The Content of Gilbert's Regulation Theory focused on the Threat System in Chronic Fatigue Syndrome in the Netherlands: A factor analysis

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Abstract

Chronic fatigue syndrome (CFS) is characterized by the persistent presence of fatigue and other symptoms. Gilbert's theory contains three interactive components called Soothers, Threats, and Drives. The threat system is responsible for recognizing dangers and preparing the body for the respective threats. Since threats can worsen illnesses, this study focuses on possible threats that occur in CFS. The aim is to determine threat factors based on 40 in previous studies examined threat items and to analyze whether the factors vary with education levels and symptom severity. A questionnaire with 40 threat items and a symptom severity questionnaire was published. A total of 612 CFS (11%), Fibromyalgia (FM) participants (72%), CFS and FM participants (17%) completed this questionnaire (aged 18 to 81 or older). To provide a meaningful factor analysis, Fibromyalgia participants were added to the sample. 95% of the participants identified as female and 93%, were Dutch origin participants. The factor analysis revealed a three-factor solution with factor 1 'negative emotions and cognitions', factor 2 'weather changes', and factor 3 'physical demands'. The level of education was not associated with different perceptions of the threats, but high symptom severity is associated with the increased perception of the threat factors. The results represent the different perceptions of individual threat factors in CFS/FM and the successful filtering and clustering of all threat items which may exacerbate the symptoms of CFS/FM. In future, the threat factors can be targeted and limited with interventions, possibly with the Soother component of Gilbert's theory.

Keywords: *Chronic Fatigue Syndrome; Threats; Theory of Gilbert; Myalgic Encephalomyelitis.*

Introduction

Chronic fatigue syndrome (CFS), also called Myalgic Encephalomyelitis is a complex disorder with unknown aetiology. The main symptom of CFS is fatigue which must be present for at least 6 months and cannot be reduced by sleep or rest. A lack of standardized

diagnostic criteria is present (Lim et al., 2020), the assumed prevalence of CFS lays therefore between 0.1 and 5 percent (Tomas et al., 2017). Also, sleep and memory problems, concentration difficulties, joint pain, and post-external malaise are common symptoms in CFS (Tomas et al., 2017). Next to those symptoms, patients may have central nervous system disturbances, in addition to cell metabolism dysfunctions and inflammations (Rasa et al., 2018).

Different external or internal circumstances affect chronic diseases like CFS. In the field of psychology, Paul Gilbert examined those circumstances and developed a theory called Gilbert's theory which states that three affect systems may either exacerbate or inhibit diseases. The systems are called the threat system, the soothing system, and the drive system. All three interact with each other and thus form a general end combination. The threat system is there to recognize potential physical or psychological dangers and to prepare the body for that potential challenge (Gilbert, 2017). Thus, when the threat system detects an acute danger, chemical and physiological changes take place so that the body can react. During this process, the hypothalamic-pituitary-adrenal axis releases hormones and neurotransmitters which ensure that processes that are not relevant to the reaction to the danger are shut down (Rasa et al., 2018). Also, feelings of anger, anxiety, and disgust arise when the threat system is activated (Gilbert, 2017). This body experience continues until the body comes back to homeostasis.

According to Gilbert, the threat system is highly adaptive. It prepares the body for dangers in an emergency but also ensures that the person stays as close as possible to homeostasis (Gilbert, 2017). Nevertheless, the threat system can become chronically hyperactivated, whereas some researchers claim that this is occurring in CFS patients (Rasa et al., 2018). Thus, the body falls into a highly sensitive mode and cannot react appropriately to every day challenges due to its inability to return to a normally activated threat system. This disturbance of the system thus certifies that small environmental, physical or psychological stimuli lead to stress reactions. In long term, this state of stress causes neuronal changes in the brain, which condition the baseline of stress again. Fatigue is increased if stressors like time management problems are apparent in CFS patients, in general, experienced stress increases physical symptoms and decreases the quality of life (Lopez et al., 2011). If threats can trigger and amplify fatigue, it is useful to assess those and to help people with CFS to cope with every day challenges. In the end, threat-related adaptation is considered very difficult for patients

(Rasa et al., 2018). Unfortunately, only 10% of CFS patients can overcome this burden without seeking treatment (Lim et al., 2020).

Interestingly, Rasa et al. (2018) investigated that experiencing threats can affect the intensity and number of symptoms in CFS patients, for example, increased cardiovascular problems and a weakened immune system are linked to the experience of threats. For example, an increased physical activity causes a decreased mood and increased muscle pain in CFS patients. Physical activity is also known for better coping and reduced symptoms, but there seems to be a certain activity limit in CFS patients which by overcrossing causes the physical activity to become a potential threat which increases CFS symptoms (Black et al., 2005). Another study found a correlation between the experience of negative emotions and increased symptom severity (Maher-Edwards et al., 2011). The drawback and extent of these outcomes may be due to the general stress system dysregulation that may occur in CFS. Therefore, any kind of psychological, physiological, or physical stimuli can cause the system to overreact because dysregulation is present and hence lead to an increase in the severity of CFS (Rasa et al., 2018).

Generally, CFS is present in all educational levels, nevertheless, a study showed that fatigue severity is higher in lower socioeconomic status groups. Here, we might relate that the level of education is associated with the illness belief in CFS and thus has an influence on the underlying coping strategies. An association between more effective coping strategies in higher educated individuals has already been proven to exist (Ross & Wu, 1995). Since general health factors also depend on education, other stimuli in their environment could be described as a threat in lower educated participants which increases the perception of symptoms. It is therefore plausible to assume that the level of education is related to certain threat factors. For example, more physical than social threats might be present in the lower educated group.

Many studies have focused on specific and stand-alone triggers known to affect the threat system and thus the perception of the disease. As a result, an overview and model of the threat network system that is comprehensive and integrative with meaningful content, such as a list of the possible threats that exist in CFS, what kind of threats occur most frequently, and in which groups these threats could vary, is necessary to help to guide coping or form interventions customized to the individuals with CFS. By figuring out the most significant

threats which create stress in CFS patients, the investigation of threat factors would help to develop tailored treatments.

By examining which threats are most severe for particular patients, in future research one could also find out which soothers or therapeutic interventions would be most successful for individual patients to eliminate their threats. In particular, the intensity of symptoms could be related to the presence of threats. We can therefore assume that patients with severe symptoms describe distinct threats as more present than patients with less severe symptoms who might classify the same threats as not present at all. By identifying the main threat factors in CFS patients, one could develop subtypes of CFS in terms of threats and therefore give support to the research of medical and psychological treatment. Therefore, the following research questions are examined:

Research questions:

1) What kind of threat factors exist in people with persistent somatic symptoms including chronic fatigue?
2) Which threats have the strongest association with the increased perception of symptoms?
3) Are there different threat factors considered as most present in different education levels?
4) Do participants with high symptom severity perceive different threats as most present compared to low symptom severity patients?

Hypotheses:

1 and 2) Increased physical activity could form a threat factor based on previous findings (Black et al., 2005). Next, ’stress’ is a second threat factor to be assumed (Lopez et al., 2011). The third threat factor to be expected is negative emotions (Maher-Edwards et al., 2011). As non-restorative sleep is a common symptom in CFS patients it is assumed that sleep disturbances or other sleeping problems also cluster a threat factor in CFS (Mariman et al., 2013). Which threats are most associated with an increase of symptoms is an explorative question.

3) Since higher-educated people, according to Ross and Wu (1995), have better coping strategies, it is hypothesized that higher-educated people perceive threat items differently compared to lower-educated participants. It is therefore predicted that the mean value of certain threats is negatively correlated with the education level. Meaning that an increase in the perceived threat is associated with a lower level of education.

4) Symptom severity is based on the PHQ-15 questionnaire. It is assumed that participants with a high PHQ-15 score perceive different threats as being most present compared to low symptom severity participants due to the increased hyperactivation of the threat system in high symptom severity cases. The prediction is that the mean value of the threat factors differs across the symptom severity groups is explorative and based on findings by Rasa et al. (2018) but has more of a theoretical origin. In addition, a positive correlation between the PHQ-15 score and the experienced threat value is hypothesized.

Methods

Procedure

The implementation of the study was approved by the Ethics Committee of the Faculty of Social Sciences and Behavioral Sciences Utrecht with the filed number 20-497. The procedure ran as follows via an online questionnaire, which included a cross-sectional study. The questionnaire was published on social media platforms and patient organization pages and thus filled in by people with chronic diseases by clicking on a link. Therefore, the participants completed the study alone without any verbal instructions or feedback. The questionnaire started with an information letter and consent form that the participants had to agree to participate in the study. The participants took an average of around 50 minutes to complete the questionnaire. Data collection took place from 10.10.2020 to 23.12.2020. The data from the study were anonymously stored on the Qualtrics platform (Qualtrics, 2021). The data analysis took place from December 23rd to January 5th.

Participants

The participants in the study were contacted via social media platforms and patient organizations in the Netherlands. In total, 1021 participants participated in the study. Inclusion criteria were a diagnosis of one of the diseases below, that they are 18 or older, and that the participants have a sufficient understanding of the Dutch language. The presumed diseases included fibromyalgia (FM), chronic fatigue syndrome (CFS), irritable bowel

syndrome, and rheumatic diseases. Since this study is focused on the CFS and FM participants, the final sample of participants is 612. Of the final sample for the factor analysis, 65 participants had CFS, 103 participants suffered from CFS and FM and 444 participants had FM only. Here, FM participants were added for the factor analysis due to the small sample size of CFS sufferers. FM is another chronic disease that has certain similarities to CFS, participants of FM were added due to the necessity of a large sample size. About 90% of FM patients have problems with fatigue. Conversely, around 95% of CFS sufferers experience myalgia. Thus, around 20 to 70% of FM sufferers could be diagnosed with CFS. A complete review of the similarities and differences between CFS and FM can be found in the research article by Buchwald (1996), or Wolfe and Häuser (2011). All participants did not receive any payment reward for participation or any other reward. Demographic information about the participants can be found in Table 1 in the results section. Information about comorbid diseases and the diagnosis of the CFS sample can be found in Appendix B.

Materials

The questionnaire included questions about demographic information, 40 soothers, 40 drives, and 40 threats based on the previous findings of Geenen et al. (2020). Soothers and drives were included due to other studies. Additional questions about mental well-being and symptom severity were also included. Multiple-choice questions included the gender of the participant (man/woman /other) and the age of the person with categories (18-20, 21-30, 31-40 ... 81 or older). The educational level was assessed with a multiple-choice question (elementary school, vocational education, secondary general education, MBO, graduate school, university, or other). Open-ended questions about the birthplace of the grandparents, parents, and participants for gathering migration information were used. Various chronic diseases were examined by the use of multiple-choice question (chronic fatigue syndrome, fibromyalgia, somatic disorder, irritable bowel syndrome, systemic lupus erythematosus, rheumatoid arthritis, osteoarthritis, axial spondyloarthritis, Sjörgen's syndrome, psoriatic arthritis, systemic sclerosis, mixed connective tissue disease, chronic pain, or other). The professional who diagnosed the chronic diseases was examined by a multiple-choice question (medical specialist, family doctor, health professional, themselves, or someone else). The final question examined whether other diseases were diagnosed (psychiatric/psychological diseases, Lung diseases, diabetes/obesity, chronic skin condition, neurological diseases, cancer, cardiovascular diseases, organ diseases, hereditary disease, none, or others).

Symptom severity:

Afterwards, the PHQ-15 questionnaire was presented in Dutch with a three Likert-scale ranging from 1 (not at all) to 3 (a lot). According to test-retest reliability and Cronbach's alpha, the PHQ-15 is validly measuring symptom severity. This self-administered health questionnaire focuses on somatic symptoms like back pain, headaches, and dizziness (Kroenke et al., 2002). A score from zero to four was considered as minimal somatic symptom severity. Mild somatic symptom severity was ranked from five to nine. Moderate pronounced somatic symptom severity was reached with scores from ten to 14. Severe somatic symptom severity was present by a score from 15-30.

Threats, soothers, and drives

For threats, soothers, and drives, the items were taken from a previous study that used interviews and a concept mapping procedure to get an encompassing and structured overview of the contents of these to affect regulation systems in people with persistent somatic symptoms (Geenen et al., 2020). There were 40 items for each affect system, which the participants, for threats, had to classify using a 4-point Likert scale on how much these items worsen their CFS symptoms. That varied from not at all, a little, medium to a lot. Example items are 'Being stressed or tense', 'Holding a certain posture for long', or 'A situation that triggers irritation or anger'. The complete list of the 40 threat items can be found in Appendix A.

Education level

High education level was considered as the completion of MBO, MTS, MEAO, hogeschool, HTS, HEAO, or any university study. Low education was considered as the completion of basisschool, LHNO, LTS, and VMBO. For the factor analysis, the fibromyalgia and CFS participants were included in the analysis. All other education levels were considered as ‚other'.

Data analysis

Qualtrics data has been downloaded into SPSS 27.0. The participants were selected with select cases according to CFS and FM patients. The analysis of the relation of education levels and symptom severity included CFS participants and CFS participants with comorbid

FM. This sample was based on 168 cases. All of the following analyzes were based exclusively on the sample of the CFS participants and CFS participants with comorbid FM. Those with missing data in the threat and PHQ-15 section were excluded. The PHQ-15 scores were calculated via a syntax file in SPSS 27.0 according to the guidelines. Data analysis was based on a significant result with a *p*-value of <.05. Score distribution was checked according to z-scores.

In SPSS, a principal axis factoring analysis was performed with oblimin rotation. Factors were extracted with an eigenvalue greater than 1. A scree plot was created alongside the factor loadings. All 40 threat items were included. Based on the factor loadings, items were excluded if they load less than .45 to a singular factor or more than .32 to two or more factors (Osborne & Costello, 2004). Also, reliability analyses were conducted for each factor based on Cronbach's alpha.

A repeated-measures ANOVA was conducted with threats as within-subject factors to examine which threat factors were perceived to have the strongest association on the deterioration of CFS symptoms. To examine which threat factors are most present in different education levels a repeated-measures ANOVA was performed with the education level (low/high/other) as a between-subject factor and the resulting factors from the factor analysis as dependent variables

Finally, a MANOVA was conducted with symptom severity (minimal/mild/moderate/severe) as a between-subject factor based on the PHQ-15 score on the resulting factors of the factor analysis as dependent variables to examine whether high symptom severity participants perceive different threats as most present compared to low symptom severity patients.

Results

Data screening and participant selection

The dataset was screened for missing values, participants with missing values in the threat section and/ or PHQ-15 section were removed. The final sample of 612 participants is sufficient for completing a reliable factor analysis, listwise deletion was used.

Table 1.

Sociodemographic Characteristics of Participants at Baseline

Baseline characteristic	Sample of factor analysis:	Sample of follow-up analyses:

	Fibromyalgia and Chronic Fatigue Syndrome participants		Chronic Fatigue Syndrome participants	
	n	%	*n*	%
Gender				
Female	578	94.44	158	94.0
Male	33	5,39	10	6.0
Other	1	.16	.	.
Age				
18-20	4	.7	2	1.2
21-30	46	7.5	23	13.7
31-40	87	14.2	34	20.2
41.50	155	25.3	47	28.0
51-60	211	34.5	46	27.4
61-70	87	14.2	15	8.9
71-80	21	3.4	1	.6
81 or older	1	.2	.	.
Education level				
High	438	71.6	129	76.8
Low	160	26.1	35	20.8
Other	14	2.3	4	2.4
Disease				
Fibromyalgia	444	72.5	0	0
Chronic fatigue syndrome	65	10.6	65	38.7
Fibromyalgia and Chronic fatigue syndrome	103	16.8	103	61.3
	4	.7	38	76
Origin				
The Netherlands	572	93.6	154	91.7
EU Country	25	4.2	9	5.4
Other European countries	5	.8	3	1.7
America	4	.6	0	0
Africa	2	.3	0	0
Middle East	3	.4	2	1.2
Asia	1	.1	0	0

Note. N = 612 for FM and CFS participants, N = 168 for CFS and comorbid FM

Factor analysis

The factor pattern of 40 threat items in CFS and FM patients was analyzed. According to the Kaiser-Meyer-Olkin measure, the sample adequacy was .931. This measure reflects the distribution of the variables which may result from a latent factor. A high score of .931

reflects that the sample is adequate to perform factor analysis. The test of sphericity of Bartlett's showed a significant result (*chi-square*(780)= 9451.45, $p<.001$). Bartlett's test of sphericity determines whether variables are redundant, meaning that it is observing whether some items are correlated and therefore forming a factor. All commonalities were larger than zero. A principal axis factoring analysis was performed with oblimin rotation to figure out what threat factors were perceived to worsen symptoms according to patients with CFS. According to the initial eigenvalues, the first factor explained 30 percent and the second factor explained 6 percent of the variance. In general, 8 factors had eigenvalues above 1. Starting with the sixth factor, the eigenvalues were just above 1. Thus, 3 to 7-factor solutions were considered and carried out with principal axis factoring and oblimin rotation to get a strong factor solution. The three-factor solution was chosen due to the interpretability of each factor with a sufficient number of items, the scree plot, the theoretical background of conditions that worsen chronic fatigue syndrome and the internal consistency based on Cronbach's alpha.

A total of 18 items had to be removed from the analysis and factor interpretation because they either influenced several factors or the specified factor loading did not meet the minimum criteria for one factor. Finally, a principal axis factoring analysis with oblimin rotation and 22 items was conducted. All items had a minimum factor loading of .47, no item loaded multiple factors through cross-loadings or had a factor loading lower than .45. The final solution of the factors and their items can be found in Table 2.

Table 2.

Factor loadings and commonalities based on principal axis factoring with oblimin rotation for 21 threat items in FM and CFS participants

	Factor 1 Negative emotions and cognitions	Factor 2 Weather changes	Factor 3 Physical demands	Communality
A negative thought	**.869**	-.082	-.103	.661
Memory of a negative past event	**.858**	.022	-.198	.589

Feeling sad or helpless	**.850**	-.016	-.057	.670
Being angry	**.763**	.002	.036	.614
A negative life event	**.754**	-.047	.045	.602
Having worries	**.719**	.049	.041	.563
Feeling lonely	**.679**	-.045	-.011	.448
A situation that triggers irritation or anger	**.631**	.151	-.038	.472
An expectation that I cannot live up to	**.621**	-.044	.148	.504
Getting negative jugdments or comments	**.604**	.014	.154	.495
Lack of understanding from others	**.533**	.058	.173	.431
Social pressure	**.519**	.006	.272	.503
Being perfectionistic	**.427**	.070	.093	.249
An abrupt change in weather	.043	**.935**	-.059	.865
A weather circumstance, such as temperature or humidity	.007	**.870**	.059	.781
Having multiple activities scheduled	-.043	-.043	**.731**	.491
Exceeding my limits	.092	.026	**.603**	.441
Little time to rest	-.052	.081	**.588**	.337
Physical effort	.022	-.015	**.560**	.297
Getting visitors at home	.168	-.135	**.499**	.360
A task at work or in the household, or an administrative task	.159	-.050	**.489**	.343
Eigenvalue	8.445	2.066	1.723	
% of Total Variance	38.388	9.393	7.831	

The labels of the factors were based on the associated items and their interpretation. Internal reliability was checked individually for each factor with Cronbach's alpha. Cronbach's alpha was satisfactory to high for all three factors. Factor 1 'Negative emotions and cognitions'(12 items) had a Cronbach's alpha value of .928. Factor 2 'Weather changes'(2 items) had a Cronbach's alpha value of .903 and factor 3 'Restlessness and physical requirements (7 items) scored by Cronbach's alpha to .771.

The factors were computed based on the mean of the items that load on the factor. A high score for all factors is associated with a major perceived threat impact on the symptoms of CFS. Despite oblimin rotation, the correlation between the three factors was relatively low to medium. Factor 1 and 2 shared a correlation of .117, factors 1 and 3 correlated .554, factors 2 and 3 had a correlation of .165. Out of the previous 40 gathered threat items, 21 items created a cluster of three threat factors.

To analyze the differences between the threat severity of the three threat factors a repeated-measures ANOVA was conducted. The analysis revealed a significant multivariate effect of threats (*Wilks' F*(2,144)=32.906), $p<.001$), *partial eta squared* =.314). Its partial eta squared value indicates a large effect. Mauchly's test showed a violation of sphericity (*chi-square* (32.062), $p<.001$). The Greenhouse Geiser estimates of sphericity were corrected with degrees of freedom (*Greenhouse-Geisser*=.834). The significance of the strongest effect according to the estimated marginal means revealed that factor 3 has the greatest association with the experience of the worsening of symptoms in CFS participants ($m = 2.61$, $sd = 0.79$), followed by the second ($m = 2.81$, $sd = 1.12$), and the first factor ($m = 3.16$, $sd = 0.61$), visible in Figure 1.

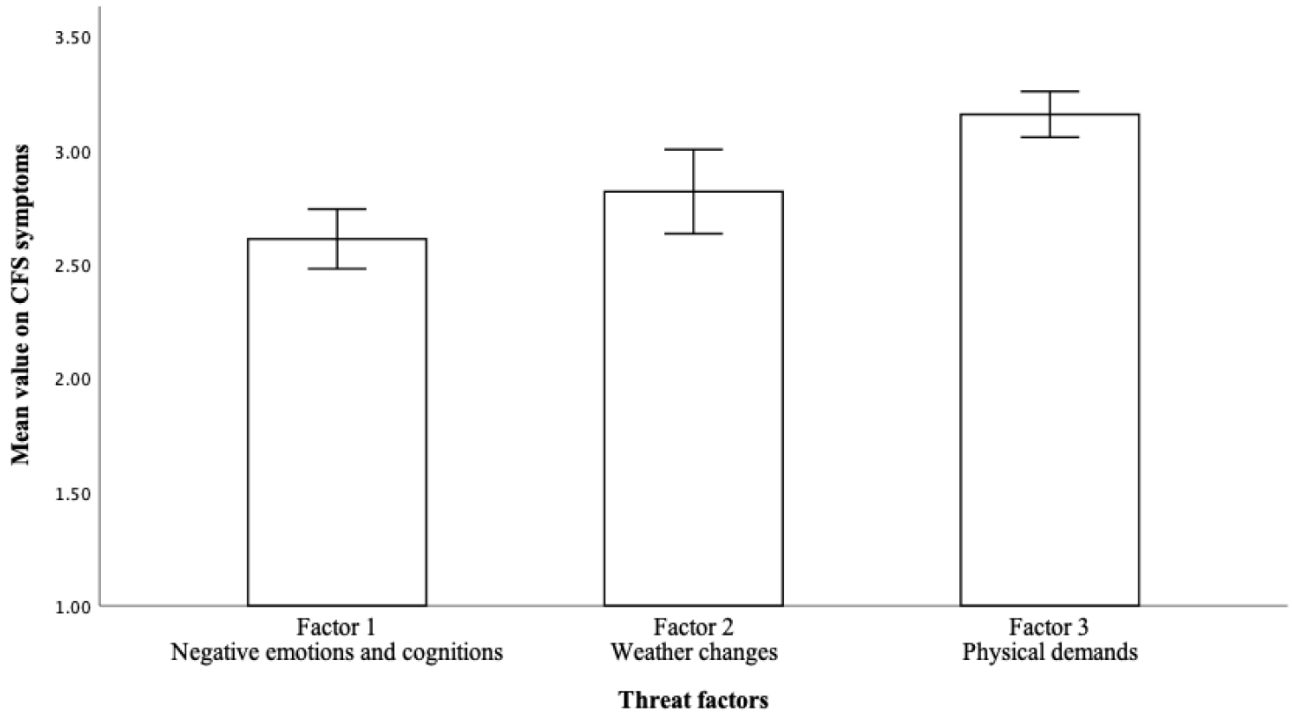

Figure 1. *Representation of the mean values of each threat factor that worsen the Chronic Fatigue Syndrome symptoms based on a 4-point Likert-scale in CFS participants.*

With the education level as a between-subject factor (high/low/other), repeated-measures ANOVA was conducted based on the three threat factors. Mauchly's test revealed that the assumed sphericity had been violated (*chi-square* (34.012), p =<.001). The Greenhouse-Geisser estimates of sphericity were corrected with degrees of freedom (*Greenhouse-Geisser* = .824). The results revealed a significant effect of threats (*Wilks' F*(2, 142)=9.055, p<.010) but a non-significant interaction effect of education level and threats (*Wilks' F*(4, 282)=1.920, p=.109). This analysis revealed that the means of the threat factors did not differ across the education level groups (high/low/other).

Table 3.

Presentation of the mean values and standard deviation of each threat factor which worsen the Chronic Fatigue Syndrome symptoms based on a 4-point Likert-scale

Factor	Education level	Mean	*Sd*
Negative emotions and cognitions	Low	2.86	.77
	High	2.56	.80

	Other	2.42	.93
Physical demands	Low	3.04	.61
	High	3.15	.61
	Other	3.36	.71
Weather changes	Low	3.07	1.04
	High	2.80	1.13
	Other	2.37	1.38

The MANOVA regarding symptom severity showed a statistically significant multivariate effect of symptom severity (mild, moderate, severe) based on the PHQ 15 score on the three threat factors ($F(8,280)=1.987$, $p<.048$, *Wilk's Lambda*=.895, *partial eta squared*=.054). According to the partial eta squared value, this effect was large. The between-subject category 'minimal' symptom severity was excluded from the analysis because of non-occurrence in this sample. The univariate effect revealed a significant effect of symptom severity on both factor 2 'physical demands' ($F(2, 145) =3.646$, $p=.029$, *partial eta squared*=.055), and factor 3 Weather changes ($F(2,145)=4.194$, $p=.017$, *partial eta squared*=.055). A non-significant univariate effect of symptom severity was found on factor 1 'Negative emotions and cognitions ($F(2,145)=2.564$, $p=.081$, *partial eta squared*=.035). The regression coefficient of mild symptom severity changes was -.729, whereas moderate symptom severity had a regression coefficient of -.432 on factor 2 weather. The regression coefficient was -.442 for mild symptom severity and -.124 for moderate symptom severity on factor 3 'Physical demands'. The relevant group descriptive statistics are displayed in Table 4. and Table 5. According to these means, symptom severity made a difference in the perception of the threat factors and also their order. All groups revealed that the third factor is perceived as the most disturbing on CFS symptoms. Followed by factor 2 and factor 1 for the severe and moderate symptom severity group. The mild symptom severity group perceived the first factor slightly more disturbing than the second factor.

Table 4.

Number of participants and percentages of the symptom severity categories in Chronic Fatigue Syndrome participants (minimal/mild/moderate/severe)

	N	Percentage
Minimal	0	.
Mild	16	9.5
Moderate	28	28.6
Severe	90	53.6
Missing value	14	8.3

Table 5.

Means, and standard errors of the symptom severity groups in CFS on the threat factors based on a 4-point Likert scale

	Group Symptom severity	Mean	Std. Error
Factor 1	Mild	2.37	.202
Negative emotions and	Moderate	2.46	.126
cognitions	Severe	2.73	.085
Factor 2	Mild	2.30	.283
Weather changes	Moderate	2.60	.161
	Severe	3.03	.119
Factor 3	Mild	2.80	.154
Physical demands	Moderate	3.19	.088
	Severe	3.24	.065

Discussion

The purpose of this study was to examine the underlying threat factors from 40 filtered threat items published by Geenen et al. (2020). The interpretation of the factor items presented a psychological, an external, and a physical factor. The psychological threat factor is called 'Negative emotions and cognitions', the external factor consists of weather-dependent external circumstances and is therefore called 'Weather changes’. The third threat factor is partly based on physical activity and restlessness and was therefore named 'Physical demands'. Based on the level of education, no significant difference in the perception of the three threat

factors could be found. Our analysis states that regardless of the level of education, all three threat factors are perceived as equally stressful. The hypothesis that higher-educated people perceive threat items as less threatening is therefore not confirmed. Nevertheless, this analysis cannot refute whether less educated people have less effective coping strategies (Ross & Wu, 1995), as this was not investigated. The PHQ-15 score, on the other hand, correlates positively with the perception of the different threats. The results showed that more severe symptom severity is associated with an increased threat value of physical demands and weather changes.

The result of the first factor, which is the experience of negative emotions or cognitions, is in line with the research by Maher-Edwards et al. (2011). The research team showed a correlation between the experience of negative emotions and increased symptom severity. The second factor, weather changes, was not hypothesized, but Geenen et al. (2020) ascertained a cluster of environmental stimuli in their research. The invention of the third factor is also in line with research according to the results of Black et al. (2005) who showed that too much physical activity can cause mood problems and muscle pain. Also, based on the items that form the third factor, the hypothesized stress and time pressure factor based on the finding of Lopez et al. (2011) alone did not arise, but these variables can be found in the third factor as items. Thus, the hypothesis of a single factor of stress and time pressure was not confirmed, but these circumstances form a large part of the third factor.

The factor with the greatest association with the worsening of symptoms of CFS patients is the ‘Physical demands’ factor, followed by the external threat factor 'Weather changes" and the psychological factor 'Negative emotions and cognitions'. ‘Physical demands’ is a very strong factor that can be specifically influenced by interventions (Black et al., 2005). By examining the patient's physical task maximum, one could align everyday life in such a way that it is not exceeded. Perhaps it is also possible to increase this presumed limit discussed by Black et al. (2005) with interventions to solve everyday challenges more easily. The psychological factor is about the perception of negative emotions or thoughts, but also about understanding of CFS by others. Psychoeducation to family/friends could potentially help people with CFS to increase social understanding of the disease and thus reduce symptoms (Montoya et al., 2004). Perfectionist traits that are also reflected in this factor can also be targeted with coping strategies (Antony & Swinson, 2009; Kempke et al., 2015). ‘Physical demands’ nevertheless stands out as a strong first factor that should have priority in clinical

practice, followed by the psychological factor. Despite this, the physical demands factor should probably be addressed with specialists from physiology; in comparison, factor 1 'negative emotions and cognitions' is a reflection of typical treatment topics in the field of clinical psychology (Koole, 2009). Factor 2 ‘weather changes’ is rather difficult to treat in clinical practice because it cannot be influenced. Nevertheless, CFS patients should be informed about this risk factor ‘Weather changes’ so that patients can recognize it. This clarification increases the patient's attention to prepare for weather changes and to reduce the possible increase in symptoms (Johnson et al., 2020). Here future research could examine the exact problem with an abrupt change in weather and why this is perceived with increased symptoms.

Since these factors are both external and physical, the theory and hypothesis that people with more extreme symptoms have increased hyperactivity of the threat system could be correct (Rasa et al., 2018). To test this statement, future research is still required. To test hypersensitivity in high vs low symptom severity, research methods from neuropsychology could be used, for example with fMRI scans to test whether a neurobiological difference can be seen in the brain regions that are active when threats are detected. Future research should perform a pure factor analysis with CFS patients to see if this forms the same factors based on the 40 threat items of Geenen et al. (2020). Also, it would be an advantage if these CFS sufferers have fewer comorbid diseases. The sample of this study includes 27% of participants who have serious diseases next to CFS. In addition, psychological interventions tailored to the threat factor should be tested.

Despite the large sample size and heterogeneity, a limitation of this study is that the proportion of CFS participants is relatively low. The main part of the sample that went through the factor analysis consists of 72% fibromyalgia (FM) patients. Also, there is generally no standardized diagnostic criterion for CFS, which makes it more difficult to specify research (Lim et al., 2020). Future research should investigate the difference between CFS, FM, and CFS with comorbid FM on the perception of the 40 threat items by Geenen et al. (2020). In addition, this study can barely make statements about the perception of threat items in male CFS sufferers, since the sample consisted of 95% of female participants. Another shortcoming of this study is that symptom severity was only measured using the PHQ-15 score. This is based purely on somatic symptoms and does not cover the entire range

of symptoms that can occur in chronic fatigue syndrome (Kroenke et al., 2002; Tomas et al., 2017).

The strength of this study is that it successfully created a threat cluster that is associated with the exacerbation of the symptoms in CFS participants. With these results, not only the factors but also the underlying items could thus be specifically treated and ideally eliminated with psychological interventions to reduce the symptom severity of patients.

In conclusion with this study, we have taken an important step in the specification of Gilbert's theory in Chronic Fatigue Syndrome and also Fibromyalgia. The selection of threat items and factors can help to analyze specific individual stress reactions of patients based on questionnaires and thus tailored treatment can be offered that possibly increases the effectiveness and comprehension of psychological interventions in Chronic Fatigue Syndrome. With the formation of the three-threat factors based on Gilbert's theory, the two other components of soothers and drives can be used in a targeted manner (Gilbert, 2017). In this way, the general end combination of the interaction of threats, soothers, and drives can be influenced and maximized in such a way that the patient achieves the optimum in symptom reduction.

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Appendix

Appendix A

Overview of the 40 threat items based on the research of Geeenen et al. (2020)

Threat items	Labels
1	A social activity outside home
2	Being stressed or tense
3	Holding a certain posture for long
4	Using medication
5	Time pressure
6	An abrupt change in weather
7	A situation that triggers irritation or anger
8	Food that is not good for me
9	Being unable to keep up in a group activity
10	Little time to rest
11	Being physically not active
12	Having worries
13	Poor sleep
14	Memory of a negative past event
15	Stimuli, such as noises, scents, bright lights or radiation
16	Feeling sad or helpless
17	Social pressure
18	Getting negative judgments or comments
19	Lack of understanding from others
20	A weather circumstance, such as temperature or humidity
21	Getting inadequate care
22	Physical effort
23	A negative life event
24	Being angry
25	An inflammation, infection, flu or other disease activity
26	Exceeding my limits
27	An argument

28	Having multiple activities scheduled
29	Feeling lonely
30	A task at work or in the household, or an administrative task
31	Doing nothing
32	A negative thought
33	An expectation I cannot live up to
34	Being out of energy
35	A change in daily routine
36	A common physical activity such as walking or cycling
37	Substances such as alcohol, cigarettes or softdrugs
38	A physical symptom such as pain, fatigue or stiffness
39	Getting visitors at home
40	Being perfectionistic

Appendix B

Table.

Number of participants and percentages of comorbid diseases in 168 Chronic Fatigue Syndrome participants

	N	Percentage
Having at least 1 comorbid disease	45	26.8
Specification of diseases:		
Psychiatric or psychological problems (depression, anxiety, schizophrenia, burnout etc.)	44	26.2
Lung disease	38	22.6
Diabetes or serious overweight	24	53.6
Chronic skin disease	12	14.4

Neurological disease (epilepsie, parkinson, dementia, migraine etc.)	16	9.5
Cancer	2	1.2
Cardiovascular diseases	23	13.7
Stomach, liver, gastrointestinal tract, kidney or other organ diseases	23	13.7
Hereditary Disease (Huntington, Ehlers-Danlos)	7	4.2
Missing value	9	5.4

Table.

Description of who made the diagnosis in number of participants Chronic Fatigue Syndrome participants

	N	Percentage
Medical specialist (rheumatologist)	142	84.5
General Practitioner	4	2.4
Health professionals (physiotherapist, psychologist etc.)	6	3.6
Internist	3	1.8
Pediatrician	1	.6
Myself	2	1.2
Missing value	11	6.5