder in that category).

Overall Subjective Health Evaluation

Patients rated their overall health by answering the item “How is your overall health status?” from the CBS questionnaire. Answers were given on a

5-point Likert scale ranging from 1 (*very good*) to 5 (*very bad*), with higher scores indicating a worse health evaluation. Because this item is not anchored to a specific somatic disease, it represents an overall, disease-independent subjective health evaluation.

Somatic Diseases

Somatic diseases were also assessed using the CBS questionnaire. Patients were asked to indicate whether they were suffering from a specific somatic disease (e.g., hypertension, arthritis). This self-reported information has been shown to represent general practitioner reports, with agreement rates of 90% to 95% for most diseases (57).

For the current study, we selected diseases whose development can theoretically be influenced by PC, such as heart or gastrointestinal disease, and excluded diseases that are caused by external events, such as concussion. Comparable with the psychiatric diagnoses and based on previous research on the effects of PC on endocrine, immune, and cardiovascular responses (12), we combined the somatic diseases into two clusters, namely, a) (cardio)vascular disease (peripheral artery disease, hypertension, heart disease, angina pectoris, stroke, vascular abnormalities) and b) immune and endocrine disease (allergies, intestinal disorders, lung disease, arthritis, rheumatism, gastric ulcer, thyroid disease, liver disease, diabetes). The latter clustering is allowed because the immune and endocrine system have been shown to cross-talk and to closely interact in the development of disease (such as with diabetes and osteoporosis; see Refs. (58–60)). Again, clusters were scored as *present* (1) or *absent* (0).

Perseverative Cognition

The PTQ (10) is a 15-item self-report questionnaire used to estimate patients' level of repetitive negative thinking. It has been designed to measure content-independent PC (10). Thus, in contrast to measures of worry and rumination, which are biased toward anxiety and depressive disorders, respectively, the PTQ captures the shared mechanisms of these processes, which represent the core of PC (9). Items are rated on a 5-point scale ranging from 0 (*never*) to 4 (*almost always*). Three lower-order factors can be distinguished, namely a) core characteristics of PC (repetitiveness, intrusiveness, difficulties to disengage; e.g., “The same thoughts keep going through my mind again and again”), b) perceived unproductiveness of PC (e.g., “My thoughts are not much help to me”), and c) mental capacity captured by PC (e.g., “I cannot do anything else while thinking about my problems”). Studies confirm the adequate psychometric characteristics of the PTQ in both healthy and clinical samples (10,61). The total scale and the subscales have demonstrated similar psychometric properties across samples (with all subscales loading on the higher-order factor of repetitive negative thinking/PC), making the PTQ an often-used questionnaire for assessing PC in psychiatric patients with various syndromes (e.g. (29,62,63)). In the current study, we used the total sum score, as well as the sum scores of the three subscales for analyses. Cronbach α values were .94 for the total scale, .93 for the core characteristics subscale (nine items), .76 for the perceived unproductiveness subscale (three items), and .80 for the capturing mental capacity subscale (three items).

Statistical Approach

All analyses were conducted using the R statistical program (64). In a first step, sample characteristics, the amount of comorbidity, and Pearson correlations among the study variables were computed. The main analyses consisted of four separate multiple regression models, with the PTQ total score and its three subscale scores as dependent variables. Predictors were mood disorder, anxiety, addiction, ASD, ADHD, (cardio)vascular disease, and immune/endocrine disease, all scored as present or absent. Moreover, we adjusted for gender and age because both may affect our dependent variable. As for gender, women are at a higher risk for both PC (65,66) and affective disorders (67), whereas it has been hypothesized that men show stronger psychophysiological reactions to PC (41). As for age, older adults

exhibit lower levels of PC, potentially because of differences in emotion regulation (68,69).

The multiple regression models were complemented by relative importance (RI) analyses. RI analysis aims at examining how the different predictors in a regression model add up to the proportion of explained variance (i.e., R^2 ; (70)). Put differently, RI analysis overcomes the problem of correlated predictors' standardized regression weights not adding up to the R^2 , by taking into account both the unique and the shared variance of the predictors in explaining the outcome. In the present study, the *lmg* metric of the package *relaimpo* (71) was used to obtain the RI of the different predictors in explaining the four PTQ scores. This metric estimates each predictor's unique R^2 contribution for every possible position in the regression model. A predictor's R^2 contribution averaged over the different orderings of predictors represents its RI. We report those estimates adjusted to sum to 100%. In addition, bootstrapping with 1000 bootstraps was applied to calculate confidence intervals for the RI estimates and to determine whether these estimates differ significantly between predictors.

RESULTS

Sample Characteristics

Data of a total of 260 psychiatric patients (58.5% female; mean [standard deviation] age = 39.85 [13.90] years) were used in the current analyses. At the time of data analysis, a total of 1024 patients had been approached for participation. Of those, 543 patients did not participate because they declined participation (e.g., because of a too high time investment or feeling too overwhelmed to participate; $n = 390$), they did not fulfill all inclusion criteria ($n = 134$), or they fulfilled an exclusion criterion ($n = 19$). In addition, 221 patients did not have full data on the key variables for the current analysis, resulting in the final data set of 260 patients. Some 4.6% of the sample had no education, 12.7% low education, 40.9% average education, and 41.7% high education (one missing). Moreover, 43.8% was unmarried, 29.3% married, 18.6% cohabiting, 7.9% divorced, and 0.4% widowed (18 missings). Ninety-five percent of the sample was born in the Netherlands. Other countries of birth were Germany ($n = 3$), Belgium, Hungary, Kosovo, Egypt, Croatia, Slovenia, Switzerland, and South Africa (each $n = 1$; 18 missings). Means and standard deviations of the PTQ scores across the sample, correlations among study variables, and the number of reported mental and somatic disorders are presented in Table 1. As evident from this table, about two-third of the sample had at least one immune/endocrine disease, and about one-third of the sample reported at least one (cardio)vascular disease. With regard to mental disorders, half of the sample experienced a depressive disorder, whereas less than one-fifth of the sample was diagnosed with addiction. About 30% of patients were diagnosed with at least one anxiety disorder (with $n = 20$ for panic disorder, $n = 3$ for agoraphobia, $n = 26$ for social anxiety disorder, $n = 8$ for specific phobia, $n = 12$ for obsessive-compulsive disorder, $n = 18$ for posttraumatic stress disorder, $n = 19$ for generalized anxiety disorder, and $n = 9$ for unspecified anxiety disorder).

The number of patients presenting with comorbidity among mental and somatic disorders is presented in Table S1 of Supplemental Digital Content 1, <http://links.lww.com/PSYMED/A779>. Overall comorbidity was high, representing clinical practice. For example, about one-third of the patients diagnosed with a mood disorder also had a diagnosis of anxiety, and about one-third of patients diagnosed with anxiety also had a diagnosis of ASD or

ADHD. Moreover, half of the patients diagnosed with addiction also had a diagnosis of ADHD. All mental disorders showed comorbidity with (cardio)vascular disease in about 25% to 35% of the cases and comorbidity with immune/endocrine disease in about 60% to 70% of the cases.

Bivariate Correlations

Correlation of PC With Overall Health Evaluation

Correlations among the mental disorders, somatic diseases, the PTQ and its subscales, as well as the covariates can be found in Table 1. To replicate previous research (e.g., (49)), we examined the associations between the PTQ and perceived health (Table 1). The PTQ total scale, and the core characteristics and capturing mental capacity subscale were significantly positively related to patient's overall health evaluation, with small effect sizes. Thus, patients with higher levels of PC reported a more negative evaluation of their overall health.

Correlation of PC With Mental and Somatic Disorders

Presence of a mood disorder, anxiety, and addiction was positively correlated with the PTQ total score. Also, the PTQ subscales were significantly related to each of those disorders, with the exception of the association between anxiety and the capturing mental capacity and perceived unproductiveness subscale. The effect sizes ranged from small to medium. ASD showed a small negative correlation with the perceived unproductiveness subscale, whereas ADHD did not demonstrate significant associations with the PTQ scores. The somatic clusters were weakly positively interrelated but did not display significant associations with any of the PTQ scores and most of the mental disorders. Solely anxiety was significantly positive correlated with the (cardio)vascular disease cluster.

Multiple Regression and Relative Importance Analyses

PTQ Total Score

As presented in Table 2, the first model predicting the PTQ total score was statistically significant ($R^2 = 0.1492$, $F(9,250) = 4.870$, $p < .001$), with the predictors collectively explaining 14.9% of the variance in the outcome. Only mood disorder ($b = 5.75$, $p < .001$), anxiety ($b = 3.41$, $p = .009$), and addiction ($b = 5.17$, $p = .001$) emerged as significant positive predictors of the PTQ total score. Regarding the RI estimates (see also Figure 1), mood disorder explained 46.8% of the total explained variance, followed by addiction (27.1%) and anxiety (13.5%). However—and probably because of their rather broad confidence intervals—those three predictors did not significantly differ from each other in their R^2 contribution (all $p > .05$). Mood disorders showed a significantly higher contribution to the variance in the PTQ score than all remaining predictors (all $p < .05$). Similarly, addiction had a significantly higher RI contribution than ASD, (cardio)vascular disease, and gender (all $p < .05$). Anxiety, on the contrary, did not have a significantly higher RI than any of the remaining predictors (all $p > .05$). None of the somatic disease clusters significantly predicted the PTQ score or was relatively important.

PTQ Subscale Scores

The three models predicting the core characteristics, perceived unproductiveness, and capturing mental capacity subscale of the

TABLE 1. Descriptive Statistics of and Bivariate Pearson Correlations Among the Mental and Somatic Disorders, PTQ Scores, and Covariates (n = 260)

Variable	M (SD) or % (n) Present	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Gender	58.5% (152) ^a	—													
2. Age	39.85 (13.90)	-0.08	—												
3. Mood	52.7% (137)	-0.01	0.09	—											
4. Anxiety	33.5% (87)	0.03	-0.01	-0.01	—										
5. Addiction	19.2% (50)	-0.08	0.04	0.09	-0.06	—									
6. ASD	30.0% (78)	-0.06	-0.13*	-0.24***	.03	-0.21**	—								
7. ADHD	40.8% (106)	0.05	-0.16**	-0.28***	-0.11	0.11	-0.01	—							
8. CV cluster	28.5% (74)	-0.10	0.26***	0.10	0.15*	-0.05	-0.06	-0.02	—						
9. IE cluster	67.3% (175)	0.12	0.20**	-0.00	-0.01	0.01	-0.10	0.06	0.13*	—					
10. Overall h.	2.4 (0.9)	-0.03	0.16*	0.20**	0.03	0.01	-0.11	-0.05	0.31***	0.21**	—				
11. PTQ-tot	36.2 (10.2)	0.00	0.09	0.28***	0.13*	0.21**	-0.05	-0.08	-0.01	0.08	0.14*	—			
12. PTQ-CC	22.6 (6.4)	0.04	0.08	0.23***	0.14*	0.19**	0.01	-0.08	0.00	0.11	0.14*	0.97***	—		
13. PTQ-U	6.9 (2.3)	-0.02	0.08	0.32***	0.10	0.17**	-0.15*	-0.10	-0.06	0.02	0.08	0.84***	0.74***	—	
14. PTQ-CM	6.7 (2.4)	-0.08	0.10	0.26***	0.10	0.23***	-0.08	-0.01	0.03	0.01	0.17**	0.86***	0.75***	0.65***	—

PTQ = Perseverative Thinking Questionnaire; M (SD) = mean and standard deviation of continuous variables; % (n) present = percentage (number) present of categorical variables; ASD = autism spectrum disorder; ADHD = attention-deficit/hyperactivity disorder; CV cluster = (cardio)vascular disease cluster; IE cluster = immune/endocrine disease cluster; Overall h. = overall health evaluation; PTQ-tot = PTQ total score; PTQ-CC = PTQ core characteristics subscale; PTQ-U = PTQ perceived unproductiveness subscale; PTQ-CM = PTQ capturing mental capacity subscale.

* $p < .05$.

** $p < .01$.

*** $p < .00$.

^a Percentage (number) of females in the sample.

TABLE 2. Multiple Regression and Relative Importance Estimates Predicting PTQ

PTQ Total Score							
	<i>b</i>	SE <i>b</i>	β	<i>t</i>	<i>p</i>	RI	RI Adj.
(Intercept)	27.54	2.52		10.937	<.001*		
Mood	5.75	1.31	0.28	4.405	<.001*	0.070	0.468
Anxiety	3.41	1.29	0.16	2.638	.009**	0.020	0.135
Addiction	5.17	1.57	0.20	3.287	.001**	0.040	0.271
ASD	1.59	1.40	0.07	1.137	.256	0.002	0.015
ADHD	0.21	1.33	0.01	0.156	.876	0.003	0.021
CV cluster	-1.63	1.41	-0.07	-1.159	.248	0.002	0.014
IE cluster	1.65	1.32	0.08	1.247	.214	0.005	0.036
Gender	0.17	1.24	0.01	0.139	.889	0.000	0.001
Age	0.06	0.05	0.08	1.205	.229	0.006	0.040
<i>R</i> ²		0.1492					
<i>F</i> for <i>R</i> ²		4.870					

Model significant with $p < .001$. PTQ = Perseverative Thinking Questionnaire; SE = standard error; RI = relative importance estimate; RI Adj. = RI metrics are normalized to sum to 100%; ASD = autism spectrum disorder; ADHD = attention-deficit/hyperactivity disorder; CV cluster = (cardio)vascular disease cluster; IE cluster = immune/endocrine disease cluster.

* $p < .001$.

** $p < .01$.

PTQ showed similar results to the model predicting the PTQ total score (see Table S2, Supplemental Digital Content 1, <http://links.lww.com/PSYMED/A779>, which displays the regression coefficients and RI for the PTQ subscales). The explained variance, and the significance and RI of predictors were comparable. Interestingly, in the model predicting the PTQ perceived unproductiveness subscale total score, (cardio)vascular disease emerged as a significant *negative* predictor ($b = -0.64$, $p = .044$) but only explained 5.7% of the total variance.

DISCUSSION

The current study explored the role of PC for both mental and somatic disorders in a naturalistic psychiatric patient sample. In line with our expectations, mood disorders, addiction, and anxiety

showed significant associations with PC and its subcomponents, as well as the highest RI estimates. Unexpectedly, no significant or relatively important associations were found between PC and ASD, ADHD, or the somatic diseases. Taken together, the results do not provide support for a) the generalizability of the PCH to somatic diseases and consequently b) the prediction that PC contributes to the comorbidity between mental and somatic disorders.

The finding that mood disorders were associated with PC is in line with studies highlighting the importance of PC in the onset and maintenance of emotional disorders (28,39) and supports the PCH (9). Addiction emerged as the second most important predictor of PC. This finding extends the literature on PC in psychopathology, which to date has primarily focused on anxiety and mood disorders but supports the classification of addiction being a stress-related mental disorder. Caselli and colleagues (32) have shown that rumination (as part of PC) is an important prospective predictor of drinking status and level of alcohol use in alcohol abusers. It may very well be the case that this predictive effect is also related to anxiety and depressive symptoms in that study, which was not explicitly controlled for. Importantly and surprisingly, PC was only modestly related to mood disorders and addiction as the effects are in the range of modest-to-small, so that also clinical benefits may be modest. Still, our findings indicate the relevance of directly targeting PC in the treatment of depressive disorders and perhaps also in addiction (as is done in cognitive behavioral therapy and also the recently developed cognitive control training; (72)).

In contrast to the PCH and previous empirical findings (29), anxiety did not show significant bivariate associations with all components of PC, and its relative contribution to PC was comparable to that of the other disorders. Potentially, the clustering of the separate mental disorders into broader categories has created more heterogeneity within the category of anxiety disorders compared with the other disorder categories examined. PC might be characteristic only for a subgroup of those anxiety disorders, so that their predictive value and RI for PC is reduced if analyzed as a single construct. Support for this explanation comes from a study showing that the magnitude of the relationship between PC and anxiety differs between specific anxiety diagnoses (73).

Despite sufficient numbers in these subgroups, ASD was only negatively correlated with the perceived unproductiveness component of PC, but its relative contribution was low. ADHD was not

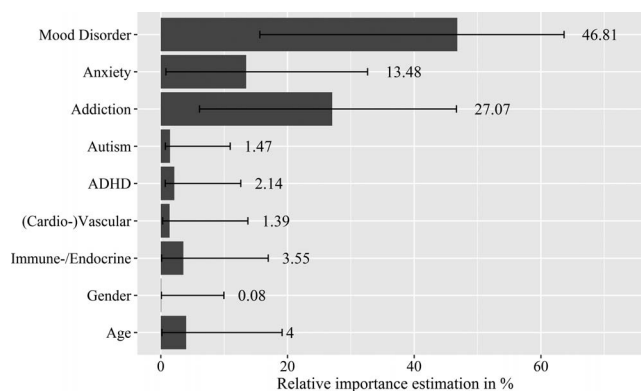


FIGURE 1. Relative importance coefficients of the different mental and somatic disorder clusters on the PTQ total score, including bootstrapped 95% confidence intervals (1000 bootstraps). The estimates represent the unique shared variances between the disorders and the PTQ total score, controlling for gender and age, and adjusted to sum to 100%. PTQ = Perseverative Thinking Questionnaire; ADHD = attention-deficit/hyperactivity disorder.

related to overall PC or any of its components. Previous studies have reported heightened levels of rumination in adults with ASD (35,38) and ADHD (37), but this was not assessed with the PTQ. Potentially, ASD and ADHD are mainly related to depressive thoughts and not so much to content-independent intrusive thinking as captured by the PTQ. Moreover—and as also suggested by the negative correlation between ASD and perceived unproductiveness of PC—neurodevelopmental disorders might be characterized by a form PC that is not perceived as maladaptive but still prolongs the stress response (e.g., because of reduced executive functioning). Relatedly, the PTQ items might be interpreted differently by individuals with and without psychopathology or depending on the type of disorder. Indeed, although the PTQ has been validated and used in clinical samples, these have mainly included patients with anxiety and depressive disorders, and to a lesser extent adjustment, somatoform, substance use, and eating disorders, but hardly patients with neurodevelopmental disorders (only associated with ASD symptoms with little confirmation of its content validity; (74)). Hence, to rule out that PC is not related to neurodevelopmental disorders, it would be important to use measures that do not include a negative perception of PC and investigate the appropriateness and importance of the different PTQ subscales for capturing PC in different disorders.

The finding that neither immune/endocrine disease nor (cardio)vascular disease was related to PC (except for a significant but weak association between (cardio)vascular disease and perceived unproductiveness) is surprising given the physiological concomitants of PC in healthy individuals (41). According to the PCH, this pathogenic state should in a next step lead to (diagnosable) clinical disorders (11). Although PC has been described as a proximal risk factor for mental disorders (28), it might represent a more distal risk factor in the case of somatic disease (75). PC might, however, influence the appraisal of amplified physiological activity, thereby explaining its link with subjective health complaints, which we replicated (76,77). Also, extended versions of the PCH emphasize that unconscious processes like automatic vigilance represent another part of PC that is responsible for a vast amount of the prolonged stress-related physiological activity (e.g., (78,79)). Although the PTQ measures the shared processes of constructs such as rumination and worry and thereby directly taps into the conscious part of PC, it does not capture its unconscious parts. Conscious and unconscious types of PC might be differentially related to mental and somatic disorders, a notion that will need to be addressed in future studies that supplement a self-report measure with automatic measures.

Strengths and limitations of the current study should be considered. The representativeness of our naturalistic sample for patients seen in clinical practice ensures that the findings have clinical relevance. Our sample seems to represent the Dutch psychiatric population (for reference, see Refs. (80–83)), although the lack of integrated prevalence ratings on the comorbidity makes comparisons difficult. It should be noted that this representativeness concerns *psychiatric* samples, and that studying samples with primarily somatic pathology might yield different results. In a similar vein, the educational level of the sample was rather high (cf. (84,85)). Because higher education is related to a healthier life-style and better somatic health (86), this composition could explain the somewhat lower somatic comorbidity in the current sample compared with more diverse psychiatric populations (see Ref. (87) and Table S3,

Digital Supplemental Content, <http://links.lww.com/PSYMED/A779>, which shows the amount of reported somatic disorders used for clustering). Also, it is conceivable that PC is implicated in even more psychiatric disorders that were not actively included and/or diagnosed in the current study, such as personality disorders, eating disorders, or schizophrenia. The clustering of the mental and somatic disorders represents a limitation of the measurement approach, as we did not examine the specificity and severity of the disorders in relation to PC. Moreover, with regard to the replication of the association between subjective health and PC, a common-method effect cannot be excluded. Lastly, because of the cross-sectional nature of the data, we cannot establish causal relationships.

In conclusion, the current study is—to the best of our knowledge—the first to explore the role of PC for a variety of mental and somatic disorders in a naturalistic patient sample. Our results provide evidence for the importance of PC in mood disorders and addiction, but not for an association with somatic comorbidity in psychiatric samples. The study thereby substantiates the literature on the PCH in clinical disorders and directs future research. This research should further examine the contribution of PC to the mental-somatic comorbidity in samples with varying types and degrees of mental and somatic pathology.

We want to thank Sophie Broelsma, Annemiek Bergman, Fleur Duyser, Eva van den Munckhof, Femke Struik, Ilze Thoonen, Laura Versteeg, and Livia van de Kraats for collecting the data for the MIND-Set Study. We would also like to thank all participants for their time and effort while taking part in our study.

Ethical standards: The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008. The MIND-Set Study was approved by the Ethical Review Board of the Radboudumc.

Source of Funding and Conflicts of Interest: The authors declare no conflict of interest. Funding for the MIND-Set Study was provided by the Radboud University Medical Centre and the Psychiatry Foundation as well as from a European Union's Horizon 2020 research and innovation program grant (grant agreement number 728018). These funding sources had no role in the study design, collection, analysis or interpretation of the data, writing the manuscript, or the decision to submit the manuscript for publication.

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