The following full text is a publisher’s version.

For additional information about this publication click this link.
http://hdl.handle.net/2066/103133

Please be advised that this information was generated on 2019-12-22 and may be subject to change.
Dimensions in Appraising Fatigue in Relation to Performance

Arno van Dam¹, Ger P. J. Keijsers², Paul A. T. M. Eling³, Eni S. Becker²

¹GGZ-Westelijk Noord Brabant, Institute for Mental Health, Bergen op Zoom, The Netherlands;
²Radboud University Nijmegen, Behavioural Science Institute, Nijmegen, The Netherlands;
³Radboud University Nijmegen, Donders Institute for Brain, Cognition and Behaviour, Nijmegen, The Netherlands.

Keywords: Fatigue, Performance, Appraisal, Perception, Cognition

Introduction

Fatigue is generally related to the time spent on a task and to the demands of that task. This task-induced fatigue may result in performance decrements, but the relation is in no way straightforward. A large variation is observed among individuals with respect to the influence of fatigue on performance (Boksem, Meijman, & Lorist, 2006), even more so in individuals suffering from disorders that are characterised by long-term fatigue (DeLuca, 2005). Some studies show reduced cognitive performance in fatigue-related syndromes (Van der Linden, Keijsers, Eling, & Van Schaik, 2005; Thomas & Smith, 2009), while others do not (Short, McCabe, & Tooley, 2002).

It is not clear which factors underlie these large inter-individual differences (Huibers et al., 2004; Nijrolder, Van der Horst, & Van der Windt, 2008). Several authors suggest that individual differences in appraisal of fatigue may be responsible (Afari & Buchwald, 2003; Knoop, Prins, Moss-Morris, & Bleijenberg, 2010; Prins, Van der Meer, & Bleijenberg, 2006). Appraisal refers to the interpretation of stimuli, situations or symptoms. Fatigue, for example, may be appraised by an individual as a signal that an activity is uninteresting or as a signal that energy resources are getting depleted (Meijman, 1991). Insight in the underlying dimensions in fatigue-appraisal may provide clues for a better understanding of the complex relation between fatigue and performance.

We performed a search in the PsychInfo and Medline databases using combinations of the following keywords: fatigue, performance, cognition and appraisal, looking for conceptual frameworks concerning the appraisal of fatigue and its relation with performance. We found several theories and elaborated notions about the appraisal of fatigue in relation to performance. Some were conceptually closely related to each other whereas others were very different. We categorized the theories and descriptions based on their conceptual differences and similarities, resulting in two conceptual frameworks regarding the fatigue-performance relationship.

Adaptation-Oriented Appraisal

In the fields of performance psychology and occupational psychology, fatigue is often regarded as the result of an adaptive mental process that protects individuals from spending effort on unrewarding activities. This idea has been elaborated by authors such as Meijman (1991) and Boksem and Tops (2008), and forms an important assumption in rather comparable theories such as the effort-reward imbalance theory (Bellgrath, Weigl, & Kudielka, 2009; Siegrist, 2002), lack of reciprocity theory (Buunk & Schaufeli, 1993; Väinänen, Buunk, Kivimäki, Vahtera, & Koskenvuo, 2008), and conservation of resources theory (Alvaro et al., 2010; Hobfoll & Shirom, 1993). According to these theories, individuals make cost-benefit analyses of goal-directed behaviour to determine whether spending effort is rewarding in terms of, for example, controllability, chances of success, and attractiveness of the rewards (Boksem & Tops, 2008; Dijksterhuis, 2004; Eccles & Wigfield, 2002; Locke & Latham, 2002; Matthews, Davies, Westernman, & Stammers, 2000). If the likelihood that spending effort will be rewarded is experienced as small, individuals will (sub) consciously reject because of fatigue. We investigated whether the different appraisal dimensions were related to general level of fatigue, anxiety and depression. Only emotion-related appraisal and general level of fatigue were related. Worrying and focusing on fatigue is apparently related to the experience of fatigue whereas attributing fatigue to the unrewarding properties of a task is not. Knowledge about the appraisal-dimensions underlying the fatigue-performance relationship may contribute to a better understanding of individual differences in fatigue effects on performance.

Studies on the relation between fatigue and performance often fail to find a strong and direct link, implying that multiple factors may be involved. A literature search on the fatigue-performance relationship suggests that two different conceptual frameworks are employed concerning the appraisal of fatigue in relation to performance: an adaptation-oriented framework and an emotion-related framework. In this study we investigated whether adaptation-oriented appraisal and emotion-related appraisal exist as separate dimensions in a healthy population. A list of statements derived from these frameworks was presented to 127 healthy individuals. A principal component analysis revealed a six-factor solution and a three-factor solution of fatigue appraisal, closely related to the conceptual frameworks. These findings are in line with our impressions from the literature that fatigue can be appraised in an adaptation-oriented way and in an emotion-related way. In addition, we found a third factor: “social rejection because of fatigue”. We investigated whether the different appraisal dimensions were related to general level of fatigue, anxiety and depression. Only emotion-related appraisal and general level of fatigue were related. Worrying and focusing on fatigue is apparently related to the experience of fatigue whereas attributing fatigue to the unrewarding properties of a task is not. Knowledge about the appraisal-dimensions underlying the fatigue-performance relationship may contribute to a better understanding of individual differences in fatigue effects on performance.

Copyright © 2011 SciRes. DOI:10.4236/psych.2011.29134
sciiously tend to evaluate the goal-directed behaviour as negative. They will experience fatigue and aversion to spend further effort and they will consequently reduce their efforts (Boksem & Tops, 2008; Van Vegchel, De Jonge, Bosma, & Schaafeli, 2005). These theories are supported by findings from many studies (see for a review: Van Vegchel et al., 2005) showing that individuals, who perceive an imbalance in efforts and rewards, experience more fatigue than individuals without experiencing such an imbalance. Moreover, experimental studies show that changing the effort-reward balance by offering individuals a reward, can counteract fatigue (Boksem et al., 2006).

Although fatigue may act as a signal to reduce effort-expenditure, individuals can ignore and override this fatigue for several reasons, for example when they expect rewards in the long term, or when they are overcommitted to their job. Overriding this fatigue may be adaptive in emergency situations, but overriding it for prolonged periods of time may lead to relatively persistent stress, strain, illness and fatigue (Boksem & Tops, 2008).

**Emotion-Related Appraisal**

The second major framework on the appraisal of fatigue in relation to performance can usually be found in the areas of clinical and medical psychology. Here, emotion-related cognitive processes, such as focusing on symptoms and worry, are regarded as important factors for developing and maintaining chronic fatigue. Several studies have shown that anxiety-related appraisal plays a role in the perception of fatigue, affecting performance, especially in chronic fatigue syndrome (CFS) (Afari & Buchwald, 2003; Knoop et al., 2010).

First, focusing on bodily sensations plays a role in the perception of fatigue in CFS. CFS patients are focused on bodily sensations such as drowsiness and concentration problems. They therefore perceive their fatigue as more intense than others do (Afari & Buchwald, 2003; Knoop et al., 2010; Vercoulen et al., 1998). Moreover, an enhanced focus on bodily sensations requires attentional resources and thus negatively affects cognitive performance (Van der Werf, De Vree, Van der Meer, & Bleijenberg, 2002).

Second, fatigued individuals may perceive their fatigue as a depletion of resources, restraining them to engage in activity any longer. This kind of fatigue appraisal, often found in patients suffering from the burnout syndrome (Schaufeli & Enzmann, 1998) or CFS (Afari & Buchwald, 2003), arouses feelings of helplessness (McMullen & Krantz, 1988) and reduced self-efficacy (Findley, Kerns, Weinberg, & Rosenberg, 1998; Knoop et al., 2010).

Third, there appears to be a relation between worry, fatigue and performance in chronic fatigue related syndromes (Sarason, Sarason, & Pierce, 1990). A worry-related cognitive phenomenon is catastrophizing which is known to influence fatigue and performance in CFS. Several authors described that CFS patients are convinced that spending effort will have adverse effects on their health and are therefore reluctant to do so (Afari & Buchwald, 2003; Knoop et al., 2010; Prins et al., 2006).

Fourth, fatigue also seems to be related to social anxiety. Surawy, Hackman, Hawton, and Sharpe (1995) argued that fatigued individuals believe that fatigue and the accompanying reduced performance lead to rejection by others. This belief prompts them to sustain high levels of effort and hence to perpetuate fatigue.

Remarkably, we found no studies which incorporated both frameworks. Apparently, there is little exchange of ideas about the appraisal of fatigue and performance between the different fields of fatigue research. Although there may be differences between the populations studied in the two conceptual frameworks, there are also similarities, since both frameworks are applied to populations suffering from long term fatigue and fatigue-related disabilities. Further, it is unclear whether these different ways of fatigue appraisal actually exist as separate dimensions and whether they are directly related to general levels of fatigue or mood.

In this study we have tried to combine both frameworks and investigated whether adaptation-oriented appraisal and emotion-related appraisal exist as separate dimensions in a healthy population.

**Method**

**Participants**

The municipal health department of Woensdrecht, a city in the Netherlands, asked 500 randomly selected inhabitants to complete a health inventory. Along with this health inventory questionnaire, they also sent our list of statements.

Hundred-thirty-eight completed forms were returned (27.6%). We excluded eleven participants who reported that they suffered from a mental disorder. The age of the 127 participants varied between 16 and 91 years with a mean of 48.6 and SD of 16.3; 64% of the participants were female. Level of education was as follows: 46.5% had a low level of education, 31.5% a medium level, and 22.0% a high level of education (See Table 1).

**Rating Scale Fatigue-Performance Appraisal**

In order to collect statements on the relation between fatigue and performance we examined fatigue inventories in the scientific literature (Ahsberg, Gamberale, & Kjellberg, 1997; Challer et al., 1993; Hann, Denniston & Baker, 2000; Mendoza et al., 1999; Smets, Garssen, Bonke, & DeHaes, 1995; Vercoulen et al., 1994). The collected inventories from the literature mainly focus on various symptoms of fatigue like reduced concentration and passivity, and they do not explore the appraisal of fatigue in relation to performance. Appraisals such as an individual’s view that fatigue is as a result of boring activities, or as depletion of resources are not part of existing fatigue inventories.

<table>
<thead>
<tr>
<th>Sociodemographic features of the participants (N = 127).</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex</strong></td>
</tr>
<tr>
<td><strong>Age</strong></td>
</tr>
<tr>
<td><strong>Education level</strong></td>
</tr>
</tbody>
</table>
The scores on the 30 statements were subjected to a principal component analysis (PCA), using varimax rotation. The Kaiser-Meyer-Olkin (KMO) measure showed proper sampling adequacy (KMO > .79 exceeded the recommended value of .6, which is considered as good). The KMO for one of the items of the catastrophizing cluster was smaller than .5 and therefore the item was excluded from further analyses. For the remaining items, KMO ranged between .55 and .90, passing the acceptable limit of .5. Bartlett’s test of sphericity reached statistical significance (p < .001), supporting the factoriality of the correlation matrix. PCA revealed eight factors with eigenvalues exceeding 1. Inspection of the screeplot revealed breaks after the third and the sixth factor.

It was decided to first perform a PCA forcing six factors. The six-factor solution explained a total of 63.7% of the variance, with Factors 1 to 6 contributing as follows to the explained variance: 27.5%, 12.2%, 8.4%, 6.2%, 5.2% and 4.4%. Inspection of the items loading on the six factors revealed the following content of the factors; see appendix 2 for details.

Factor 1: Six items from the “uninteresting” and “no personal relevance clusters” loaded on this factor (internal consistency reliability is high, Cronbach’s alpha is .87). A high score on Factor 1 indicates that respondents relate reduced cognitive performance, such as concentration problems, to activities they consider as unimportant or unrewarding and therefore are unwilling to spend effort. We referred to this factor as: “reduced cognitive performance due to motivational problems”.

Factor 2: All five items from the “resource depletion cluster” loaded on this factor (internal consistency reliability is high, Cronbach’s alpha is .82). A high score on Factor 2 indicates that fatigue is related to energy depletion and that respondents believe that fatigue will lead to reduced cognitive performance. We referred to this factor as: “resource depletion”.

Factor 3: All five items from the “social rejection” cluster loaded on this factor (internal consistency reliability is high, Cronbach’s alpha is .84). A high score on Factor 3 indicates that respondents believe that fatigue will lead to social rejection. We referred to this factor as: “social rejection because of fatigue”.

Factor 4: Four items from the “focusing on fatigue cluster” and one from the “catastrophizing cluster” loaded on this factor (internal consistency reliability is high, Cronbach’s alpha is .84). A high score on Factor 4 indicates that respondents view performance decrements, such as concentration problems, as signs of fatigue. We referred to this factor as: “focusing on fatigue”.

Factor 5: Four items from the “uninteresting” and “no personal relevance clusters” loaded on this factor (internal consistency reliability is high, Cronbach’s alpha is .84). A high score on Factor 5 indicates that respondents relate fatigue to activities which they consider as unimportant or unrewarding and therefore are unwilling to spend effort. We referred to this factor as: “fate due to motivational problems”.

Factor 6: Three items from the catastrophizing cluster and one from the focusing on fatigue cluster loaded on this factor (internal consistency reliability is moderate, Cronbach’s alpha is .67). A high score on Factor 6 indicates that a respondent believes that spending effort while fatigued is harmful to one’s health. We referred to this factor as: “catastrophizing”.

Because the screeplot also allowed a three factor solution, we investigated whether a reduction to three factors would lead to a meaningful alternative solution. The three-factor solution explained a total of 48.3% of the variance with Factor 1 contributing 27.8% of the variance, Factor 2 contributing 12.2 percent of the variance, and Factor 3 contributing 8.4% of the variance. Inspection of the item loadings revealed the following, see ap-
Discussion

In the literature on fatigue and performance, we observed two conceptual frameworks on the cognitive appraisal of this relation: an adaptation-oriented framework, which concerns the regulation of effort-expenditure, and an emotion-related framework, which concerns the regulation of emotion. Remarkably, we found no studies which incorporated both frameworks. In this study we tried to combine both frameworks and investigated whether adaptation-oriented appraisal and emotion-related appraisal exist as separate dimensions in a healthy population.

We calculated correlations between the factor scores of both solutions and the scores on the CIS, the anxiety subscale and the depression subscale of the SCL-90. Only the correlation between Factor 2 of the three-factor solution and the CIS reached statistical significance, $r = .30, p < .001$. Focusing on fatigue was the only emotion-related factor of the six-factor solution that was related to the CIS, $r = .25, p < .05$. Correlations between the CIS, the anxiety subscale and the depression subscale of the SCL-90 revealed that general fatigue correlated with anxiety, $r = .29, p < .001$.

An explanation for the observed relation between focusing on fatigue and fatigue is in line with several studies that showed that focusing on signs of fatigue is related to level of fatigue (Knoop et al., 2010). Individuals who are inclined to interpret reduced performance as signs of fatigue, apparently perceive more fatigue than individuals who are not.

General level of anxiety and general level of fatigue appeared to be related, which is in line with studies that showed that neuroticism is a predictor of elevated levels of fatigue (Harvey, Wessely, Kuh, & Hotopf, 2009).

In summary, the results of our study suggest that adaptation-oriented and emotion-related appraisal can be distinguished as separate dimensions of fatigue-appraisal in a healthy population with normal levels of fatigue. Emotion-related appraisal is related to general level of fatigue, whereas adaptation-oriented appraisal is not. Worrying and focusing on fatigue is apparently related to the experience of fatigue whereas attributing fatigue to the unrewarding properties of a task is not.

Our finding that general level of fatigue is related to emotion-related appraisal and not to adaptation-oriented appraisal may explain why the emotion-related framework is mainly studied in the fields of clinical and medical psychology and the adaptation-oriented framework is mainly studied in the fields of occupational and performance psychology.

It would be interesting to know whether the two conceptual frameworks on fatigue and performance can also be distinguished in a population of patients suffering from long term fatigue and whether they report more emotion related appraisal than adaptation related performance. Gielissen et al. (2007) showed that CFS patients perceived fatigue as more negative compared to healthy controls. It is not known, however, to what degree fatigue is also appraised as adaptive by individuals suffering from long-term fatigue. We are preparing a paper on a study with the measures applied in the present study in a population of patients suffering from burnout as well as patients suffering from depression and anxiety disorders.

The present study has a number of limitations. The response to the set of statements was only 28 percent. We have no indi-
cations however, how the limited response may have affected our results. What we can say is that the group of participants that did respond did not differ from the whole sample on demographic variables. Further, self-report measurement of appraisals, the way we applied it in the present study, implies that implicit aspects of fatigue-performance appraisals were not taken into account. An interesting line of research (e.g., Dijkstra, 2004) shows, however, that people have incomplete access to their appraisals. Finally, one should keep in mind that in the present study appraisals about performance were measured and not performance itself. Appraisal or perception of performance may be quite different from actual performance (see e.g. Metzger & Denney, 2002).

Despite these limitations, we think that the present study shows that adaptation-oriented appraisal, emotion-related appraisal and “fear of social exclusion because of fatigue” can be distinguished as separate dimensions in a healthy population. This finding may be useful for researchers studying fatigue in for example the working situation or in clinical syndromes.

Knowledge about the appraisal-dimensions underlying the fatigue-performance relationship may contribute to a better understanding of individual differences in fatigue effects on performance. Longitudinal research in populations suffering from fatigue and in healthy individuals may shed more light on the relevance of individual differences in appraisal of fatigue for performance.

References


Appendix 1: Statements on the Appraisal of Fatigue in Relation to Performance (English Translation)

1) When I am getting tired, it means I do not enjoy what I am doing at that moment.
2) When I am getting tired, it means that I do not consider what I am doing at that moment as important.
3) If you are frequently tired, you do not matter anymore.
4) When I am doing something and I have problems concentrating it means I do not feel like doing what I am doing.
5) When I have to do something boring, I get tired quickly.
6) When I am tired and I keep on making an effort, it only gets worse.
7) When I get tired, I can not focus on what I am doing.
8) When I am tired, I am not able to concentrate anymore.
9) When I have to do something which I do not consider as meaningful, I get tired easily.
10) When I am tired, I am not able to take part in a conversation anymore.
11) When I get trouble concentrating it means that what I am doing at the moment is not interesting.
12) If you are frequently tired, people will consider you as troublesome.
13) When I have trouble concentrating it means that what I am doing at that moment I do not consider as important.
14) When I can not concentrate during a conversation it means that the conversation is actually not enjoyable.
15) If you are frequently tired, people will not take you seriously anymore.
16) Making an effort is harmful when you are exhausted.
17) When I can not concentrate, it means that what I am doing is not important to me.
18) When I am tired, I feel I run out of steam and cannot go on.
19) If you are frequently tired, you do not mean anything according to others.
20) When I forget something easily it means that I am tired.
21) When I cannot keep my attention during a conversation it means that it actually is not an important conversation to me.
22) If you are often tired, people do not take you seriously.
23) When a certain word does not come to my mind it means that I am tired.
24) When I have difficulty concentrating it means that I am tired.
25) When I am tired, I am not capable to do anything.
26) I always pay attention to whether I am tired or not.
27) I have to take a rest when I am tired, otherwise I become ill.
28) When I have difficulty expressing myself properly it means that I am tired.
29) When I cannot concentrate during a conversation it means that I am not well.

Appendix 2: Distribution of Items over the Clusters and Dimensions of Fatigue-Performance Appraisal

<table>
<thead>
<tr>
<th>A priori clusters</th>
<th>Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adaptational framework</td>
<td></td>
</tr>
<tr>
<td>Not interesting</td>
<td>1, 4, 5, 11, 14</td>
</tr>
<tr>
<td>No relevance</td>
<td>2, 9, 13, 17, 21</td>
</tr>
<tr>
<td>Anxiety-related framework</td>
<td></td>
</tr>
<tr>
<td>Focusing on fatigue</td>
<td>20, 23, 24, 26, 28</td>
</tr>
<tr>
<td>Resource depletion</td>
<td>7, 8, 10, 18, 25</td>
</tr>
<tr>
<td>Catastrophizing</td>
<td>6, 16, 27, 29</td>
</tr>
<tr>
<td>Social rejection</td>
<td>3, 12, 15, 19, 22</td>
</tr>
<tr>
<td>Three factor solution</td>
<td></td>
</tr>
<tr>
<td>1) Adaptation-oriented appraisal</td>
<td>1, 2, 4, 5, 9, 11, 13, 14, 17, 21</td>
</tr>
<tr>
<td>2) Emotion-related appraisal</td>
<td>6, 7, 8, 10, 16, 18, 23, 24, 25, 26, 27, 28, 29</td>
</tr>
<tr>
<td>3) Social rejection</td>
<td>3, 12, 15, 19, 20, 22</td>
</tr>
<tr>
<td>Six factor solution</td>
<td></td>
</tr>
<tr>
<td>1) Reduced cognitive performance due to motivational problems</td>
<td>4, 11, 13, 14, 17, 21</td>
</tr>
<tr>
<td>2) Resource depletion</td>
<td>7, 8, 10, 18, 25</td>
</tr>
<tr>
<td>3) Social rejection because of fatigue</td>
<td>3, 12, 15, 19, 22</td>
</tr>
<tr>
<td>4) Focusing on fatigue</td>
<td>20, 23, 24, 28, 29</td>
</tr>
<tr>
<td>5) Fatigue due to motivational problems</td>
<td>1, 2, 5, 9</td>
</tr>
<tr>
<td>6) Catastrophizing</td>
<td>6, 16, 26, 27</td>
</tr>
</tbody>
</table>