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WHAT IS BEHIND "I'M SO TIRED"? FATIGUE EXPERIENCES AND THEIR RELATIONS TO THE QUALITY AND QUANTITY OF EXTERNAL STIMULATION

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Abstract—In the present study, it is hypothesized that both low quality and high quantity of external stimulation are related to elevated levels of fatigue. This is proposed by the Quality–Quantity model for understanding fatigue (QQuF model). The relations between the quality and quantity of external information and the Multidimensional Fatigue Inventory (MFI-20) are examined. Moreover, the role of depression (measured with the CES-D) in relation to the QQuF model is explored. The results show low quality of external stimulation, that is, low "attractiveness of external stimulation," relating to all five dimensions of fatigue. A high quantity of external stimulation, that is, high "experienced overload," related primarily to general and mental fatigue. The QQuF model was only slightly moderated by depression, but depression directly and strongly related to all dimensions of fatigue. It is concluded that fatigue related to low quality of external stimulation can be distinguished from fatigue related to a high quantity of external stimulation. This distinction is useful when considering theoretical issues and treatment of fatigue. © 1999 Elsevier Science Inc.

Keywords: Fatigue; Competition of cues; Depression; External stimulation; Multidimensional Fatigue Inventory (MFI-20).

INTRODUCTION

Fatigue is a common problem. Depending on the conceptualization and the operationalization of the complaint, the population prevalence is between 7% and 45% [1–3]. In general medical practice, 10% to 41% of patients report fatigue and 1% to 18% of doctors actually record fatigue as a reason for medical consultation [1, 4, 5]. The body of knowledge on the factors associated with fatigue is still growing. It is now generally believed that fatigue complaints must be understood within a biopsychosocial framework. One aspect of fatigue within such a framework is the level of external stimulation. External stimulation is defined as the stimuli perceived in daily life. On the basis of a stress model, many authors assume a positive correlation between external stimulation and fatigue [6–10], but empirical evidence has

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also shown that low levels of external stimulation correlate with fatigue [11–13]. Bensing et al. [2] found empirical evidence in support of too much external stimulation (having a job and children under 6 years of age) in women and too little external stimulation (being unemployed) in men relating to fatigue. As will be illustrated in what follows, Pennebaker's notion of a "competition of cues" [14] can explain these apparently conflicting and rather confusing findings. We will further explore the relations of two aspects of external stimulation to a range of fatigue experiences and hopefully reveal some of what is hidden behind the statement "I'm so tired."

Competition of cues

In a curvilinear model of the relation between external stimulation and fatigue, in which fatigue can be the result of both too little as well as too much external stimulation, the aforementioned findings and assumptions are combined. Pennebaker [14] suggested that such a curvilinear relation between external cues and health complaints (e.g., fatigue) may be the result of a competition of cues. Five basic assumptions have been made [14–16]: (1) a one-to-one relation between physiological state and symptom does not exist; (2) people have only a finite information processing capacity; (3) potential sources of information (stimuli or cues) exist both inside and outside the organism; (4) a certain level of internal stimulation always exists in the form of internal cues, although these cannot be measured directly; and (5) external cues are defined as "any stimulus emanating outside the body, such as sights, sounds, smells, tactile information and the like" [17]. A competition between internal and external cues thus exists. In situations with few external cues, attention is driven toward internal cues. If the surroundings are experienced as boring, one becomes more sensitive to internal cues and may actually experience these as symptoms. In situations with too many external cues, or "overstimulation," increased internal arousal or stress will be the result and thereby the possible perception of internal symptoms as well. In the state between these two extremes, the environment will attract relatively more attention than the internal state and the levels of symptom report will be low [14–17].

In an earlier study, the authors of the present work analyzed the relations between external stimulation and the complaint of fatigue. They found that external stimulation involves two different aspects that *linearly* relate to fatigue in *opposite* directions. The two different aspects of external stimulation can be referred to as: (1) *attractiveness of external stimulation*, which pertains to the pleasantness or *quality* of external cues; and (2) *experienced overload*, which pertains to having too much to do or the *quantity* of the external cues. When the quality of external stimulation increased, the chances of fatigue being reported was shown to decline. When the quantity of external stimulation increased, the chances of fatigue being reported also increased. These two aspects of external stimulation still related to fatigue when a range of other risk factors, including aspects of health and critical life events, were controlled for [18]. In the present study, this "Quality–Quantity model for understanding fatigue" (QQuF model) [18] is proposed, which thus suggests that both the attractiveness of the external stimulation (quality) and the experienced overload (quantity) relate linearly to fatigue. Furthermore, and as elaborated in what follows, we take various fatigue experiences into consideration.

Fatigue experiences

What is fatigue? Although some have tried to define fatigue with a single, scientific term, there is growing consensus that it refers to a variety of subjective experiences [1, 18, 19–21]. The most elementary distinction is derived from the mind–body paradigm and distinguishes physical or biomedical (causes of) fatigue from nonphysical, mental, psychological, or psychosocial (causes of) fatigue [1, 22–25]. In their review, Lewis and Wessely [1] suggested that the emotional, behavioral, and cognitive components of fatigue should be distinguished. Finally, Smets and colleagues [26] postulated five dimensions of fatigue based on the different expressions of fatigue. In their opinion, fatigue can be expressed in terms of: (1) general observations concerning an individual's functioning (*general fatigue*); (2) observations referring to physical sensations and/or feelings of tiredness (*physical fatigue*); (3) declining activity as a (not necessary) consequence of fatigue (*reduced activity*) (see also ref. 27); (4) lack of motivation to undertake any activity (*reduced motivation*); and (5) cognitive symptoms such as difficulties in concentrating (*mental fatigue*). These five dimensions are used in the present study.

We hypothesize that the attractiveness of external stimulation will correlate negatively with the various dimensions of fatigue (higher attractiveness relates to lower fatigue scores) and experienced overload will correlate positively with the different dimensions (more overload relates to higher fatigue scores). In addition, the possibility of certain dimensions of fatigue relating more strongly to the attractiveness of external stimulation while other dimensions relate more strongly to experienced overload will be explored.

Depression certainly cannot be ignored in a study addressing the experience of fatigue although depression and fatigue have a complicated relation [27, 28]. Fatigue is strongly related to depression [29, 30], but neither dependent on nor specific to the diagnosis [5]. Therefore, the question is, What role would depression play in the proposed QQuF model? More specifically, Do the external stimulation–fatigue relations in depressed individuals differ from those in nondepressed individuals? Put differently, Are the relations between aspects of external stimulation and fatigue experiences moderated by depression?

Aim of the study and research questions

The aim of the present study is to investigate the relations of two aspects of external stimulation (attractiveness of external stimulation and experienced overload) to five dimensions of fatigue (general fatigue, physical fatigue, reduced activity, reduced motivation, and mental fatigue). Just how depression relates to these external stimulation–fatigue relations will also be explored. The specific research questions are: (1) What are the relations between the two aspects of external stimulation and the five fatigue dimensions? and (2) Does depression appear to moderate the external stimulation–fatigue relations?

METHOD

Procedure

The present study is a part of a larger, longitudinal project on fatigue; for this study, the data from the first wave are analyzed. The study took place among patients at seven general practices, which varied according to socioeconomic strata, and were situated in different geographical regions. During a 2-week

Table I.—Overview of sample characteristics

Characteristic	Total sample (n = 677)	Female sample (n = 472)	Male sample (n = 205)
Age[c]	40.7 (14.1) (range 18–87)	39.0 (13.3)	44.8 (15.1)
Female	70%		
Marital status[a]			
Married	57.5%	54.4%	64.7%
Widowed	3.8%	4.7%	2.0%
Divorced	8.1%	9.3%	5.4%
Unmarried	30.5%	31.6%	27.9%
Living situation (NS)			
Living with partner	70.9%	43.5%	75.5%
One-parent family	4.8%	6.0%	2.0%
Alone	14.9%	15.6%	13.2%
Educational level[a]			
Low	22.6%	20.8%	26.8%
Middle	51.3%	54.2%	44.4%
High	25.4%	24.4%	28.3%
Working >12 hours/week[c]	58.1%	57.6%	70.2%
Hours working/week	30.4 (12.4)	26.0 (12.6)	40.5 (12.1)
Occupational grade[c]			
Blue collar	21.6%	17.6%	28.6%
White collar	54.0%	59.4%	42.2%
Management/board level	12.5%	15.4%	24.5%
Number of health complaints[c]	5.4 (4.6)	6.0 (4.7)	4.2 (3.9)
Number of health complaints according to GP (NS)	1.6 (2.3)	1.6 (2.4)	1.6 (2.2)
Duration of current fatigue (NS)			
Not fatigued	29.0%	25.6%	36.6%
2–7 days	24.8%	25.2%	23.9%
1–2 weeks	6.5%	6.6%	6.3%
2 weeks to 1 month	7.5%	7.2%	8.3%
1–6 months	9.5%	10.8%	6.3%
6 months to 1 year	5.5%	5.9%	4.4%
1–2 year(s)	5.5%	5.5%	5.4%
>2 years	11.5%	12.7%	8.8%

Significance of gender comparison: [a] $p > 0.05$; [b] $p \leqslant 0.01$; [c] $p \leqslant 0.001$ (NS = not significant).

period in September to October 1997, research assistants asked every patient over 17 years of age to participate in a study on fatigue. Participation involved completion of a questionnaire at home and the general practitioner (GP) filling in a health checklist for the relevant participant.

Sample

Response. Of the 1249 patients asked to participate, 1085 (86.9%) agreed but only 777 (62.2%) actually completed the questionnaire and gave informed consent. Those patients who did not return the questionnaire within 2 weeks were telephoned. The reasons given for nonparticipation did not relate to the content of the study. Dropout was not found to depend on age or gender but somewhat on the characteristics of the general practice, with a higher dropout rate observed for the lower socioeconomic status general-practice populations. Due to missing values, the final sample for the present study consisted of 677 respondents (54.2% of the total population sampled); compared with the group of respondents initially returning the questionnaire (n=777), the mean age of the final sample was somewhat lower (by 2 years), a slightly greater percentage of the respondents were working, and the educational level of the respondents and the occupational grade were somewhat higher.

In Table I, an overview of the sample characteristics can be found. The male respondents were, on average, somewhat older than the female respondents. The majority of the sample had a job. The men worked more hours per week than the women, on average. The women generally had more health complaints than the men. The general practitioners, however, did not report different complaint frequencies for men vs. women. Finally, the duration of the fatigue varied widely.

Measures

External stimulation. As the level of external stimulation is constantly changing, a judgment with regard to the last month was requested. The External Information Questionnaire (EIQ), developed by Gijsbers van Wijk and Kolk [16], was administered to test for low levels of external stimulation. This measure consists of 17 items, and the subjects are asked to rate the degree to which the statements apply to their daily life along a five-point Likert scale, ranging from "not at all" (1) to "very much" (5). To cover high levels of external stimulation as well, a modified version of the Role Conflict Scale (RCS), developed by Giesen [31], and based on Berkowitz and Perkins [32, 33], was also administered. The items are rated along a four-point Likert scale ranging from "seldom or never" (1) to "very often" (4). A principal components analysis with varimax rotation on the items from the two external stimulation measures revealed two new factors. Two scales were constructed on the basis of these two factors. One scale was derived from the first factor and named *experienced overload* (13 items, $\alpha=0.86$). This scale consisted of five items from the EIQ and eight items from the RCS; it included items such as "I had too much to think about during the last month" and "During the last month I did not get around to myself." As this scale was a mixture of four- and five-point Likert-scale items, the scale mean equals the mean for the *standardized* item scores. The other scale was referred to as *attractiveness of external stimulation* (eight items, $\alpha=0.79$), consisted of eight items from the EIQ, and included items such as "I often had nothing meaningful to do" and "My life was a routine" (both reversely scored). The correlation between the two scales was low but significant ($r=-0.11$, $p\leqslant 0.01$). (See ref [18] for details of the scales.)

Fatigue. The dimensions of fatigue were assessed using the Multidimensional Fatigue Inventory (MFI-20) [26], which is a self-report instrument consisting of five scales measuring *general fatigue*, *physical fatigue*, *reduced activity*, *reduced motivation*, and *mental fatigue.* This inventory refers to the last few days. Each scale consists of four items, which are rated along a five-point Likert scale ranging from "No, that is not true" (1) to "Yes, that is true" (5). Examples of the items include: "I feel tired" (general fatigue); "Physically I don't feel able to do very much" (physical fatigue); "I think I do very little in a day" (reduced activity); "I dread having to do things" (reduced motivation); and "My thoughts wander easily" (mental fatigue). High scores reflect a high degree of fatigue [26, 34]. The α's ranged from satisfactory to good: general fatigue, $\alpha=0.87$; physical fatigue, $\alpha=0.83$; reduced activity, $\alpha=0.81$; reduced motivation, $\alpha=0.76$; and mental fatigue, $\alpha=0.88$.

Depression. Depression was measured using the Center for Epidemiological Studies Depression Scale (CES-D), which is known to have good properties for population studies [35]. The conceptual overlap between the CES-D and symptoms of physical diseases is also known to be small [36, 37]. The CES-D consists of 20 items such as "Last week . . . I was happy" or ". . . I felt lonely." The items are rated along a four-point Likert scale ranging from "seldom or never" (0) to "(almost) always" (3). We used the Dutch version from Beekman and colleagues [38, 39]. A high score reflects greater depression, with the traditional cutoff point recommended (for the elderly) in The Netherlands [39] being $\geqslant 16$. The reliability of the scale was found to be very good: 0.91.

To check for any interdependence between the measures, a principal components analysis was conducted on all of the items in the present study. The results of this analysis showed that attractiveness of external stimulation, experienced overload, and CES-D can be regarded as separate constructs. Interestingly, the mental fatigue items constituted a single factor, whereas the remainder of the MFI-20 items constituted another factor. For the purpose of comparison, we decided to use the five separate MFI-20 scales in the analyses.

Analyses

In the analyses, scale means divided by the number of items were used. When respondents had one value missing for an external stimulation scale, the item was replaced by the individual's scale mean. A maximum of 3.4% answers per item were missing, except for one item that had 9.5% missing values. When respondents had one or two missing values for the CES-D, these were replaced by the individual's scale mean.

To address the first research question, linear multiple regression analyses with method Enter, that is, all variables were hierarchically entered into the regression equation, were conducted. Hierarchical multiple regression analyses with interaction terms were conducted to test the interactions or to test for moderator effects. To reduce the multicollinearity in these analyses, variables were first centered (mean minus standard deviation). Interaction terms equaled the cross-product terms for the two centered independent variables that constituted the interaction term. In the first regression step, the control variables age and gender, and the two components of the QQuF model (attractiveness of external stimulation, experienced overload) were entered; in the second step, the moderator (CES-D); and, in the third step, the interaction terms (attractiveness of external stimulation$\times$CES-D, experienced overload$\times$CES-D). For every multiple regression analysis, the successive changes in explained variance (ΔR^2), and the adjusted explained variance and regression coefficients (β) from the final regression equation are presented. When significant interactions were found in the regression analysis, graphs with the two regres-

Table II.—Means, standard deviations, and empirical ranges for variables under study (n = 677)

Variable	Mean (SD)	Range
Attractiveness of external stimulation	3.75 (0.67)	1.5–5
Experienced overload	0.00 (0.61)	−1.14–1.90
Depression	0.81 (0.52)	0–2.55
MFI-20 scales		
General fatigue	3.08 (1.18)	1–5
Physical fatigue	2.75 (1.12)	1–5
Reduced activity	2.55 (1.07)	1–5
Reduced motivation	2.33 (0.98)	1–5
Mental fatigue	2.46 (1.17)	1–5

sion lines for the moderator equaling 1 SD below the mean (−1 SD) and 1 SD above (+1 SD) were made to identify the direction of the moderating effect (for testing interactions see ref. 40).

RESULTS

Descriptions

The item means, standard deviations, and empirical ranges for the variables under study are presented in Table II. In addition, the mean CES-D scale total was 16.1; 42% of the sample had a CES-D score of ⩾16 and the level of CES-D thus resembled that in other studies [34, 39]. The levels for the MFI-20 scales are relatively low compared with various norm groups, but never exceeded the reported ranges [26].

In Table III, the Pearson correlation coefficients for the variables under study are presented. Age correlated negatively with experienced overload and positively with reduced motivation. Being female correlated positively with experienced overload, CES-D, general fatigue, and physical fatigue. Attractiveness of external stimulation was negatively related to all dimensions of fatigue and experienced overload was positively related to all dimensions of fatigue. CES-D correlated positively with all measures except age. Finally, the correlations between the different MFI-20 scales were all highly significant.

External information and the dimensions of fatigue

In Table IV, the results of the multiple linear regression analyses of age, gender, attractiveness of external stimulation, and experienced overload on general fatigue, physical fatigue, reduced activity, reduced motivation, and mental fatigue are presented. Some 22% to 27% of the variance in the fatigue scales was explained by this model. Attractiveness of external stimulation again bore a negative relation to the measures of fatigue, whereas experienced overload bore a positive relation. Attractiveness of external stimulation was more strongly related to the measures of fatigue than experienced overload. Experienced overload related clearly to general fatigue and mental fatigue, a lesser extent to physical fatigue and reduced motivation, and not at all to reduced activity. Attractiveness of external stimulation related to general fatigue, physical fatigue, reduced activity, and reduced motivation, and—to a relatively lesser extent—mental fatigue. Moreover, age bore a slight relation to reduced motivation (being older related to more reduced motivation) and gender was slightly related to general fatigue and physical fatigue (with women scoring some-

Table III.—Pearson's correlation coefficients (n = 677)

Variables	1	2	3	4	5	6	7	8	9
(1) Age									
(2) Being female	−0.19[c]								
(3) Attractiveness of external stimulation	−0.07	0.05							
(4) Experienced overload	−0.23[c]	0.15[c]	−0.11[b]						
(5) Depression	−0.05	0.11[b]	−0.54[c]	0.39[c]					
MFI-20 scales									
(6) General fatigue	−0.06	0.11[b]	−0.41[c]	0.37[c]	0.61[c]				
(7) Physical fatigue	0.00	0.10[b]	−0.41[c]	0.21[c]	0.54[c]	0.81[c]			
(8) Reduced activity	0.04	0.02	−0.47[c]	0.10[a]	0.46[c]	0.55[c]	0.66[c]		
(9) Reduced motivation	0.10[a]	0.02	−0.49[c]	0.15[c]	0.50[c]	0.54[c]	0.55[c]	0.62[c]	
(10) Mental fatigue	−0.07	0.07	−0.36[c]	0.35[c]	0.56[c]	0.51[c]	0.48[c]	0.43[c]	0.47[c]

[a] $p < 0.05$; [b] $p \leqslant 0.01$; [c] $p \leqslant 0.001$.

Table IV.—Multiple regressions of age, gender, attractiveness of external stimulation, and experienced overload on MFI-20 scales (n = 677)

MFI-20 scale variable	General fatigue (β)	Physical fatigue (β)	Reduced activity (β)	Reduced motivation (β)	Mental fatigue (β)
Age	0.00	0.03	0.03	0.10[b]	−0.02
Gender	0.08[a]	0.11[b]	0.04	0.05	0.04
Attractiveness of external stimulation	−0.38[c]	−0.40[c]	−0.46[c]	−0.47[c]	−0.33[c]
Experienced overload	0.31[c]	0.16[c]	0.05	0.11[c]	0.30[c]
Total adjusted R^2	0.28[c]	0.21[c]	0.22[c]	0.26[c]	0.22[c]

[a] $p < 0.05$; [b] $p \leq 0.01$; [c] $p \leq 0.001$.

what higher than men) when attractiveness of external stimulation and experienced overload were taken into account.

Depression as moderator in external stimulation–fatigue relations

In Table V, analyses regarding the possible interactions between depression and aspects of external information on fatigue are presented. The influence of the interaction between attractiveness of external stimulation and CES-D on the five dimensions of fatigue and between experienced overload and CES-D on the five dimensions of fatigue is depicted after the independent effects of the different variables have been taken into consideration. Attractiveness of external stimulation, experienced overload, and CES-D all had a main effect on the different dimensions of fatigue with the exception of experienced overload, which did not relate to physical fatigue, reduced activity, or reduced motivation. Contributions of experienced overload to physical fatigue and reduced motivation thus disappeared when CES-D was entered into the regression equation. CES-D can also be seen to moderate clearly the relations between attractiveness of external stimulation and general fatigue, physical fatigue, reduced activity, and reduced motivation.

In Figures 1 through 4, the preceding interactions are illustrated.

For individuals with high CES-D scores (1 SD above the mean or a score of 26.6), attractiveness of external information related somewhat weaker (i.e., the regression line is less steep) to general fatigue, physical fatigue, reduced activity, and reduced motivation than for individuals with low CES-D scores (1 SD below the mean or a score of 5.8).

DISCUSSION

The proposed Quality–Quantity model for understanding fatigue (QQuF model) with both low attractiveness of external stimulation (quality) and experienced overload (quantity) related to elevated levels of fatigue [18] was generally supported by the present study. Again, attractiveness of external stimulation related negatively to fatigue; that is, the higher the attractiveness of the external stimulation, the lower the fatigue levels. Also, experienced overload related positively to fatigue; that is, the more overload was experienced, the higher the fatigue levels. Moreover, the present study revealed the different experiences hidden behind indicating that one

Table V.—Hierarchical multiple regressions of age, gender, attractiveness of external stimulation, experienced overload, CES-D, and interaction terms of attractiveness of external stimulation with CES-D and experienced overload with CES-D on MFI-20 scales (n = 677)

MFI-20 scales variable	General fatigue		Physical fatigue		Reduced activity		Reduced motivation		Mental fatigue	
	ΔR^2	β	ΔR^2	β	ΔR^2	β	ΔR^2	β	ΔR^2	β
1. Age		−.01		.03		.03		.10[b]		−.02
Gender		.04		.07[a]		.01		.01		.00
Attractiveness of external stim.		−.16[c]		−.20[c]		−.32[c]		−.32[c]		−.11[b]
Experienced overload	.28[c]	.16[c]	.21[c]	.02	.22[c]	−.06	.26[c]	.00	.23[c]	.16[c]
2. CES-D	.13[c]	.50[c]	.11[c]	.45[c]	.06[c]	.34[c]	.06[c]	.35[c]	.11[c]	.44[c]
3. Attractiveness of external stim. ×CES-D		.14[c]		.13[c]		.11[b]		.09[b]		.03
Experienced overload ×CES-D	.01[c]	−.02	.01[b]	.02	.01[a]	.00	.01[a]	.03	.00	.03
Total adjusted R^2	.42[c]		.32[c]		.29[c]		.32[c]		.33[c]	

[a] $p < 0.05$; [b] $p \leq 0.01$; [c] $p \leq 0.001$.

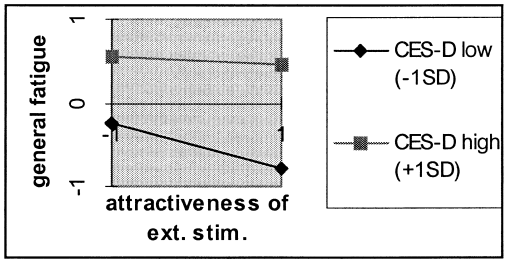

Fig. 1. Interaction of attractiveness of external stimulation and CES-D for general fatigue, controlled for age, gender, and experienced overload.

is tired. (Low) attractiveness of external stimulation related to all measures of fatigue, whereas experienced overload particularly related to general and mental fatigue. Depression moderated the QQuF model only slightly, but was directly and strongly related to all dimensions of fatigue. The relations between experienced overload and the different dimensions of fatigue did not differ for people with low vs. high levels of depression. However, in depressed people, the attractiveness of external stimulation related more weakly to the different fatigue experiences than in nondepressed people (except for mental fatigue). The results will be discussed in greater detail and considered from theoretical and practical points of view.

Theoretical considerations

The present findings are intriguing when viewed in light of the competition of cues [14]. The results refer to the two "legs" of the curvilinear relation between external cues and symptoms that schematically represents the competition of cues [14]. Too little stimulation in terms of quality (i.e., low attractiveness of external stimulation) related to all dimensions of fatigue, but particularly to signs of attention to bodily signals (physical fatigue) and "understimulation" (reduced activity and reduced motivation). In contrast, too much stimulation in terms of quantity or amount (i.e., a high level of experienced overload) was particularly related to mental fatigue. The relations between experienced overload and both physical fatigue and reduced motivation disappeared after controlling for depression, which suggests that experienced overload was related to these fatigue experiences via depression. Thus, mental fatigue emerged as a single, clear factor. It should be noted that

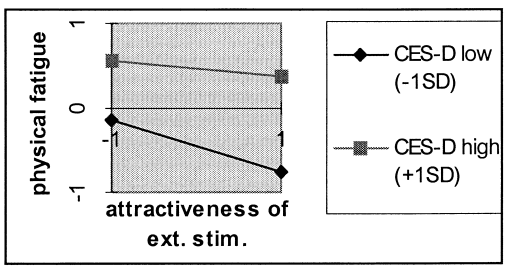

Fig. 2. Interaction of attractiveness of external stimulation and CES-D for physical fatigue, controlled for age, gender, and experienced overload.

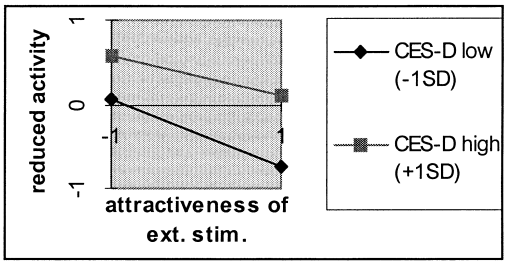

Fig. 3. Interaction of attractiveness of external stimulation and CES-D for reduced activity, controlled for age, gender, and experienced overload.

the mental fatigue items were formulated in terms of the confrontation with external cues as reduced concentration can only be experienced when confronted with (mental) demands. This suggests that mental fatigue in particular may reflect "overstimulation" in line with a stress model of fatigue. Thus, although the QQuF model discriminates between the quality and quantity of the external cues, the present findings can still be explained in line with the two processes that the competition of cues notion [14] refers to. The results concerning general fatigue confirm the nonspecific character of this fatigue experience. It thus appeared that general fatigue is more like a "container" concept than a distinctive type of fatigue.

There is, however, an alternative explanation for the relation between attractiveness of external stimulation and fatigue. Negative affect [41] may underlie both the low attractiveness of external stimulation and the various aspects of fatigue. An indication may be that attractiveness of external stimulation always explains some part of the fatigue. Low attractiveness may lead to feelings of unhappiness and generally high complaint levels. This explanation would be in line with somatization [42].

Negative affectivity and somatization are also known to correlate with depression [43, 44]. This may evoke the impression that low attractiveness of external stimulation, depression, and fatigue are three of a kind. However, the present study clearly does not subscribe to such a simple explanation, because depression mainly *added* to the explanation of fatigue by attractiveness of external stimulation. Nevertheless, the interactions can raise questions about direction of causality; for instance, Is it not likely that depression was the result of low attractiveness of external stimulation? A different relation between depression and attractiveness of external stimu-

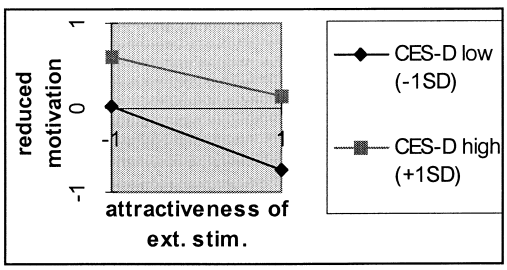

Fig. 4. Interaction of attractiveness of external stimulation and CES-D for reduced motivation, controlled for age, gender, and experienced overload.

lation is, however, much more plausible. Depression probably decreases the receptivity to the fatigue-reducing effects of attractive external stimulation in two ways. First, being depressed will certainly influence the perception of the attractiveness of external stimulation, because an important indication of depression is loss of interest or pleasure [30]. We indeed found that attractiveness of external stimulation is more strongly related to depression than experienced overload. Second, depressed people will be less sensitive to differences in the reported attractiveness of external stimulation; that is, the fatigue-reducing capacities that "high quality" stimulation possesses are less effective when someone is depressed. This was clearly represented by the figures that represented the interactions. Thus, regarding the relation between depression and the QQuF model [18], the present findings suggest that external stimulation relates to fatigue differently than depression, and, moreover, depression seems to decrease the perceived attractiveness of external stimuli and the fatigue-reducing effects of attractive external stimuli.

In conclusion, the attractiveness of external stimulation and experienced overload clearly play a role in various fatigue experiences, even in cases of depression, although we do not know what process exactly *causes* fatigue. The present dichotomy between fatigue related to low attractiveness of external stimulation and fatigue related to high levels of experienced overload appears to be a promising alternative to the physical–psychological dichotomy [1, 22–25] for a number of reasons. First, it is difficult to differentiate physical and psychological fatigue, as mind and body are strongly related. Both events outside the body and cognitive processes can prompt increased attention to bodily sensations, and physical sensations (e.g., symptoms of chronic diseases) can clearly influence cognitive processes. Second, the assumption that purely physical causes prompt physical fatigue and psychological causes prompt mental or psychological fatigue can be questioned on not only theoretical but empirical grounds. Third, the physical–psychological dichotomy does not help us handle fatigue whereas the present dichotomy has a number of practical implications.

Practical recommendations

The results of the present study suggest that a reduction of experienced overload (reducing workload and/or number of activities) can only help in cases of general and/or mental fatigue. Increasing the attractiveness of external stimulation, in contrast, may affect a wide variety of fatigue sensations. When an individual complains of fatigue, he or she should thus be stimulated to find pleasurable activities and engage in them. Not only the practical barriers but also the cognitions that keep a person from undertaking such activities must be modified. Cognitive therapy for chronic fatigue syndrome, which aims at altering avoidance behavior, has produced promising results with regard to physical symptoms, activity level, and mood [43–46]. Depressed individuals need specific help to reduce the depression in the first place. However, the principles just explained may further reduce fatigue in (not severely) depressed individuals.

Age and gender

The results with regard to age and gender in relation to fatigue merit attention. The relation between age and fatigue appears to be inconsistent [1, 3, 25, 47, 48]. In the present study, older people showed a greater degree of reduced motivation

than younger people. The reduced motivation on the part of older people was not related to depression and may simply reflect a tendency to make fewer plans as ones becomes older. The failure to detect other relations between age and fatigue can be attributed to nonlinear relations. Gender was somewhat related to general and physical fatigue, but the relation to general fatigue disappeared and the relation to physical fatigue declined after controlling for depression. The observation that women complain of fatigue two to three times more than men was not confirmed in the present study (for a review see ref. 1). This may be partially explained by the fact that most studies measure fatigue with only a single item or scale [1]. Moreover, many of the women in the present study were relatively healthy as they were accompanying a child or adult or simply visiting the GP for prevention/diagnostic purposes [49]. The men were, on average, older than the women, and therefore probably less healthy. The absence of gender differences in the GP's report of complaints supports this reasoning.

Methodological considerations

The design of the present study was cross-sectional; the measures were all administered at the same time. The correlations between the attractiveness of external stimulation on the one hand, and general fatigue, physical fatigue, reduced activity, and reduced motivation, on the other hand, can therefore be partly ascribed to the occurrence of depression, which also holds for the relations between experienced overload and physical fatigue and reduced motivation. It is difficult to preclude mood from playing a role when studying the competition of cues in real life situations. A longitudinal design could help to partial out the direct influence of depressive feelings on the external stimulation measures, but distraction by external cues could probably not be identified with such a design. A diary study, however, prevents distortion by retrospective symptom reporting [15], but not by depressive feelings.

Future research

Now that the QQuF model appears to explain not just frequencies of fatigue complaints [18] but also the level of different fatigue experiences, it is recommended that the different dimensions of external stimulation and how they relate to fatigue be carefully attended to in future research. Moreover, the dichotomy between fatigue related to low quality of external stimulation and fatigue related to high quantity of external stimulation constitutes a concise and practical means for characterizing fatigue complaints and should therefore be considered in future research. Conceptual and methodological attention should also be paid to depression when studying fatigue and the determinants of fatigue. Finally, our recommendations for the treatment and handling of fatigue certainly deserve further examination in the future.

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