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Complaints of Fatigue: Related to Too Much as Well as Too Little External Stimulation?

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Fatigue has been acknowledged as a widespread problem associated with a variety of factors. In the present paper, we attempt to explain fatigue complaints on the basis of Pennebaker's (1982) "competition of cues" notion. Competition of cues suggests that both extremely low and extremely high levels of external stimulation in daily life may be related to relatively higher frequencies of complaint. The dimensional structure of external stimulation is first explored and then the shape of the relation between external stimulation (i.e., stimuli perceived in daily life) and fatigue was studied in a sample of 777 general-practice patients. Other risk factors for fatigue and moderating factors are also taken into consideration. Results show that quantity and quality of external stimulation can be distinguished. Both high quantity (high "experienced overload") and low quality (low "attractiveness of external stimulation") are related to higher fatigue frequencies. "Experienced overload" is a particularly strong predictor, in addition to "perceived health" of fatigue complaints. It is concluded that the "quality–quantity model for understanding fatigue" proposed here highlights psychological factors important for any theoretical framework of fatigue.

KEY WORDS: fatigue; external stimulation; competition of cues; demands; external information.

INTRODUCTION

During the past two decades, fatigue has been acknowledged as a widespread problem associated with a variety of factors. Epidemiological studies

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have shown complaints of fatigue to be common. Depending on the conceptualization and operationalization of the complaint, the population prevalence is between 6.9 and 45% (Lewis and Wessely, 1992; Bensing *et al.*, 1999; Pawlikowska *et al.*, 1994). In general medical practice, between 10 and 41% of patients report fatigue (Cathébras *et al.*, 1992; Lewis and Wessely, 1992; Fuhrer and Wessely, 1995), and 1 to 18% of physicians actually record fatigue as a reason for consultation (Cathébras *et al.*, 1992; Lewis and Wessely, 1992; Fuhrer and Wessely, 1995). A wide range of factors has been found to be consistently associated with fatigue: gender, with women complaining more than men (Lewis and Wessely, 1992; Cathébras *et al.*, 1992; Pawlikowska *et al.*, 1994; Fuhrer and Wessely, 1995; Bensing *et al.*, 1999); poor physical health (Morrison, 1980; Sugarman and Berg, 1984; Kroenke *et al.*, 1988; Kirk *et al.*, 1990; David *et al.*, 1990); most physical illnesses (Lewis and Wessely, 1992); and both psychiatric disorders and psychological morbidity (Morrison, 1980; Sugarman and Berg, 1984; Kroenke *et al.*, 1988; McWhinney, 1989; Lewis and Wessely, 1992; Ridsdale *et al.*, 1993; Pawlikowski *et al.*, 1994; Fuhrer and Wessely, 1995). The associations with age, educational level, and occupation appear to be inconsistent and depend on the subject sample and research methodology (van Mens-Verhulst and Bensing, 1997). A physiological indicator specific to fatigue has not as yet been discovered. That is, anemia or low hemoglobin values are found in only a very few fatigued individuals (Knottnerus *et al.*, 1986; Zaat *et al.*, 1991; Dinant *et al.*, 1994), while chronic fatigue syndrome (CFS) research has yielded no evidence to support such somatic pathogenetic hypotheses as persisting infections, intoxications, metabolic or immunologic disturbances, nervous system diseases, and endocrine pathology (van der Meer, 1997).

Fatigue has been a topic of considerable theorizing among physicians since the end of the nineteenth century or even earlier (for an overview see Wessely, 1990). The recent empirical interest in fatigue has been concentrated on the prevalence and associations with other variables rather than on explanation. It is, nevertheless, clear that fatigue must be approached in terms of multifactoral etiology or a biopsychosocial model (Lewis and Wessely, 1992; Abbey, 1993; Saultz, 1993; Ware, 1993; RCPPGP, 1996). In addition, researchers and theorists agree that fatigue is a subjective and ill-defined symptom (e.g., Lewis and Wessely, 1992). The question is whether complaints of fatigue have any common underlying determinants. Unfortunately, most theory-driven studies of fatigue are limited to the explanation of fatigue for a particular group of people: employees (e.g., Meijman, 1991), cancer patients (e.g., Smets *et al.*, 1998), or chronic fatigue syndrome patients. The present study therefore initiates a series of studies into an explanation of the generic aspects of fatigue in a heterogeneous sample of subjects. The studies aim at a psychosocial explanation of fatigue that adds to the explanation by biological and other psychological and social factors. Hypotheses are derived from the work of Pennebaker (1982) on symptom percep-

tion and from the puzzling relations that have been observed between "external stimulation" and fatigue.

External Stimulation and Fatigue

In handbooks for general practitioners, fatigue is now commonly related to overwork, overexertion, and/or psychosocial stress (e.g., Hennen, 1987; Murthagh, 1994; Davies and Lipkin, 1996; McPhee and Schroeda, 1996). In a similar vein and as illustrated by Smets *et al.* (1998), psychologists often regard fatigue as a stress reaction to overwhelming life demands.

Some recent empirical studies have also shown low levels of external stimulation to be related to fatigue. Shahar and Lederer (1990) found complaints of fatigue in a kibbutz population to be more frequently presented in the season with less work. In a study among 13,705 temporary employees, Finkelman (1994) also found fatigue to be associated with low physical demand and low information-processing demand. In a general population, Gijsbers van Wijk and Kolk (1997a) similarly found health complaints, with fatigue as the most common among them, to be explained successfully by a low level of external information. Other studies show a more complicated picture. For instance, in their large-scale study, Bensing and colleagues (1999) found both "white-collar work" and "not working" to be predictors of fatigue for men, while both "work outside the house" and "caring for children under six" were predictors of fatigue for women.

Although the preceding studies differ in a number of respects, they, nevertheless, all address the phenomenon "external stimulation," which can be defined in the present context and parallel to the "demands" of Smets and colleagues (1998) as "the stimuli perceived by people in their daily lives." This stimulation can be too much, too little, or just right.

Competition of Cues

Finkelman (1994) concludes that fatigue may be the result of having to process too much or too little information and therefore explained by a "limited channel capacity information-processing model." A theoretical basis for such a model is found in Pennebaker's (1982) book on the psychology of physical symptoms, where several theoretical traditions are combined to formulate notions relevant to symptom perception. Pennebaker (1982) starts from the assumption that a one-to-one relation between physiological state and symptom does not exist. On the basis of a human information-processing model, it is further assumed that people have only a finite information-processing capacity. It is also assumed that potential sources of information exist both inside and out-

side the organism and that a certain level of internal arousal always exists. As a consequence, a "competition of cues" can arise.

Awareness of an internal state, which also means the perception of symptoms, is the result of a competition between internal and external cues (Pennebaker, 1982). Internal cues or information cannot be measured directly and is therefore measured indirectly by symptom report, which is always the result of processed internal cues. External information is defined as "any stimulus emanating outside the body, such as sights, sounds, smells, tactile information and the like" (Pennebaker and Brittingham, 1982). Both the quantity and the quality of stimuli are important for the competition of cues (Pennebaker, 1982; Gijsbers van Wijk and Kolk, 1997b). In situations with few external cues, for example, attention is driven to internal cues. This means that if the surroundings are experienced as boring, one may be more sensitive to internal symptoms. In situations with too many external cues, however, the high level of stimulation leads to increased internal arousal and thereby to the perception of internal symptoms as well. The latter is an explanation of symptom perception in line with stress reactions. Both extreme situations will lead to an increase in somatic sensations compared to the optimal situation, where there is a match between person and environment (Gijsbers van Wijk and Kolk, 1997b). In the state between these two extremes, the environment will attract relatively more attention than the internal state and level of reported symptoms is low. Thus, a U-shaped curve characterizes the relation between external information and complaints. As a consequence, Pennebaker (1982, p. 158) suggests that "symptoms may signal that something is wrong with your environment (e.g., that you are under- or overworked or are in social isolation) as well as your body."

In the present study, hypotheses derived from the competition of cues are applied to the symptom of fatigue. Whether fatigue is related to too much external stimulation (stress) as well as to too little external stimulation (boredom) is examined, but there are, nevertheless, a number of obstacles to doing this. One is the conceptualization and operationalization of what we have defined as "external stimulation." Demands, external stimuli, cues, information, and stimulation clearly resemble each other but, nevertheless, represent a broad range of phenomena (cf. Pennebaker, 1982). In The Netherlands, van Vliet *et al.* (1994) and Gijsbers van Wijk and Kolk (1995) have developed an instrument to measure, as they call it, external information. While the instrument is based on Pennebaker's (1982) theoretical framework, it has been used to date only to study the effects of too little external stimulation, which means that daily life situations with too much external stimulation may not be adequately measured by this instrument. A related problem is that the degree of external stimulation (or the concept related to this) is generally regarded as unidimensional. It may certainly be the case, however, that apparently contradictory research findings with regard to the relation between external stimulation and fatigue can be attributed to the examination

of different aspects of external stimulation. In such a manner, numerous linear relations will be detected rather than a single U-shaped relation.

The adoption of a biopsychosocial model of fatigue implies that the contribution of external stimulation should be studied in relation to other risk factors as well. Age, gender, educational level, general health, chronic disease, and present health have all been shown to put people at risk. Given our focus on daily life situations, moreover, the number of critical life events was also regarded as a risk factor for fatigue. The question is whether external stimulation independently adds to the explanation of fatigue by these risk factors or not.

A final problem constitutes possible interactions with social characteristics. While our focus on generic aspects of fatigue suggests that similar relations between external stimulation and fatigue are expected across subgroups, such characteristics as gender, having a chronic disease (or not), and professional status may interact with the relation between external stimulation and fatigue. Gijsbers van Wijk and Kolk (1997a) found, for example, the association between external information and health to be stronger for women than for men. For the chronically ill, fatigue may be a direct consequence of their physical condition and psychological factors may add relatively little or operate differently than in those who are not chronically ill. Professional status refers to occupational prestige and thus the resources or control that one has to adapt a situation to one's own preferences (cf. Wohlfarth, 1997; Siegrist *et al.*, 1990). External stimulation may have stronger effects for low professional status people and high professional status people are presumably in more of a position to seek the optimal degree of external stimulation.

Aim of the Study and Research Questions

The aim of the present study was to test whether fatigue can be explained by too much as well as too little external stimulation. The specific research questions were as follows.

1. Does external stimulation appear to be a unidimensional concept?
2. Does a relation exist between external stimulation and fatigue, and is this relation U-shaped?
3. Does external stimulation supplement the explanation of fatigue by other risk factors? In connection with questions 2 and 3, the following question was added: Is the relation of external stimulation (and other risk factors) to fatigue found to be the same for men and women, the same for the chronically ill and people who are not chronically ill, and the same for both low and high professional status people?

METHOD

Procedure

The present study is a part of a larger, longitudinal research project on fatigue. The data for the present study are based on the first wave of this research. The study was conducted among general-practice patients for a period of two weeks in September and October 1997. In seven general practices, a research assistant asked every patient to participate in a study of fatigue. This involved the patient completing a questionnaire at home and the GP completing a health checklist for every respondent.

Sample

Of the 1249 patients who were recruited, 1085 (or 86.9%) agreed to participate but only 777 (71.6%) of them actually completed the questionnaire and gave informed consent. Those patients who did not return the questionnaire within two weeks were telephoned; some of them could not be reached despite several attempts. Most did not spontaneously mention their reason for nonresponse or no participation. The main reasons mentioned were poor mastery of the Dutch language, unable to participate at the time, did not give informed consent, and too difficult. In both stages, the dropout of subjects was found to depend not on age or gender but somewhat on the general practice, with underprivileged general-practice populations (i.e., those with a greater percentage of low SES and more immigrant patients) showing higher dropout rates than more privileged populations. Table I lists the social–demographic characteristics of the sample.

All categories of demographic characteristics were sufficiently represented in our sample. Women were more frequently unmarried and living alone than men. Women more frequently had middle-level education as their highest level of education than men. With regard to employment, 67% of the men and 55% of the women were working according to the criterion of the Dutch Institution for Statistics (CBS, 1998). On average the men worked full-time, while the women worked about 26 hr per week. Relatively more women than men were working in white-collar jobs. Some 49.9% of the respondents had a low "professional status" (see below), i.e., were blue-collar workers or were not working.

Compared to the average Dutch general-practice patient in 1987 (see Verhaak and Tijhuis, 1994), men were underrepresented in our sample, there were somewhat more patients under the age of 45 years, and our sample comprised relatively more highly educated people. Compared to the Dutch population in 1997 (CBS, 1998), there were more women in our sample, somewhat more people under the age of 45 years, somewhat more highly educated people, and more

Table I. Characteristics of the Sample ($n \leq 777$)

Characteristic	All *N*	Frequency/ mean (SD)	Male *N*	Frequency/ mean (SD)	Female *N*	Frequency/ mean (SD)
Age***	776	42.7 (15.6) Range, 18–88	234	46.72 (16.0) Range, 18–86	542	40.89 (15.1) Range, 18–88
Female	776	69.8%				
Marital status***	775		233		541	
Married		58.7%		67.8%		54.7%
Widowed		5.2%		2.1%		6.5%
Divorced		8.3%		5.6%		9.4%
Unmarried		27.9%		24.5%		29.4%
Living situation*	768		230		537	
Living with partner		30.9%		37.8%		27.9%
Living with partner and children		40.4%		39.6%		40.6%
One-parent family		4.6%		2.2%		5.6%
Living alone		15.8%		12.2%		17.3%
Otherwise		8.5%		8.3%		8.6%
Educational level**	768		233		534	
Primary school		10.9%		10.7%		11.0%
Lower-level vocational training		15.5%		18.5%		14.2%
Middle-level secondary education		19.4%		12.4%		22.4%
Middle-level vocational training		18.6%		21.5%		17.2%
Higher-level secondary education		12.4%		9.9%		13.5%
Polytechnics, college		13.8%		14.2%		13.7%
University education		9.4%		12.9%		7.9%
Employment***	755		230		524	
Not working because of school/study		3.6%		2.2%		4.2%
Unemployed		5.3%		5.7%		5.2%
Unfit for work		5.8%		6.1%		5.7%
Retired		10.7%		17.8%		7.6%
Other reason for not working (mostly housekeeping)						
Working ≧12 hr		9.8%		2.2%		13.2%
per week***		57.0%		67.0%		55.0%
Occupational grade***	481		155		325	
Blue collar		22.9%		30.3%		19.4%
White collar		49.3%		30.3%		58.2%
Departmental chief		5.6%		10.3%		3.4%
Manager		5.4%		5.2%		5.5%
Staff		7.7%		9.7%		6.8%
Board of directors		5.4%		9.7%		2.8%
Hours working per week***	482	30.48 (14.4) Range, 2–100	155	40.26 (12.3) Range, 5–100	326	25.88 (12.9) Range, 2–70
Low professional status	776	50.0%	411	53.0%	378	48.7%

Table I. Continued

Characteristic	All *N*	Frequency/ mean (SD)	Male *N*	Frequency/ mean (SD)	Female *N*	Frequency/ mean (SD)
Complaint of fatigue during previous 2 weeks indicated by patient***	775	52.1%	233	41.6%	541	56.7%
Complaint of fatigue during previous 2 weeks indicted by GP	703	16.2%	207	16.4%	495	16.2%
Number of acute complaints[a] indicated by patient***	775	4.84 (4.25)	233	3.79 (3.61)	541	5.29 (4.42)
Number of acute complaints[a] indicated by GP	703	1.74 (2.41)	207	1.67 (2.25)	495	1.77 (2.48)
Having (a) chronic disease(s)	776	53.4%	393	50.7%	351	45.2%

[a]The number of acute complaints from the Acute Complaints List (Foets and van der Velden, 1990) without the items "fatigue" and "problems at work/home"; maximum score is 39.

Note. *$.05 > p > .01$, **$.01 > p > .001$, and ***$p < .001$ regarding differences between men and women.

employed women. Not presented in Table I are the frequencies of the different categories of chronic diseases; compared to the results of a large-scale nationwide study using the same measure (van der Velden *et al.*, 1991), our sample appears to represent all of the categories quite well.

About 50% of the patients complained of fatigue, with more women than men. This is relatively higher than in the Dutch population in 1987 (Bensing *et al.*, 1999). Women generally had more health complaints than men. The general practitioners did not, however, report different complaint frequencies for men versus women. Some 58.6% of the sample had one or more chronic disease(s); this is somewhat higher than in the Dutch population in 1987 (van der Velden *et al.*, 1991). All in all, the present sample is rather representative of the Dutch population and of Dutch general-practice patients.

Instruments

External Stimulation. In order to construct a scale for external stimulation, we administered two measures. First, the External Information Questionnaire (EIQ) developed by Gijsbers van Wijk and Kolk (1995) and also used to test for effects of too little stimulation. The measure consists of 17 items; subjects are asked to rate the degree to which the statements apply to their daily life on a 5-point Likert scale ("not at all" to "very much"). Cronbach's α in a student as well

as a patient sample was found to be .80; the test–retest correlation was found to be .74 (Gijsbers van Wijk and Kolk, 1995). Second, and in order to cover overloaded daily life situations as well, a modified version of the Role Conflict Scale (RCS) developed by Giesen (1991) on the basis of Berkowitz and Perkins (1984, 1985) was administered. Cronbach's α for Giesen's (1991) scale was .82 for men and .87 for women. The items were rated on a 4-point Likert scale ranging from "seldom or never" to "very often" (after pilot testing the questionnaire, we decided to add the category "not applicable" but recoded this to "seldom or never"). Given that the level of external stimulation is constantly changing, the questions were posed with regard to the last month. For the items, see Table II.

Fatigue. Fatigue was 1 of the 43 complaints on the Acute Complaints List (Foets and van der Velden, 1990; Tijhuis *et al.*, 1995), which is frequently used in The Netherlands. Respondents indicate the complaints they have suffered from during the last 2 weeks. The embedding of the fatigue item among numerous other items allowed us to avoid the overrepresentation of fatigue complaints in this "Fatigue Study."

The following risk factors were included.

Number of Life Events. The number of life events was measured with a list developed by Schut (1992). The list was selected on the basis of its face validity and has been used as the control variable in a study of bereavement (Schut, 1992). The respondent is asked whether he or she has experienced 1 or more of the following 13 critical life events during the previous year: change of residence, serious accident, dismissal, death of a beloved, serious illness, serious illness of a beloved, start of new work/study, bankruptcy, abortion, child moved out of parental home, crime victim, large financial setback, and childbirth.

Health Status. A number of indicators were used to determine the health status of the individual.

- *General health status as judged by GP.* GPs indicated the patient's general health on a 5-point scale ranging from "very poor" (1) to "very good" (5) (see Foets and van der Velden, 1990).
- *Number of chronic diseases.* The GPs indicated the illnesses suffered by the patient on a checklist with 25 frequently occurring chronic diseases, such as asthma, hay fever, hypertension, cardiac failure, and backache (Foets and van der Velden, 1990; Tijhuis *et al.*, 1995). This information was recoded by us into the number of chronic diseases with respectively mild, moderate, or severe consequences (categories according to van de Lisdonk, 1985; Tijhuis, 1994).
- *Perceived health.* Patients were asked to indicate their general health during the month prior to completion of the questionnaire on a 5-point scale similar to that for the GPs (Foets and van der Velden, 1990; Tijhuis *et al.*, 1995).

Table II. Results of Principal-Component Analysis with Items from the External Information Questionnaire and the Role Conflict Scale ($n = 676$; Missing Deleted Listwise)

Item	Factor I	Factor II	h^2
Factor I			
External Information Questionnaire (Gijsbers van Wijk, 1995)			
1. I had too much to think about during the last month.	.64	–.11	.42
2. I never had enough time.	.66	.26	.50
3. I can carry out most of my daily routine without giving it a thought.[a] R[b]	.30	.05	.09
4. I feel like I'm in a straightjacket.[c] R	–.41	.55	.47
5. I had (too) many social obligations	.50	.01	.25
6. My work or study pressure was too high.	.62	–.03	.39
8. I often had too many things to do at the same time.	.75	.04	.56
Role Conflict Scale (cf. Giesen, 1989)			
How often in the previous month did you have the feeling that...			
9. you could not give enough attention to your housekeeping?	.57	–.00	.33
10. you wanted to spend more time on your partner?	.47	–.02	.22
11. you could not give enought attention to social obligations?	.62	–.08	.39
12. you could not give enough attention to your work?	.46	–.13	.23
13. you could not give enough attention to things that you liked to do?	.70	–.16	.51
14. you wanted to spend more time on your children?[a]	.31	–.11	.10
15. you did not get around to yourself?	.73	–.07	.54
16. you did not get around to your own household administration activities?	.53	–.09	.29
17. you wanted to spend more time on the maintenance of your house and/or garden?	.47	–.06	.23
Factor II			
External Information Questionnaire (Gijsbers van Wijk, 1995)			
1. During the last month, my weekdays were pretty much the same. R	.07	.51	.27
2. I didn't have much to do. R	.27	.59	.42
3. My life was a routine. R	–.09	.76	.59
4. During the last month, there was enough room for self-expression in my life.	–.22	.59	.39
5. My daily life had a lot of variation	–.01	.64	.41
6. I found most things that I did a bore. R	–.24	.57	.38
7. I often got bored. R	.06	.67	.46
8. I often spent several days on my own. R	–.01	.45	.20
9. I often had to perform meaningless activities.[c] R	–.30	.46	.30
10. I often had nothing meaningful to do. R	.01	.70	.49
Eigenvalue	5.67	3.77	
Variance (%)	21.8	14.5	

[a]Item removed from scale because factor loading too low.
[b]R indicates reverse scoring.
[c]Item removed from scale because loaded on both factors.

Educational Level. Respondents indicated the highest level of education completed by them along an ordinal scale with seven categories.

The following moderating factors were included.

Gender. Patients had indicated their sex.

Chronic Disease. Whether one had one or more chronic diseases or not was derived from the chronic disease checklist completed by the GP (see "Number of chronic diseases").

Professional Status. Respondents indicated whether or not they were working and, if so, what the occupational grade of their work was. People with white-collar work or on the chief, management, staff, or board level were defined as "high professional status," while those without a job or with blue-collar work were defined as "low professional status" [derived from Wohlfarth's (1997) social class concept].

Finally, the following measures were used to validate the new external stimulation scales.

Activities. Respondents indicated which of the 14 activities on a list were conducted during the previous month: work, unpaid work with social benefits, volunteer work, traveling 1 hr or more per day to/from work/school, school/study, housekeeping activities, child care, care for sick person, hobby, club/association activity, visiting or having visitors, holiday, administration for own household, and maintenance of house/garden. van Vliet *et al.* (1994) previously validated an earlier version of the External Information Questionnaire (Gijsbers van Wijk and Kolk, 1995) by relating it to only five daily activities. In order to improve validation, we have extended their list. Both engagement or not in each of 14 activities and the total number of activities engaged in were used for validation purposes in the present study.

Degree of Pleasantness of Activities. Respondents related the pleasantness of each of the aforementioned activities by assigning a score of between 0 and 10. In such a manner, information on the subjective attributions of the patients with regard to the different activities was gained.

Analyses

Principal-components analysis with varimax rotation was first conducted using the items of the two initial external stimulation measures, EIQ and RCS. Two new scales were later constructed, by selecting factors with eigenvalues >2 and items with factor loadings >.30 while the factor loading for the other factor was <.30. If a respondent had one missing value in a scale, this was replaced by the individual's item mean. A maximum of 3.4% values per item was missing, with the exception of one item with 9.5% missing values.

In order to explore the relation between external stimulation and fatigue,

the relation was first plotted. This also allowed us to determine whether a curvilinear relation should be tested for. Five groups of more or less equal subject numbers were first formed by rank ordering the cases according to the score on the independent variable; the percentage reporting fatigue was then calculated for each group. To test the relation, logistic regression analyses were conducted with the external stimulation measures as the independent variables and fatigue as the dependent variable.

In order to test for an effect of external stimulation in addition to the effects of various risk factors on fatigue, logistic regression analyses were undertaken with the risk factors and external stimulation measures together and the risk factors alone.

The regression analyses were performed for the subject population as a whole and the subgroups of men versus women, chronically ill versus non-chronically ill, and low versus high professional status subjects.

RESULTS

Scale Construction for External Stimulation

The principal-components analysis (PCA) with varimax rotation for the two items of the two external stimulation measures EIQ and RCS revealed two new factors, containing items with factor loadings >.30 (and factor loadings <.30 for the other factor). Two of the items from the RCS (regarding volunteer work and study) were not used due to extreme skewness and kurtosis. Table II presents the items, factors, factor loadings, and explained variance of this PCA. As can be seen, the first factor accounted for 21.8% of the common variance and the second factor accounted for 14.5% of the common variance; both factors had eigenvalues >2.

Two scales were constructed on the basis of these two factors. The first scale was derived from the first factor and named *experienced overload*; this scale consisted of five items from the EIQ and eight items from the RCS (Cronbach's α = .86; $n = 676$). Compared to the first factor, two items were not used in the scale due to low factor loadings ("wanted to spend more time on your children" and "I can carry out most of my daily routine without giving it a thought"). Given that the *experienced overload* scale contained both 4- and 5-point scale items, the item scores were standardized before computing the item mean. The second scale was derived from the second factor and named *attractiveness of external stimulation*; this scale consisted of eight items from the original EIQ (Cronbach's $\alpha = .79$; n = 730). Compared to the second factor, two items were not used in the scale because they loaded on both factors ("I feel like I'm in a straightjacket" and "I often have to perform meaningless activities"), and one item was removed because it was found

to reduce reliability ("I often spent several days on my own"). The two new scales correlated weakly but significantly ($r = -.11$, $p \leq .01$).

To validate the new scales, they were related to the 14 daily activities. Some 15.3% of the variance in *experienced overload* ($p \leq .001$) was found to be explained by whether or not the following activities had been conducted: work, traveling 1 hr or more per day to/from work/school, housekeeping, care for sick person, and doing administration for own household. Some 12.4% of the variance in *attractiveness of external stimulation* ($p \leq .001$) was found to be explained by whether or not the following activities had been conducted: work, volunteer work, hobby, visiting or having visitors, and maintenance of house/garden. With regard to the total number of activities, the correlation with experienced overload was .25 ($p \leq .001$) and the correlation with attractiveness of external stimulation was .24 ($p \leq .001$). With regard to the rated pleasantness of the activities, the only significant correlation larger than .30 was found between pleasantness of work and *attractiveness of external stimulation* ($r = .36$, $p \leq .001$; $n = 416$). In the remaining analyses, these two new external information scales (*attractiveness of external stimulation* and *experienced overload*) are used (and not the initial measures, EIQ and RCS).

Descriptives

The means, standard deviations, and correlations for the variables under consideration are listed in Table III. As can be seen, fatigue correlated most with perceived health, followed by the two new external stimulation scales. In addition, *experienced overload* correlated positively with being female, educational level, professional status, and number of life events. *Experienced overload* correlated negatively with age, number of moderate chronic diseases, number of severe chronic diseases, and perceived health. *Attractiveness of external stimulation* correlated positively with educational level, professional status, general health status, and perceived health. *Attractiveness of external stimulation* correlated negatively with number of moderate chronic diseases, number of severe chronic diseases, and having one or more chronic diseases.

Relations Between the Two New External Stimulation Scales and Fatigue

In Fig. 1, the relations between 5 categories of ascending *experienced overload* and fatigue are depicted. In Fig. 2, the relations between five categories of ascending *attractiveness of external stimulation* and fatigue are depicted. Figure 1 shows a positive linear relation between *experienced overload* and fatigue, while Fig. 2 shows a negative linear relation between *attractiveness of external stimulation* and fatigue.

Table III. Descriptives of Variables Under Consideration in the Analyses (Correlations: Missing Pairwise)

Variable	M (SD)	Max. range	*n*	2	3	4	5
1. Age	42.66 (15.59)	18–88	776	−.17***	−.31***	−.31***	−.20***
2. Being female		0–1	776	—	−.04	.04	.10**
3. Educational level	3.85 (1.82)	1–7	768		—	.46***	.05
4. Professional status		0–1	777			—	.07
5. Number of life events	1.10 (1.11)	1–13	777				—
6. General health (GP)	4.06 (.85)	1–5	703				
7. Having (a) chronic disease(s)		0–1	773				
8. Number of mild chronic diseases	.13 (.38)	0–5	725				
9. Number of moderate chronic diseases	.33 (.61)	0–7	725				
10. Number of severe chronic diseases	.24 (.53)	0–10	725				
11. Perceived health (patient)	3.47 (.86)	1–5	768				
12. Experienced overload[a]	.003 (.61)	−1.10–1.94	734				
13. Attractiveness of external stimulation	3.73 (.67)	1–5	751				
14. Fatigue		0–1	775				

[a] Because the *experienced overload* scale was composed of both 4-point and 5-point items, the item scores were standardized before computing the scale mean.

Note. *$.05 > p > .01$; **$.01 > p > .001$; ***$p < .001$.

In Table IV, the results of the logistic regression analysis are presented and can be seen to confirm these linear relations. It should be noted that the absolute values of the Exp(B)'s cannot be compared because the logistic regression coefficients are scale dependent. Both the presence and the absence of fatigue appear to be equally predicted by the model. As can be seen from the percentages predicted and the fit measures, the fit of the model is moderate.

Similar results were also found for the various subgroups. Strikingly, the effects of both new scales for external stimulation are somewhat larger for the female group compared to the male group [regarding *experienced overload*, $\text{Exp}(B)^{\text{women}} = 3.41$ ($p < .001$) and $\text{Exp}(B)^{\text{men}} = 2.02$ ($p < .01$); regarding *attractiveness of external stimulation*, $\text{Exp}(B)^{\text{women}} = .37$ ($p < .001$) and $\text{Exp}(B)^{\text{men}} = .51$ ($p < .01$); N.B., regarding B coefficients <1, a smaller size means a larger effect in a negative direction]. The effects of *experienced overload* were also somewhat larger for the non-chronically ill [$\text{Exp}(B) = 3.44$, $p < .001$] compared

6	7	8	9	10	11	12	13	14
.32***	.25***	–.01	.37***	.43***	–.01	–.28***	–.07	–.18*
.04	–.05	.11**	–.08*	–.10**	.02	.13**	.06	.14***
–.19***	–.20***	.04	–.20***	–.14***	–.05	.24***	.19***	.03
.21***	–.17***	.05	–.15***	–.21***	.06	.28***	.17***	.02
.03	.00	–.04	–.08*	–.08*	.13***	.26***	–.09*	.21***
—	–.29***	.15***	.39***	.47***	.37***	–.03	–.23***	.21***
	—	.14***	.30***	.24***	.04	–.17***	.27***	.10***
		—	.07	.10*	.08*	.03	–.03	.04
			—	.24***	.12**	–.15***	–.09*	–.05
				—	.15***	–.19***	–.10***	.02
					—	.19***	–.39***	.41***
						—	–.11**	.31***
							—	–.27***
								—

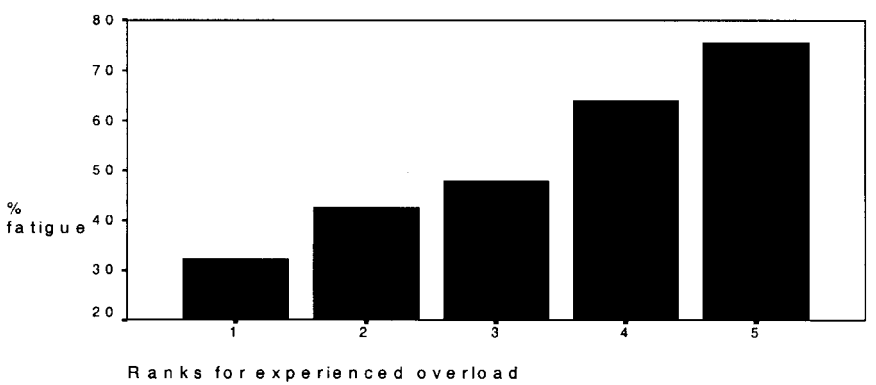

Fig. 1. Relation between experienced overload and percentage fatigue.

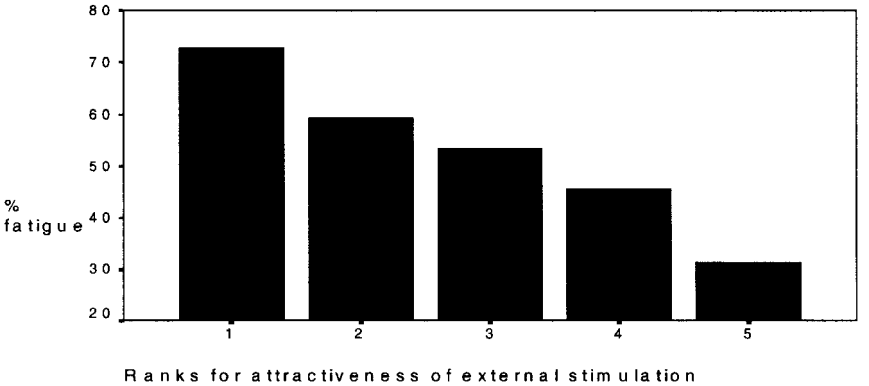

Fig. 2. Relation between attractiveness of external stimulation and percentage fatigue.

Table IV. Logistic Regression Analysis of *Experienced Overload* and *Attractiveness of External Stimulation* on Fatigue for Total Sample ($n = 730$)

Independent variable	B (SE)	Exp(B)[a]	R
1. Experienced overload	1.10 (.14)***	2.99**	.24***
2. Attractiveness of external stimulation	−.88 (.13)***	.43*** (inverse = 2.31)	−.20***
Percentage predicted correct total	65.07%	−2 log likelihood	892.19
Percentage not fatigue predicted correct	63.40%	Goodness of fit	739.74
Percentage fatigue predicted correct	66.58%	Model χ^2	118.03*** (df = 2)
Percentage fatigue observed	52.46%		

[a]If the independent variable increases by 1 point, the *odds ratio* for fatigue increases by a factor equal to Exp(B).

Note. **$.01 > p > .001$; ***$p < .001$.

to the chronically ill [Exp(B) = 2.88, $p < .001$] and for high professional status people [Exp(B) = 3.60, $p < .001$] compared to low professional status people [Exp(B) = 2.70, $p < .001$].

Effects of External Stimulation in Addition to Risk Factors on Fatigue

In Table V, the results of the logistic regression of the risk factors and the new external stimulation scales on fatigue are presented. Both of the new external stimulation scales added significantly to the prediction of fatigue by the other risk factors. However, *experienced overload* was more important in terms of statistical significance and R. Moreover, the Exp(B) for *experienced overload*

Table V. Logistic Regression Analysis of *Experienced Overload* and *Attractiveness of External Stimulation* in Addition to Risk Factors on Fatigue for Total Sample ($n = 650$)

Independent variable	B (SE)	Exp(B)[a]	R
1. Age	.00 (.01)	1.00	.00
2. Gender (1 = men, 2 = women)	.46 (.21)*	1.60*	.05*
3. Educational level	.00 (.06)	1.00	.00
4. Number of life events	.23 (.09)*	1.26*	.07*
5. General health (GP)	–.41 (.14)**	.66**	–.08**
6. Number of mild chronic diseases	–.11 (.24)	.90	.00
7. Number of moderate chronic diseases	–.29 (.18)	.75	–.02
8. Number of severe chronic diseases	–.13 (.23)	.88	.00
9. Perceived health (patient)	–.95 (.14)***	.39***	–.22***
10. Experienced overload	1.06 (.18)***	2.87***	.19***
11. Attractiveness of external stimulation	–.44 (.16)*	.65* (inverse = 1.54)	–.08*
Percentage predicted correct total	72.77%	–2 log likelihood	687.48
Percentage not fatigue predicted correct	70.16%	Goodness of fit	664.93
Percentage fatigue predicted correct	75.07%	Model χ^2	211.15*** (df = 11)
Percentage fatigue observed	53.08%		

[a]If the independent variable increases by 1 point, the *odds ratio* for fatigue increases by a factor equal to Exp(B).

Note. $^{*}.05 > p > .01$; $^{**}.01 > p > .001$; $^{***}p < .001$.

was more similar to that in the regression equation without the risk factors than the Exp(B) for *attractiveness of external stimulation*. Of the risk factors, being female, number of life events, general health status, and perceived health status predicted fatigue significantly. Across the subgroups, only *experienced overload* and perceived health predicted fatigue consistently. *Attractiveness of external stimulation* did not predict fatigue for the male subgroup, the high professional status subgroup, or the chronically ill subgroup. For the remaining subgroups and parallel to the total sample, the differences between the Exp(B)'s of *attractiveness of external stimulation* in the regressions with and without the risk factors were larger than the differences between Exp(B)'s of *experienced overload*.

The regression results for the prediction of fatigue by the risk factors without the two new external stimulation scales are presented in Table VI. Gender, number of life events, general health status, and perceived health were found to predict fatigue significantly.

With regard to the fit of the different models, the model with both risk factors and the two new scales for external stimulation (*experienced overload* and *attractiveness of external stimulation*) produced the best fit according to the percentages fatigue predicted and the model χ^2. This was also the case for all subgroups.

Table VI. Logistic Regression Analysis of Risk Factors on Fatigue for Total Sample ($n = 685$)

Independent variable	B (SE)	Exp(B)[a]	R
1. Age	.00 (.01)	1.00	.00
2. Gender (1 = men, 2 = women)	.46 (.20)*	1.59*	.06*
3. Educational level	.05 (.05)	1.06	.00
4. Number of life events	.31 (.09)***	1.36***	.11***
5. General health (GP)	−.43 (.13)**	.65**	−.09**
6. Number of mild chronic diseases	−.05 (.23)	.95	.00
7. Number of moderate chronic diseases	−.26 (.17)	.77	−.02
8. Number of severe chronic diseases	−.32 (.21)	.73	−.02
9. Perceived health (patient)	−1.22 (.13)***	.33***	−.28***
Percentage predicted correct total	70.70%	−2 log likelihood	772.60
Percentage not fatigue predicted correct	69.66%	Goodness of fit	696.93
Percentage fatigue predicted correct	71.55%	Model χ^2	174.80*** (df = 9)
Percentage fatigue observed	52.85%		

[a]If the independent variable increases by 1 point, the *odds ratio* for fatigue increases by a factor equal to Exp(B).

Note. *$.05 > p > .01$; **$.01 > p > .001$; ***$p < .001$.

DISCUSSION

In the present study, the relation between external stimulation and fatigue was explored. Two clear dimensions could be distinguished: a dimension called *experienced overload* and a dimension called *attractiveness of external stimulation*. Both aspects of external stimulation contributed significantly to the prediction of fatigue, even when the GP reports on health and other risk factors were taken into consideration. Experienced overload consistently predicted increased fatigue, while attractiveness of external stimulation consistently predicted decreased fatigue.

The different dimensions of external stimulation in the present study can be interpreted in terms of both quantity and quality. It seems that experienced overload refers to quantitative aspects in the sense that a high amount of external stimulation appears to be disadvantageous and thus predicts high levels of fatigue. Attractiveness of external stimulation refers to the quality of the external stimulation. High quality or engagement in such pleasant activities as enjoyable work, hobbies, and various social events predicts a low level of fatigue.

This two-factor structure perfectly reflects the theoretical assumption that both the quantity and the quality of external stimulation play an important role in the competition of cues (Pennebaker, 1982; Gijsbers van Wijk and Kolk, 1997b). But, interestingly, the results of our study show these two aspects of external stimulation to have opposite relationships to fatigue. Also, the two dimensions are only weakly correlated, which means that their effects are almost entirely

additive. That is, people who characterize their daily life as always having enough time and/or always having interesting activities are least likely to complain of fatigue. Conversely, people who characterize their daily life as never having enough time and never having interesting activities are most likely to complain of fatigue.

This model, which explains fatigue in terms of experienced overload (quantity) and attractiveness of external stimulation (quality), is referred to as the "quality–quantity model for understanding fatigue" (QQuF model). The model predicted fatigue in various subgroups. When risk factors are included in the model, moreover, the overload one experiences and one's current health appeared to be the most common predictors of fatigue. The prediction of fatigue by the attractiveness of external stimulation appeared to be limited to women, people without a job or with blue-collar work, and/or the non-chronically ill. For some, thus, the attractiveness of external stimulation appears to depend on the risk factors and perceived health in particular.

Methodological Considerations

A number of methodological considerations should be addressed. The relation between the two dimensions of external stimulation may be more complicated than their low correlation indicates. It is very possible, for example, that the relation between the two dimensions may be stronger for some people and also vary in direction. For some people, doing too much may be positively and strongly related to the attractiveness of the activities. For others, doing too much makes it more or less impossible actually to enjoy any of their activities. In those cases, the experience of overload relates to low attractiveness of external stimulation. The latter seems to be supported by the finding that the item "I feel like I'm in a straightjacket" loaded positively on experienced overload and negatively on attractiveness of external stimulation. Nevertheless, the conclusions regarding the relations between external stimulation and fatigue are not affected by the existence of such underlying relations between the two external stimulation dimensions.

Fatigue was measured with a single question in the present study. Of course, various subjective experiences underlie the statement "I feel so tired." However, the use of a single question does not undermine our conclusions because we aimed at generic aspects of fatigue, and, moreover, the measurement used here relates the present study to the multitude of studies on fatigue (see Lewis and Wessely, 1992).

Our conclusions are based on cross-sectional data, which limits the explanatory power of our statistical model. First, the causality can go in two directions. Experienced overload comprised items referring to having too much to do and

was also related to the number of activities such as work, traveling, housekeeping, and care. This suggests that experienced overload leads to fatigue, as it is difficult to believe the opposite, namely, that fatigue makes people do more than when they are not fatigued. Second, the relation between the perceived attractiveness of external stimulation and fatigue may be influenced by a third variable that relates to the attractiveness of external stimulation and to fatigue, such as health. That is, worsened health may both cause fatigue and reduce the attractiveness of activities. In the present study there was considerable overlap between perceived health, attractiveness of external stimulation, and subjective fatigue. A more precise measure of the quality of external stimulation could have explained fatigue in addition to the explanation by health within the chronically ill subgroup. For example, Jackson *et al.* (1997) found the degree of structured and *purposeful* time use (i.e., the quality of activities), and not the amount of activity, to be the most significant predictor of the level of emotional distress in both cases of chronic pain and healthy cases.

Conclusions with regard to the causal relations between external stimulation and fatigue cannot as yet be made. This is also because our scales involve a mixture of the objective and subjective characteristics of the situation. This is not a methodological shortcoming, of course, but a reflection of reality. In a recent in-depth study of the demands of combining a job with housekeeping and child-care tasks, for example, differences in the perceptions of the 78 women under consideration were found to play a large role in the experience of combining the tasks and health consequences (Groenendijk, 1998).

To our surprise, the prediction of fatigue by the GP's judgments of health or reports of chronic disease was not extremely strong or consistent across the subgroups. The relations between chronic disease and fatigue are generally quite strong and consistent (Lewis and Wessely, 1992; Bensing *et al.*, 1996). However, the GPs' judgments of health or reports of chronic disease did not refer to the current health status, which suggests that perceived health may be a better indicator of the current course of a chronic disease and thus fatigue. Similarly, general health status was not a very good predictor of fatigue compared to perceptions of current health.

Theoretical Implications

Despite some methodological limitations, we feel that the present study clearly contributed to the development of a framework for a better understanding of fatigue. In the field of psychology, fatigue is frequently regarded as the label a person gives to the experience of lacking the necessary resources to cope with the demands facing him or her (Smets *et al.*, 1998). Our research shows high-quality demands (or external stimulation) actually to be related to

decreased fatigue, which underlines the importance of distinguishing the different dimensions of external stimulation and any related concepts. The present findings also shed light on the apparent contradictions found in previous empirical studies and the hypothesis of a U-shaped relation between external stimulation and fatigue/health complaints (cf. Wundt, 1911, in Strelau, 1995; Seleye, 1975; Frankenhaeuser, 1981, 1986; Pennebaker, 1982; van Vliet, 1991; Finkelman, 1994; Gijsbers van Wijk and Kolk, 1997b). It appears that different operationalizations of external stimulation have generally been used to support the existence of a curvilinear relation between external stimulation and health/fatigue while such different operationalizations may actually tap completely different aspects of external stimulation.

With regard to actual theory, a number of questions remain unanswered. Strictly speaking, the competition of cues assumes an unconscious bottom-up process (Gijsbers van Wijk and Kolk, 1997b). This means that the objective characteristics of external stimulation directly influence symptom perception. However, in the present study and in, for example, the study by Groenendijk (1998), the labeling of external stimulation as being attractive appeared to be an important factor. Thus, in addition to the objective characteristics of the external stimulation, the appraisal of it may play a role as well. It is also theoretically unclear whether the competition of cues refers to a short- or a long-term process. It may be that settings with unattractive stimuli elicit immediate symptom perception, while overloaded settings cause increased arousal and thus have more long-term, cumulative effects. Frankenhaeuser (1989) and Siegrist *et al.* (1990), for example, have shown sustained activation to produce chronically raised (nor)adrenalin and cortisol responses, which may in turn be related to fatigue (Meijman and Schaufeli, 1996). Finally, depression was not included in the present study but certainly merits attention. The relation between depression and fatigue is complicated: fatigue is strongly related to depression (e.g., Fuhrer and Wessely, 1995) but neither sensitive nor specific to the diagnosis (Fuhrer and Wessely, 1995). As a consequence, the relation between depression and the present model deserves thorough examination.

Practical Implications

The present study suggests a number of strategies for successful treatment of fatigue. While health and life events are (often) difficult to influence, daily life circumstances offer opportunities for change. However, the advice provided in handbooks for general practitioners appears to confuse fatigue related to experienced overload and fatigue related to the stress of unattractive external stimulation (Hennen, 1987; Murtagh, 1994; Davies and Lipkin, 1996; McPhee and Schroeda, 1996). In cases of fatigue related to insufficient time, increased rest

and reducing the number of activities can be recommended (cf. Hennen, 1987). In cases of fatigue related to low attractiveness of external stimulation, the person is presumably not tired by pleasurable activities (cf. Hennen, 1987) and should therefore be encouraged to find such activities and participate in them. It should not be forgotten, however, that social status is also difficult to change. The findings of the present study, for example, showed experienced overload to particularly predict fatigue among high professional status people, while attractiveness of external stimulation particularly predicted fatigue among low professional status people. These relations are complex: the first group may have so many opportunities for pleasant activities that they simply do not have the time to participate in all of them, while the second group may simply not have sufficient opportunities to engage in pleasant activities.

Future Research

The role of depression in relation to the QQuF model certainly deserves attention in future research. The use of longitudinal measurements and inclusion of psychobiological measures may certainly increase our understanding of the processes underlying the current findings. Greater attention should also be paid to the roles of high experienced overload and low attractiveness of external stimulation in complaints of fatigue. Finally, the diversity of the subject sample on which the QQuF model has been based makes the model highly generalizable and thus particularly suited for use with different subject populations in future research.

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