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First indications of the effectiveness of an IAT in modifying attentional bias regarding tiredness or vitality.

Olga Klaus (B.Sc.)

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Supervisors:
Dr. Christina Bode
Dr. Marcel E. Pieterse

Faculty of Behavioral, Management and Social Sciences
Psychology
Department of Psychology, Health and Technology
University of Twente
P.O. Box 217
7500 AE Enschede
The Netherlands

Abstract

Aims: The aim of this study was to assess word associations with tiredness and vitality in healthy individuals. The most elected word associations were further used as items for a modified IAT (ABM-IAT), which aimed to modify an attentional bias regarding tiredness respectively vitality implicitly. This was intended to influence healthy individuals implicitly in becoming implicitly and explicitly more tired respectively vital.

Method: The word association task was an online survey. 46 participants were asked to name word associations for tiredness and vitality. The ABM-IAT was a self-concept IAT which was intended to modify attentional bias regarding tiredness and vitality. 63 participants were alternately assigned two conditions: In the vitality condition 100% of the trials were congruent (vitality +I), and none were incongruent (vitality+ others). In the tiredness condition 100% of trials were incongruent (tiredness + I), and none were congruent (tiredness + others). Further, it was tested if the initial state of tiredness respectively vitality moderated the effect of the ABM-IAT.

Results: 72 different word associations for tiredness and 77 word associations for vitality were found. Further, after the ABM-IAT the participants were significantly more tired – implicit and explicit. Thus an ABM-IAT is effective in influencing healthy individuals in becoming more tired. However, this effect was not significant for vitality. Moreover, baseline tiredness respectively vitality did not moderate the effect of the ABM-IAT.

Conclusions: A comparison of the elected word associations of healthy individuals with exiting measures for tiredness and vitality for "unhealthy" individuals revealed that the word associations were at a large extent identical. Moreover, an ABM-IAT strengthened tiredness in healthy individuals. However, the effect of the ABM-IAT was clearly smaller on vitality. But, taken into account that the participation needed effort and concentration, the ABM-IAT prevented the participants from becoming tired due to participation. Thus, there were first indications for the effectiveness of an ABM-IAT in influencing implicit and explicit tiredness and vitality. Further, the identical word association of healthy and "unhealthy" individuals might be an indication that an ABM-IAT with the found word associations regarding tiredness and vitality might also modify an attentional bias regarding tiredness and vitality in "unhealthy" individuals. After more research, this could be a possibility to carry out training with ABM-IAT and possibly reduce suffering because of a high level of tiredness in healthy and "unhealthy" individuals.

Samenvatting (Dutch Abstract)

Doelstellingen: Het doel van deze studie was om woordassociaties met vermoeidheid en vitaliteit bij gezonde personen te bepalen. De meest gekozen woordassociaties werden verder gebruikt als items voor een gewijzigde IAT (ABM-IAT), dat tot doel had een aandachtsbias over vermoeidheid respectievelijk vitaliteit te wijzigen. Dit was bedoeld om gezonde individuen impliciet te beïnvloeden om impliciet en expliciet vermoeider respectievelijk vitaler te worden.

Methoden: De woord associatie opdracht was een online onderzoek. 46 deelnemers werden gevraagd om woordassociaties voor vermoeidheid en vitaliteit te noemen. De ABM-IAT was een zelfbeeld IAT welke de bedoeling had de aandachtsbias over vermoeidheid en vitaliteit te veranderen. 63 deelnemers werden afwisselend toegekend aan twee condities: In de vitaliteitsconditie waren 100% van de trials congruent (vitaliteit + ik), en geen trial incongruent (vitaliteit + anderen). In de vermoeidheidsconditie waren 100% van de trials incongruent (vermoeidheid + ik) en geen congruent (vermoeidheid + anderen). Verder werd getoetst of de begintoestand van vermoeidheid respectievelijk vitaliteit de effect van de ABM-IAT modereerd.

Resultaten: 72 verschillende woordassociaties voor vermoeidheid en 77 woordassociaties voor vitaliteit werden gevonden. Verder was de ABM-IAT significant effectief in het beïnvloeden van gezonde individuen in het impliciet en expliciet vermoeider te worden. Dit effect was voor vitaliteit echter niet significant. Bovendien, de initiale vermoedheid en vitaliteit was geen moderator voor het effect van de ABM-IAT.

Conclusies: Een vergelijking van de gevonden woordassociaties voor vermoeidheid en vitaliteit van gezonde en "ongezonde" deelnemers openbaarde dat deze woordassociaties op een groot deel identiek waren. Bovendien is een ABM-AT geschikt om vermoeidheid te versterken. Voor vitaliteit was dit effect daarentegen laag. Echter, in aanmerking genomen dat de deelname inspanning en concentratie benodigde, kon de ABM-IAT ten minste voorkomen dat de deelnemers in de vitaliteitsconditie door de participatie vermoeider worden. Dit betekent dat er algeheel eerste aanwijzingen zijn voor de effectiviteit van de ABM-IAT. Verder zijn de identieke woordassociaties van gezonde en "ongezonde" mensen een indicatie dat een ABM-IAT mogelijk ook bij ongezonde mensen de aandachtsbias en daarmee ook vermoeidheid en vitaliteit modficeerd. Dit kan een mogelijkheid bieden om te trainen met ABM-IAT en eventueel lijden vanwege een hoge mate van vermoeidheid te verminderen.

Table of content

1. Introduction

1.1.   Tiredness and vitality

Although everyone knows the feeling of tiredness there is no clear definition for tiredness. Jason, Evans, Brown and Porter (2010) state that tiredness is a subjective feeling of weakness and commonly experienced in the general population. Jason et al. (2010) stress moreover that the general population experiences tiredness as consequence of their lifestyle or situational factors, like a lot of stress or lack of sleep. Regarding the prevalence of tiredness in the general population a research was done by Van't Leven, Zielhuis, Van Der Meer, Verbeek and Bleijenberg (2010). They state that the prevalence of tiredness is much higher than previously indicated and about 20-30% of the complaints of patients by GP's concern tiredness. Further they emphasize that in the general population at large about 30-50% report symptoms of tiredness. But although everyone knows the feeling of tiredness, a clear definition of tiredness doesn't exist (Cardol, Bensing, Verhaak, & De Bakker, 2005). Nevertheless, because of the high prevalence of tiredness in the population there is a necessity of research about this topic.

Regarding the classification of a non-pathological tiredness literature research revealed three general aspects of tiredness. A non-pathological tiredness is a temporarily tiredness with a known cause which can be relieved by rest (Jason et al., 2010). The first aspect of tiredness is physical tiredness (Gandevia, 2001). A synonym for physical tiredness is muscle fatigue. During physical activity gradually the muscle fatigue increases and can be reversed by rest. The second aspect of tiredness is cognitive tiredness. This type of tiredness can be defined as a decrease in or an inability to sustain a certain level of task performance throughout the duration of a continuous information processing process (Bryant, Chiaravalloti, & DeLuca, 2004). The last type of tiredness is mental tiredness (Marcora, Staiano, & Manning, 2009). A characteristic of mental tiredness is the temporarily inability of a mentally tired person to maintain optimal mental performance. Moreover, this literature research revealed that tiredness is not a one-dimensional factor but a multi-dimensional factor, which has physical, cognitive and mental aspects, as stated above (Franssen, Bültmann, Kant, & Van Amelsvoort, 2003).

The etiology and pathophysiology of a non-pathological tiredness is poorly understood. But the contemporary state of scientific knowledge suggests that the expression of tiredness is mediated by both central and peripheral mechanisms within the body (Jason et

al., 2010). First, the peripheral mechanism is caused by a lack of response in the neuromuscular system after central stimulation. And second, the central mechanism is caused by a failure of transmission motor impulses or performing voluntary activities (Chaudhuri & Behan, 2004).

Three groups of causes are associated with increased tiredness in humans. One group consists of lifestyle or situational factors (Jason et al., 2010). These factors include a lot of stress, a high workload, boredom or lack of sleep. This cause belongs to a non-pathological tiredness, whereas the following two causes belong to a pathological tiredness because the cause is unknown /cannot be eliminated and this tiredness cannot be relieved by rest. The second group consists of certain (chronic) physical diseases (Franssen et al., 2003). Here, especially chronic diseases like intestinal problems, cirrhosis or hepatitis, rheumatoid arthritis, migraine and cancer are known to produce a high level of tiredness. Furthermore, physical deficiencies, such as lack of minerals or vitamins or an anemia, can cause tiredness. And a third group, which is known to cause tiredness, are psychological problems. Jason et al. (2010) state that generalized anxiety disorders, major depressive disorders, and dysthymic disorder can cause a high level of tiredness.

Pathological tiredness can also become chronical. As mentioned above and by Norheim, Jonsson and Omdal (2011) certain diseases are often associated by chronical tiredness. Moreover, as no causal disease can be found but a strong tiredness is prevalent in individuals, there is a disease which is called 'Chronic Fatigue Syndrome' (CFS). CFS is characterized as enduring symptoms of tiredness which can't substantially be relieved by rest and are not adequately explained by another medical or psychiatric disease (Perry & Santhouse, 2012). If the state of a high level of tiredness lasts for more than 6 month it becomes chronic (Perry & Santhouse, 2012). CFS affects about 0.1–2.5% of the general adult population (Nater, Maloney, Heim, & Reeves, 2011). Van't Leven et al. (2010) estimate for example that 30 000–40 000 individuals fit the diagnosis of CFS in the Netherlands. For CFS is no single cause known (Perry & Santhouse, 2012). Perry and Santhouse (2012) state further that it is likely that it is a condition of multiple etiologies that include biological, social and psychological factors. CFS is mentioned in this report for the sake of completeness about tiredness. However, this article deals entirely with the non-pathological form of tiredness in healthy humans.

Pathological and also non-pathological tiredness have several consequences. Basically, tired individuals function at a significantly lower level. This results in considerable personal and economic consequences (Jason et al., 2008). Jason et al. (2010) mention that

tiredness causes declines in work productivity which in turn causes economic consequences. Furthermore tiredness causes high direct costs, for example, for medical care. Among the personal consequences Jason et al. (2010) mention that strong tiredness often causes or worsens depression, anxiety and other psychological diseases. Mental and cognitive impairments are also common in tired individuals (Bryant et al., 2004; Marcora et al., 2009). Moreover, physical complaints, such as myalgia, arthralgia, headache, are also a consequence of tiredness (Jason et al., 2002). Consequently, a lot of these consequences require a treatment.

The treatment of tiredness depends on the cause and is intended to result in an improvement in vitality. One possibility to treat tiredness is to treat the disease which causes it as a side effect (Franssen et al., 2003). Some treatments for conditions that cause tiredness include medications, antibiotics, vitamins, and exercise (Thorsteinsson & Brown, 2010). More specifically, Thorsteinsson and Brown (2010) state that psychological treatments can improve the effectiveness in treating tiredness by targeting social support and sleep hygiene. So, successful treatment of the causal diseases and/or the tiredness is intended to result in a decrease in tiredness, which is in turn associated with increase in vitality. Consequently, as tiredness decreases, researchers call that an improvement in vitality, which is the feeling of having energy (Nix, Ryan, Manly, & Deci, 1999). Thus, it is assumed that vitality is the opposite of tiredness.

Vitality is the positive feeling of having energy available to the self (Ryan & Frederick, 1997). According to Ryan and Frederick (1997) subjective vitality is a dynamic state. That means that individuals recognize ongoing changes in the energy they possess. So, individuals vary in their experience of vitality as a function not only of physical influences, for example states of illness and fatigue, but also of psychological factors, for example being in love or being effective (Ryan & Frederick, 1997). Moreover, literature research revealed that the subjective feeling of vitality promotes a better health and well-being (Ryan & Frederick, 1997). More specifically, a high level of vitality is associated with less depressive symptoms and better health (Niemiec, Ryan, Patrick, Deci, & Williams, 2010). According to Niemiec et al. (2010) a high level of vitality even facilitates behavior that promotes healthy lifestyles. This is in line with Nix et al. (1999); they concluded that vitality covaries with both, with physical and psychological well-being.

There seem to be physical, mental and cognitive aspects of vitality. But since there is relatively little research on vitality until today, it is not scientifically confirmed if vitality really has multiple aspects. However, literature research indicates that vitality has, like

tiredness, also several aspects (Nix et al., 1999; Shalev, 2014). According to Nix et al. (1999) individuals recognize ongoing changes in their energy levels, which result in changes in physical and mental energy levels, which are assumed to be the physical and mental aspect of vitality. Moreover, Shalev (2014) states that there is also a cognitive factor in the perceived level of energy in individuals. This is assumed to be the cognitive aspect of vitality. Consequently, it can be assumed, that there are physical, mental and cognitive aspects of vitality. But one problem with these aspects is probably that they are not called physical, mental and cognitive vitality but that we use other words for these aspects. If we or Ryan and Frederick (1997) talk about vitality, mostly the mental aspect is referred to. This limits the true scope of vitality.

It can be assumed that we call physical vitality 'fitness', cognitive vitality 'concentration' and mental vitality 'subjective feeling of energy' or 'well-being'. So, we have probably different words, which don't contain the component "vitality" for the different aspects of vitality. Consequently, it can be assumed that our common word for physical vitality is 'fitness'. Fitness is defined as a state of wellbeing with the energy to participate in a variety of physical activities. Fitness is seen as one of the most important predictors for good health and the prevention of lifestyle-related diseases (El Ghoch, Soave, Calugi, & Dalle Grave 2013). Moreover, our common used word for cognitive vitality could be 'concentration' in the sense of attentional control. To concentrate refers to an individual's capacity to choose what they pay attention to and what they ignore (Astle & Scerif, 2009). And finally, what research on vitality mostly refers to as (subjective) vitality is the mental form of vitality. On this form Ryan and Frederick (1997) mainly focused their research. As stated above, their definition of (mental) vitality is that vitality is the positive feeling of having energy available to the self.

1.2.   Tiredness, vitality and implicit processes

Literature review revealed that tiredness and vitality were assessed in healthy individuals only one-dimensional and explicitly until now. Explicit assessment of tiredness is in the context of this study the knowledge that you deliberately think about and report consciously. Further, literature review revealed two disagreements regarding the aforementioned approach of assessing tiredness and vitality. The first disagreement is that particularly tiredness was seen as a one dimensional construct (Lavidor, Weller, & Babkoff, 2002). This means that only one of the aspects was measured. As mentioned in the first part of the introduction, however, it

can be assumed that tiredness and vitality have more than one aspect, there are particularly physical, mental and cognitive aspects (Gandevia , 2001; Bryant et al., 2004; Marcora et al., 2009). The second disagreement is that tiredness and vitality were assessed explicitly until now (Kahneman, 2003). This raises the question if these states are really exclusively explicit. Nisbett and Wilson (1977), for example, state that individuals only can tell what they know and are willing to tell. But states of both tiredness and vitality are also partially implicit according to Kahneman (2003). This means that tiredness and vitality are partially outside of our conscious awareness and control. Consequently, it can be assumed that assessing and influencing of these two states could be done explicitly and also implicitly.

Individuals process information in two ways - implicit and explicit. Kahneman (2003) states that implicit processes need low effort to be processed, have a large capacity and include perceptions. In contrast, the second system, thus the explicit system, has opposite characteristics. It needs high effort, has a small capacity and includes rules following comparisons and weighing of options consciously. This assumption of two different systems is based on the Dual Process Theory (Evans, 2009). According to the Dual Process Theory a phenomenon results in one of the two processes. The two processes consist of an implicit (automatic), unconscious process and an explicit (controlled), conscious process. Moreover, the explicit system does not permanently stay active, it depletes after a while, wherever the implicit system always stays active (Kahneman, 2003). This indicates that focusing on the implicit processes could have some significant advantages for this study because they are permanent influenceable, need low effort and have a larger capacity and this is relevant for tiredness and vitality since these states are partially implicit (Kahneman, 2003).

Regarding the interrelation between implicit processes and influences on it research demonstrated that our environment influences us implicitly, thus without our consciousness. For example, unconscious environmental aspects influence the experience of depletion (Ryan et al., 2010). So, it is considered that certain conditions in the environment influence the experience of energy without conscious awareness (Ryan et al., 2010). A similar sight on this topic provides embodied cognition research (Barsalou, 2008). Embodied concepts activate associations that influence behavior implicitly indicating that this process of concept activation carries motivational value to approach or avoidance behavior and feelings (Barsalou, 2008). This means that these associations are able to influence us without our consciousness. So, according to the literature there is strong support for the assumption that the environment influences us implicitly. Moreover, there is a great deal of self-regulation, including the regulation of the energy levels, which takes place without our consciousness.

Consequently, since the environment influences us implicitly, it should also be possible to influence individual's states of tiredness and vitality implicitly and intentionally.

Literature research regarding the reason how individuals are influenced implicitly revealed that this might be due to a biased self-concept. Individual's explicit self-concept can be biased (Clarkson, Hirt, Jia, & Alexander, 2010). Back, Schmukle, Egloff and Carver (2009) state that self-concept is a collection of conscious beliefs about one self. However, individuals process information about themselves not only explicit but also implicit. Regarding the perceived energy in individuals, research on ego depletion demonstrated that explicitly available energy can be depleted by a temporary reduction in the willingness to engage in volitional action caused by prior volition. But the perceived energy for other tasks than the volitional action is unaffected by this (Baumeister, 2002). Thus, there is evidence that the explicit perception of our energy level is not always reliable (Clarkson et al., 2010). Kahneman (2003) emphasized, for example, that after an individual's interpretation of depletion of the explicit system, the implicit system still stays active.This means that the explicit self-concept is biased and there is implicitly more energy left than one might explicitly assume. So, the interpreted depletion can impact subsequent task performance and this impact can be independent of one's actual and implicit state of depletion (Clarkson et al, 2010). Therefore, the implicit system, in comparison with the explicit system, has the advantage of giving a more realistic picture of one energy level while the explicit system including the self-concept can be biased.

The biased self-concept might be caused by an attentional bias. An attentional bias is a "form of cognitive bias involving preferential attention to one type of particular information" (MacLeod & Matthews, 2012, p. 191). This means in the case of tiredness that an individual thinks to be tired because of preferential interpreting information from inside and outside the body of being tired, but in fact there is, as stated above, more energy left than this individual assumes. Consequently, to modify the biased self-concept of being tired the attentional bias has to be modified. Attentional bias modification (ABM) is a promising therapeutic tool aimed at patterns of attentional selectivity (Lee & Lee, 2015). More specifically, Lee and Lee (2015) state that it is a training which directs attention away from the preferential attention. Thus, to modify a biased self-concept, which is based on interpretation of incoming information, first an attentional bias, which is based on perception, has to be modified. This means on a more practical level that if an individual perceive information which direct the attention away from being tired and to being vital, this new perceptions enable this individual to interpret this new information and accordingly to change the (biased) self-concept.

There are already promising studies which used ABM. Barkby, Dickson, Roper and Field (2012) used ABM successfully to direct attention away from alcohol-related stimuli. In their study drinkers were exposed to alcohol-related stimuli and non-alcohol related stimuli. The attention in drinkers is more likely to shift, without effort, to alcohol-related stimuli because of attentional bias. To modify this they used the ABM to reduce the attentional bias, thus to direct attention to non-alcoholic related stimuli. In line with this, for the purpose of this study this means that a training which directs the attention away from tiredness respectively vitality is needed to reach an attentional bias modification for these states.

One possible solution to modify the attentional bias is the IAT (implicit association test). This method was developed 1998 by Greenwald, McGhee and Schwartz. The IAT is a test which can measure the intensity between two opposite criteria implicitly (Glashouwer, Smulders, de Jong, Roefs, & Wiers, 2013). The underlying assumption for the IAT is that it is easier for participants to classify stimuli that are related or associated in memory and that it is more difficult for participants to classify unrelated or not associated stimuli. More difficult classification decisions should result in longer reaction times, whereas more easy classifications should result in lower response times (Grumm, Erbe, von Collani, & Nestler, 2008). More specifically, for this study a modified version of the IAT, which is called self-concept IAT, is used (Greenwald, Farnham & Diener, 2000). Thereby the tiredness- and vitality-related stimuli have to be classified with "self" and "other" items in order to modify the attentional bias. This approach of using an IAT for ABM is relatively new. Due to more knowledge about implicit processes and IAT's, it became more practical to use IAT's not only to measure implicit associations but also to modify the relation between certain associations implicitly.

Since this study intends to modify implicit associations, the IAT is used to direct the attention implicitly away from tiredness and direct it implicitly to vitality, or vice versa. For this purpose a self-concept IAT, which is called ABM-IAT in this study, is used. This means that dependent on the condition, either tiredness or vitality items are shown with "self" or "other" items together in order to modify the implicit perception of one's tiredness or vitality which is intended to result in an ABM and consequently in a modification of the self-concept. And there are already some promising results which indicate that modifying implicit processes in order to modify an attentional bias is effective. For example, Wiers, Rinck, Kordts, Houben and Strack (2010) influenced implicit processes already successfully in modifying alcohol related associations in hazardous drinkers. Moreover, Haynes, Kemps and Moffitt (2015) used a self-concept IAT to change food evaluations implicitly. They concluded

that an IAT intervention which retrains implicit food evaluations could be effective at reducing unhealthy eating. So, since this kind of attentional bias modification was never done with tiredness and vitality, it seems to be a promising way to work in line with the aforementioned authors in order to modify tiredness and vitality implicitly.

The validity of IAT's to measure and modify automatic associations is supported by several researchers (Banse, Seise, & Zerbes, 2001; Gawronski, 2002). However, although there is a quite clear picture of the relationship between implicit and explicit processes in general, there is still lack of clarity about the consistency of measurement of these two processes. On the one hand there are researchers like Grumm, Hein and Fingerle (2011) who found a positive correlation between implicit and explicit measures of aggression. Contrary to this, Klavina, Schröder-Abé, & Schütz (2012) found for the most facets of self-esteem no correlation between implicit and explicit measures. It follows from this that more research is needed to achieve more knowledge on this topic.

1.3.   Research questions and hypotheses

The rationale of the present study is to evaluate the effectiveness of the self-concept IAT in attentional bias modification regarding the feelings of tiredness and vitality in healthy individuals. Basically, the method includes a phase approach. In the first phase word associations in healthy individuals with the feeling of tiredness respectively vitality are assessed and furthermore clarified what these two constructs mean for healthy individuals. This has to be done because there is no research on word associations with the feeling of tiredness and vitality of healthy individuals. Until now this was only done with CFS patients or other diseases which are associated with strong tiredness. Consequently, if this study wants to influence healthy individuals implicitly, the associations of healthy individuals have to be assessed beforehand. With these associations, in the second phase, a modified self-concept IAT (ABM-IAT) is developed to implicitly modify an attentional bias in healthy individuals regarding the feelings of tiredness and vitality. Literature research revealed that everyone has an attentional bias (Bradley, Mogg, Millar, Bonham-Carter, Fergusson, Jenkins, & Parr, 1997). So, it can be assumed that also healthy individuals have an attentional bias regarding tiredness and vitality, which is tried to be modified implicitly in this study. A detailed description of the study approaches of the two phases are presented in chapter 2. for the first phase and in chapter 6. for the second phase of this report.

Consequently, regarding the preliminary study, the following research questions are examined:

1. Which word associations with the feeling of tiredness are suitable to use in a modified self- concept IAT in a sample of healthy individuals?
2. Which word associations with the feeling of vitality are suitable to use in a modified self- concept IAT in a sample of healthy individuals?

Further, regarding the second phase respectively the main study, the following hypotheses are predicted:

1. It is predicted that healthy participants feel implicitly more tired respectively vital after the ABM-IAT.
2. It is predicted that healthy individuals feel explicitly more tired respectively vital after the ABM-IAT.
3. It is predicted that there are differential effects of the ABM-IAT depending on baseline tiredness respectively vitality.

2. Study approach preliminary study

A fact which supports the necessity if this preliminary study is shown by literature review. It showed that questionnaires to measure fatigue, like the "Checklist for Individual Strength (CIS)" (Vercoulen, Swanink, Fennis, Galama, Van der Meer, & Bleijenberg, 1994), were made with individuals who have CFS. So, taking over words from these questionnaires, thus words which humans with CFS associate with fatigue and vitality, would probably not meet the associations of healthy individuals who have a normal level of tiredness. Because there is no research regarding the associations with tiredness and vitality of healthy individuals, this preliminary study had to be done to find out what these individuals associate with tiredness and vitality.

Moreover, regarding the preliminary study there were two possibilities to find words which healthy individuals associate with of tiredness and vitality. The first possibility was to ask these individuals for activities they associate with tiredness and vitality. The second possibility is to ask these individuals for associations they have if they think about the feeling of tiredness and vitality. In the following sections a short literature review on these two possibilities is presented.

Literature research showed regarding the first possibility that associations of the activities for becoming tired or vital are not suitable for this research. The main reason is the ambiguity of words. Rodd, Gaskell, & Marslen-Wilson (2002) state for example that over 80% of common English words have more than one dictionary definition. Consequently, reasons for becoming tired or vital could have ambiguous meanings for different individuals. One reason for this is that the evaluation of the given reasons for becoming tired or vital would depend a lot on the experiences of the participants (Rodd et al., 2002). For example reading a book is an ambiguous reason because, dependent on the experiences and characteristics of an individual, one individual could become tired from reading a book and another individual could become more vital as a consequence of new inspirations.

Regarding the second possibility the literature shows that a more suitable way to find out what individuals associate with certain concepts is to use the free association task (Schnabel & Asendorpf, 2013). There is a long history of using word associations in psychology which was started by Siegmund Freud (Schnabel & Asendorpf, 2013). Word associations are built in the semantic memory. The semantic memory is responsible for the brain's ability to memorize the meaning of words and concepts and also their mental representation, including their properties and functions and the relation to each other. So, one possible tool to study semantic memory is the free association task (Ludueña, Behzad, & Gros, 2014). The free association task is based on the assumption that asking participants what spontaneously comes to their minds when they are probed with a certain stimulus would give relatively unrestricted access to the participant's mental representations of this stimulus (Sester, Dacremont, Deroy, & Valentin, 2013).

So, it is assumed that associations regarding the feeling towards the cue words are suitable to measure unrestricted mental representations. This is also supported by Schnabel and Asendorpf (2013). They emphasize that " within one of the most comprehensive research projects on free association techniques, Szalay and Deese (1978) explored the stability of word associations to various stimuli and found that the percentage of recurrence of associations to a given stimulus was usually about 32%. Probability of recurrence was higher for words that were generated in the first position (61%) than for words that were generated in the 11th position (13%) of association tasks. A recurrence probability of 61% for the first association is relatively high considering the open-response format of free association tasks." (p. 39). Consequently, to find words which healthy individuals associate with the feeling of tiredness and vitality the second possibility, the free association task towards the feeling of being tired and vital, is used.

3. Method preliminary study

3.1.   Participants preliminary study

For the preliminary study in total 50 participants filled in the questionnaire. Four participants were excluded because of exclusionary diseases (1x cancer, 2x COPD, 1x CFS). The exclusion criteria for the preliminary study were as follows: CFS (Chronical Fatigue syndrome), cancer, COPD, arthritis or other diseases which are strongly associated with tiredness; younger than 18 years and/or not capable of a sensible judgement of their own interest in this matter; no internet access; not able to read, speak and write in German. Consequently, 46 participants were allowed to participate (33 women and 13 men). Two of these 46 participants registered other than the mentioned exclusionary diseases which could cause tiredness. One participant registered Ferritin deficiency and Hashimoto's thyroiditis. And the other participant registered several allergies. The age of the respondents varied from 21 to 65. The mean age of the population is 32 years. Table 1 presents the demographic characteristics of the participants.

Table 1.
Demographic characteristics of the participants in the preliminary study

Sex, n (%)	
Women	33 (72)
Men	13 (28)
Age	
M in years (SD), range	32 (12), 21-65
School education, n (%) [+]	
No/low	1 (2)
Middle	14 (28)
High	31 (62)
Professional education, n (%) [++]	
No	3 (6)
Middle	28 (56)
High	14 (28)
Unknown	1 (2)
Average sleep duration	
M in hours (SD), range	7.4 (1.02), 4-10
Actual tiredness [+++]	
M (SD), range	5.6 (2.2), 1-10
Actual vitality [++++]	
M (SD), range	4.6 (2.3), 1-9

Note. n = number of individuals; *M* = mean; *SD* = standard deviation.
[+]No/low school education: Volks- and Hauptschule; middle school education: Mittlere Reife, Realschulabschluss; high school education: Fachabitur, Abitur.
[++] No professional education; middle professional education: Berufsausbildung; high professional education: Bachelor, Master, Magister, Staatsexamen; unknown professional education.
[+++] from 1(not tired)-10 (very tired).
[++++] from 1(not vital)-10 (very vital).

3.2.   Procedure preliminary study

A German online survey was set up with the software "qualtrics". The study protocol was approved by the ethical commission of the University of Twente. The participants were required via the private network of the researcher. The link of the online survey was spread out on 5th of April 2016 and the end of the online survey was scheduled on 13th of April 2016. In the preliminary study all participants had to follow the same procedure. Completing the task took 15-20 minutes. The global topic of this research was outlined at the beginning of the survey. Respondents agreed to the informed consent form assuming that all data will be processed in an anonymous manner and will not be made accessible to third parties by agreeing to continue the participation. Participation was voluntary and respondents could stop the survey at any time. So, after agreeing with the informed consent, the participants filled in the questions which assess the demographic data (age, sex, education level, chronic diseases). Participants which had one or more of the mentioned chronic diseases were excluded. Furthermore there was a possibility to fill in other diseases than the mentioned by the researcher which are associated with strong tiredness. So, for participants who filled in other diseases the decision if their answers are included was done afterwards. After the demographic data was completed the first free association question, that is: "Which words do you associate with the feeling of tiredness? Name only one word! ", was asked. The second free association question is in line with the first one but has the opposite topic, namely: "Which words do you associate with the feeling of vitality? Name only one word!" For each free association question the participants were asked a maximum of 5 associations with each of the two cue words. It was not mandatory to fill in all 5 spaces of the free association task. After they named up to 5 words per cue word these were shown again and the participants were asked to describe in 2-3 sentences which personal meaning the mentioned word regarding the cue word has for them. After completing these tasks the participants were asked to fill in their average sleep duration and how tired and vital they are at that moment. The whole questionnaire with all questions can be found in appendix A. After completing the survey, the researchers mailing address was provided for further questions about the content and results of the study.

3.3.   Materials preliminary study

An overview of all questions regarding demographic data, association with tiredness and vitality can be found in appendix A: Questionnaire preliminary study).

3.4.   Analysis preliminary study

All qualitative variables were screened for outliers and violations of normality. After this screening 20 words were deleted. The most deleted words were reasons for becoming tired or vital (e. g. lack of sleep or summer time) and not associations with the feelings of being tired or vital. After that the answers to the main questions regarding words which the participant associates with the feeling of tiredness respectively vitality and the meaning to the participants were analyzed for every participant apart. Thereby the mentioned words were on the first level coded into the two categories – either tiredness or vitality. After that these words were coded on the second level into three aspects of tiredness/vitality – physical, cognitive and mental tiredness/vitality. This coding was based on top-down development of codes. Consequently, the meaning for every word association was given by the participant and the word associations were assigned dependent on this meaning to one of the three aspects of tiredness/vitality by the researcher. The reason for dividing the answers into these aspects was to find for every supposed aspect of tiredness and vitality (as mentioned in the introduction) the most mentioned words which the participants associate with the two cue words. Moreover, this study is conducted in order to improve the understanding of these constructs, particularly for vitality, because little research is done in this context. Multiple counting for one given word was also possible if the participant's given meaning was clearly related to more than one aspect (e. g. physical and cognitive meaning). Moreover, if the given meaning of the participant was not clearly belonging to one of the three aspects, the researcher decided which category of aspects seems to be the most likely meant by the participant dependent on the given indefinite meaning. If the same word with the same meaning was given more than once by different participants, the frequency of election was written down and increased with every additional election (e. g. exhaustion (3)). After analyzing all answers the given answers for all aspects were determined. The analysis was done by one researcher and Microsoft Office Word was used for this analysis. Moreover, for reading convenience, the German expressions were presented with an English translation.

For the analysis of the quantitative data SPSS version 23 was used. The means, standard deviations and ranges were determined and represented in table 2. Moreover, the distribution of the aspects for tiredness and for vitality was determined and presented in figure 1 respectively figure 2. In the last step the correlation between the number of elected words, actual tiredness and vitality and average sleep duration was calculated. The correlation matrix is presented in table 4.

4. Results preliminary study

4.1. Word associations with the feeling of tiredness

A total of 72 different words were mentioned when participants were asked to write down five words they associate with the feeling of tiredness. The majority of these given meaning of these words (n=36) was related to physical tiredness, such as exhaustion, feeling floppy or being listlessness. The least mentioned meanings of word associations were related to mental tiredness (n=16). For mental tiredness, listlessness and exhaustion were like for physical tiredness also the most given word associations with tiredness. Regarding cognitive tiredness 20 different word associations were given and particularly having problems with concentrating and being listlessness was mentioned. The given answers for the associations with the feeling of tiredness are presented for every aspect in table 2. For reading convenience, the German expressions were presented with an English translation.

Table 2.
Associations with the feeling of tiredness per aspect in German and English with number of elections

Physical		Cognitive		Mental	
German	**English**	**German**	**English**	**German (n)**	**English**
Erschöpfung (16) *	Exhaustion (16)	Konzentrationsprobleme/ Konzentrationsschwierigkeiten /Unkonzentriert//Fehlende Konzentration; deficiency in concentration (16) *	Deficiency in concentration (16)	Lustlosigkeit (5) *	Listlessness (5)
Schlapp (fühlen/sein) (13) *	Feeling floppy (13)	Lustlosigkeit (6) *	Listlessness (6)	Erschöpfung (4) *	Exhaustion (4)
Lustlos(igkeit)/Unlust (10) *	Listlessness (10)	Trägheit (6) *	Sluggishness (6)	Abgeschlagenheit/ Niedergeschlagenheit (3) *	Lassitude (3)
Träge/Trägheit (8) *	Slugishness (8)	Erschöpfung (3) *	Exhaustion (3)	Unentspannt/angespannt/ abgespannt (3)	Enervation (3)
Gähnen (7)	Yawning (7)	Unmotiviert/Motivationslos (3)	Being unmotivated (3)	Antriebslosigkeit (2) *	Lack of drive (2)
Energielos (5) *	Being without energy (5)	Trance (3)	State of trance (3)	Kraftlos (2) *	Powerless (2)
Antriebslosigkeit drive (5)	Lack of drive (5)	Antriebslosigkeit (2)	Lack of drive (2)	Schwach/Schwäche (1)	Weakness (1)
Kraftlos(igkeit) (4)	Powerless (4)	Schlapp (2) *	Being floppy (2)	Unzufriedenheit (1)	Dissatisfactiont (1)
schläfrig sein (4)	Peing sleepy (4)	Langsam (2)	Being slowly (2)	Schlapp (1) *	Being floppy (1)
Trockene/brennende/schwere Augen (4)	Dry/burning/severe eyes (4)	Schläfrig sein (1)	Being sleepy (1)	Ausgelaugt (1)	Leached out (1)
Ausgelaugt (3)	Leached out (3)	Abgeschlagenheit (1)	Lassitude (1)	Überforderung (1)	Overburdening (1)
Kaputt sein (3)	To be on the blink (3)	Mattigkeit (1)	Oscitancy (1)	Reizbarkeit (1)	Irritability (1)
Schweregefühl/Bettschwere (3)	Feeling heavy(3)	Schlechtes Auffassungsvermögen (1)	Bad apprehension (1)	Aggressivität	Aggressiveness (1)
Matt fühlen/Mattigkeit (3)	Oscitancy (3)	Energielos (1) *	No energy available (1)	Mürrisch	Grumpy (1)
Unwohlsein (2)	Indisposition (2)	Anstrengend (1)	Strenous (1)	Kräfteraubend	Energy sapping (1)
Langsam (2)	Being slowly (2)	Desinteresse (1)	Disinterest (1)	Traurigkeit	Sadness (1)
Abgeschlagenheit (2)	Lassitude (2)	verlangsamtes Denken (1)	Slow thinking processes (1)		
Kältegefühl (2)	Sensation of cold (2)	Geschafft sein (1)	Being done (1)		
Antriebsarmut (2)	Poor drive (2)	Schwindel=wattiger Kopf (1)	Dizziness (1)		
„groggi" (1)	Groggy (1)	Erholungsbedürftig (1)	In need of rest (1)		
Schwere Beine (1)	Heavy legs (1)				
Bewegungsarm (1)	To move hardly (1)				
Ausgepowert sein (1)	Impoverish (1)				
Faulheit (1)	Lazyness (1)				
Schwindel=wattiger Kopf (1)	Dizziness (1)				
Benommenheit (1)	Benommenheit; daze feeling (1)				
K. O. (1)	Knockout (1)				
Kräfteraubend (1)	Energy sapping (1)				
Erholungsbedürftig (1)	In need of rest (1)				
Appetitlosigkeit (1)	Loss of appetite (1)				
Geschafft sein (1)	Being done (1)				
Erschlagenheit (1)	Feel slain (1)				
Anstrengend (1)	Strenous (1)				
Verlangen nach Schlaf (1)	Demand for sleep (1)				
Gefahr (1)	Danger (1)				
Verspannungen (1)	Having tenseness (1)				

*These words were used for the ABM-IAT.

Table 2 shows that physical tiredness was mostly associated with 'exhaustion'. 16 of 46 participants named exhaustion as an association. An example of the meaning of physical exhaustion is illustrated in the following quote:

"It is a feeling of a lassitude in your body and only wanting to sleep. […]" (Respondent 32)

Next to 'exhaustion', 'feeling floppy' was mentioned very often. 'Feeling floppy' was elected by 13 of 46 participants as an association of feeling tired in a physical way.

„The body has no power to do something. You just want to sit or lie." (Respondent 11)

Table 2 shows moreover that regarding cognitive tiredness the most associated word with feeling cognitively tired was 'having problems with concentrating' or similar constructs with the same meaning, like having a 'poor concentration'. This was mentioned by 16 of the 46 participants.

"One is not able to concentrate for a long time. The thoughts digress." (Respondent 43)

Another often mentioned word association which belongs to the cognitive aspect of tiredness is 'being listlessness', which was elected by 6 of 46 participants. An example of the meaning of this cognitive listlessness is illustrated in the following quote:

"It is easy to distract me. My thoughts digress." (Respondent 17)

Table 2 shows furthermore that tiredness is associated with words which belong to the mental aspect of tiredness, which was the least chosen aspect for tiredness. The most often mentioned word here is the mental form of 'listlessness', which was elected by 5 participants, like illustrated in the following quote:

"Things I've done with joy are difficult to start for me" (Respondent 24)

Furthermore, the most chosen combination of aspects consisted of the physical and cognitive aspect for tiredness. Words which belonged to both aspects were also assigned to both

aspects. The following quote is an example of meaning for 'listlessness' which clearly belongs to the physical and cognitive aspect:

"It is the feeling of not wanting to strain either physically nor cognitively and instead to rest and to let the time simply go by." (Respondent 6)

A relatively rarely given combination of aspects was physical and mental tiredness. An example which illustrates such a rare combination for 'lack of drive' is the following quote where the first part belongs to the physical aspect of 'lack of drive' and the latter part to the mental aspect:

"Not able to get out of the bed. Not able to be enthusiastic about something" (Respondent 31)

However, for word associations with the feeling of tiredness the combination of cognitive and mental aspect was not found. But besides the clear assignable combinations or to two aspects assignable word associations there were also word associations with the feeling of tiredness which were difficult to assign to the three aspects. In these cases the researcher decided dependent on the given meaning which aspect(s) are most likely to be meant by the participant. The following quote illustrates such an example for 'sluggishness', which was assigned to all three aspects, thus, to the physical, cognitive and mental aspect:

"I do not feel like starting something new. My tasks are hard for me." (Respondent 16)

Regarding the distribution of aspects of the associations with the feeling of tiredness the data showed that the majority, 25 participants (54%), elected words which belong to two aspects of tiredness. More specifically, for the associations with tiredness the most elected combination of associations belongs to physical and cognitive tiredness. 12 participants (26%) elected associations from all three aspects regarding the feeling of tiredness. Moreover, the data showed that only eight participants (17%) elected associations with the feeling of tiredness from only one aspect. Here, the most elected aspect belonged to physical tiredness. An overview of the distribution of aspects of the elected association regarding the feeling of tiredness is shown in Figure 1 underneath.
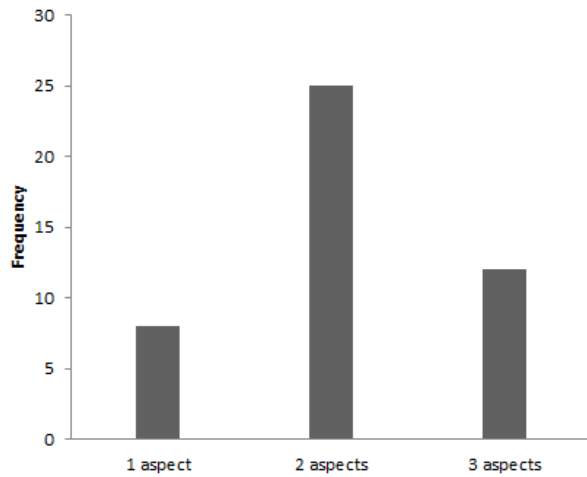
Figure 1.
Distribution of aspects of associations with the feeling of tiredness

4.2. Word associations with the feeling of vitality

For vitality a total of 77 different word associations were mentioned when participants were asked to write down five words they associate with the feeling of vitality. Like for associations with the feeling of tiredness, the majority of the meanings of the word associations (n=36) was related to physical vitality, e. g. feeling energetic, being healthy or feeling fit. Unlike for tiredness, the second most salient word associations were related to mental vitality with 23 different word associations. Here, the most elected associations were love of life, joy and happiness. The least mentioned word associations were related to cognitive vitality (n=18). Regarding cognitive vitality particularly being energetic, motivated and concentrated were mentioned. The answers for the associations with the feeling of vitality are presented for every aspect in table 3. For reading convenience, the German expressions were presented with an English translation.

Table 3.

Associations with the feeling of vitality per aspect in German and English with number of elections

Physical		Cognitive		Mental	
German	**English**	**German**	**English**	**German**	**English**
Energiegeladen/Energie/energievoll (19) *	Energy/energetic (19)	Energie(-voll)/energiegeladen (10) *	Energy/energetic (10)	Lebenslust/Lebensfreude/Lebenskraft (14) *	Love of life/joy of life/life energy (14)
Gesundheit (15) *	Health (15)	Motivation/motiviert (8) *	Motivation/motivated (8)	Freude (8) *	Joy (8)
Fit (9) *	Fit (9)	Konzentration/konzentriert (4)	Concentration/concentrated (4)	Glücklich (4)	Happy (4)
Sportlich (7) *	Sporty (7)	Leistungsstark/leistungsfähig (3)	High-performance/ highly productive (3)	(Geistige) Gesundheit (4) *	(Mental) health (4)
Aktiv/Aktivität (6) *	Active/activity (6)	Tatendrang (2)	Thirst for action (2)	Energie/energiegeladen (4) *	Energy/energetic (4)
Kraft/kraftvoll/kräftig (6)	Power/powerfull/strong (6)	Lustvoll/(Unternehmungs-)Lust haben (2)	Feel like doing something (2)	Fit (3) *	Fit (3)
Unternehmungslustig/-freudig (5)	Adventuresome (5)	Aufmerksam (2)	Attentive (2)	Fröhlichkeit (3)	Cheerfulness (3)
Wach (5)	Alert (5)	Aktivität/aktiv (2) *	Activity/active (2)	Lebendigkeit (3)	Liveliness (3)
Power (4)	Power (4)	Schnell (2)	Fast (2)	Zufriedenheit (2)	Satisfaction (2)
Tatendrang (3)	Thirst for action (3)	Wach (2)	Alert (2)	Munter (2)	Blithely (2)
Spritzigkeit (3)	Liveliness (3)	Power (2)	Power (2)	Stärke (2)	Strength (2)
Beweglich (2)	Being moveable (2)	Bereit fühlen/sein (1)	In readiness (1)	Ausgeglichenheit (2)	Balance (2)
Lust (2)	Zestfulness (2)	Lebhaftigkeit (1)	Liveliness (1)	Ausgelassenheit (1)	Jollity (1)
Antrieb (-skraft) (2)	Driving force (2)	Stark/Stärke (1)	Strong/strength (1)	Frieden (1)	Peace (1)
Sexuelle Lust (1)	Sexual desire (1)	Kreativität (1)	Creativity (1)	Lebensqualität (1)	Quality of life (1)
Drahtig (1)	Wirily (1)	Interessiert (1)	Being interested (1)	Optimismus (1)	Optimism (1)
Dynamik (1)	Dynamic (1)	Fit (1) *	Fit (1)	Freiheit (1)	Freedom (1)
Lebendigkeit (1)	Liveliness (1)	Geistig voll da (1)	To be of sound mind and disposing memory (1)	Aktiv (1) *	Active (1)
Lust auf Sport (1)	Desire for sports (1)			Lust haben (1)	Feel like doing something (1)
Schnell (1)	Fast (1)			Euphorisch (1)	Euphoric (1)
Stark/Stärke (1)	Strong/strength (1)			Wohlbefinden (1)	Well-being (1)
Motiviert (1) *	Motivated (1)			Glückseligkeit (1)	Felicity (1)
Bereit fühlen/sein (1)				Kraft (1)	Strength (1)
Ausgeruht (1)	In readiness (1)				
Leichtigkeit (1)	Lightness (1)				
Körperliche Fitness (1)	Fitness (1)				
Schwung(-voll) (1)	momentum (1)				
Kraftprotz (1)	Muscle man (1)				
Drang nach (körperl.) Aktivität (1)	Drive for bodily activity (1)				
Energiebündel (1)	Life wire (1)				
Leistungsstark/ -fähig (1)	High-performance/ highly productive (1)				
Aufmerksam (1)	Attentive (1)				
Agil (1)	Agile (1)				
Lebhaftigkeit (1)	Liveliness (1)				
Frisch (1)	Being fresh (1)				
Entspannt (1)	Being relaxed (1)				

*These words were used for the ABM-IAT.

Table 3 shows that like for tiredness for vitality the most chosen aspect was physical vitality. Here, the most elected word association was 'energy' respectively 'being energetic'. 19 of 46 participants elected this association. An example of the meaning of physical energy is illustrated in the following quote:

"With energy I move faster." (Respondent 39)

Moreover, 'feeling healthy' was elected by 15 of 46 participants as a word association of feeling vital in a physical way. The following quote gives an illustration of a meaning for physical health:

„You have no pain or other complaints " (Respondent 4)

Table 3 shows moreover that the second most frequent elected aspect of vitality was mental vitality. For this aspect the most associated word with feeling mentally vital was 'love/joy of life' or similar constructs with the same meaning like 'life energy'. This was mentioned by 14 of the 46 participants. An example for love/joy of life is this:

"You enjoy life and are satisfied with the circumstances of your life." (Respondent 29)

The second most often mentioned word association which belongs to the mental aspect of vitality is 'joy', which was elected by 8 of the 46 participants. An example of the meaning of the mental form of 'joy' is illustrated in the following quote:

"Joy means for me that you have fun doing something. One feels fine and loves it to start something new. " (Respondent 28)

Furthermore, table 3 shows that the least elected aspect for vitality was the cognitive aspect. The most often mentioned word association here is, like for physical vitality, the cognitive form of 'energy' or 'being energetic'. This association was elected by 10 participants but in every case in combination with the physical form of being energetic, like illustrated in the following quote:

"The body is well rested, fit and healthy. The head is awake, it is easy to think" (Respondent 27)

The second most often elected word association in the cognitive aspect was 'motivation' respectively 'being motivated'. This association was elected by 8 of 46 participants. Here is an example which illustrates this:

"To be motivated to complete daily tasks but also to start new challenges" (Respondent 6)

Furthermore, although the most elected aspect for vitality was the mental aspect, the most chosen combination of aspects consisted of the physical and cognitive aspect of vitality. Words where the meaning belonged to two aspects were also assigned in both aspects. The following quote is an example of the meaning for 'being fast', which clearly belongs to the physical and cognitive aspect. The first part of the second sentence illustrates a cognitive task of making decisions and the latter part of this sentence illustrates a physical transformation of plans:

"With the sense of vitality all things are faster and easier. I make faster decisions and transform them into practice" (Respondent 25)

A relatively rarely given combination of aspects for vitality was physical and mental vitality. An example which illustrates this rare combination for 'being fit' is the following quote where the first sentence belongs to the physical aspect of being fit and the latter two sentences to the mental aspect:

"Feeling physically well. Being in a good mood. Mental well-being." (Respondent 32)

For word associations with the feeling of vitality the combination of cognitive and mental aspects was only one time given. The following quote illustrates this answer where the first part belongs to mental vitality and the second part to cognitive vitality for 'joy of life':

"Joy of life, motivation and energy are to my opinion a definition of vitality." (Respondent 24)

Besides the assignable combinations of to one or two aspects assignable word associations there were for vitality also word associations which were difficult to assign to one or two of the aspects. The following quote illustrates such an example for 'strength', which was assigned to all three aspects, thus, to the physical, cognitive and mental aspects of vitality because the given meaning can be interpreted in all three ways:

"One feels like he or she can do everything. Unsolvable tasks don't exist." (Respondent 14)

The distribution of aspects of the associations with the feeling of vitality shows that the majority, 22 participants (48%), elected word associations which belonged to all three aspects of vitality. Two of the three aspects of vitality were elected by 21 participants (46%). The most chosen combination of aspects was physical and cognitive vitality. Moreover, the data showed that only three participants (7%) elected associations with the feeling of vitality from one aspect, mostly mental vitality. Overall, these data demonstrates that the concept of vitality of healthy individuals consists of three aspects. The overview of the distribution of the aspects for vitality is shown in Figure 2 underneath.

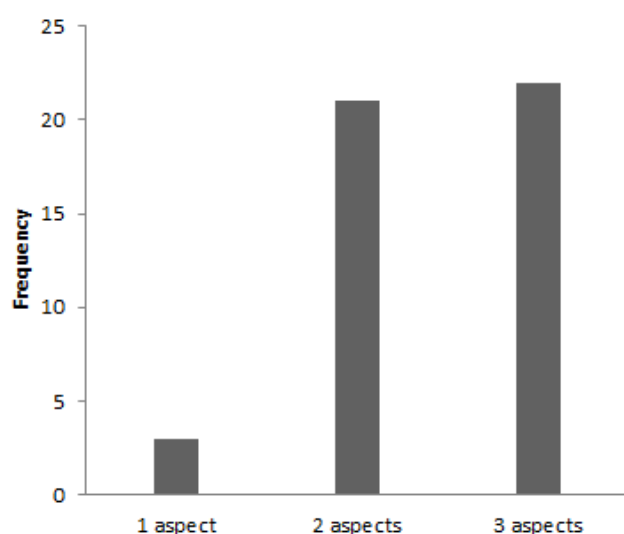Figure 2.
Distribution of aspects of associations with the feeling of vitality

4.3. Quantitative results for the word associations with the feeling of tiredness and vitality

Further analyses of the number of given aspects, average sleep duration and current tiredness and vitality during participation revealed the following results, which are also presented in

table 4 underneath. The data revealed that regarding the number of elected aspects there is a significant correlation between the number of elected aspects for tiredness and vitality. This picture is consistent with the distribution of aspects, where for tiredness and for vitality the most participants elected words from two or three aspects (see also Figure 1. and 2.). Moreover, this analysis revealed that there was strong correlation between the current tiredness and vitality of the participants. This seems to be the case because most participants selected a current tiredness or vitality of around 5 from a scale from 0 to 10 and all other current tiredness and vitality levels were less common chosen. All remaining results, especially the sleep duration, were not significantly correlated.

Table 4.
Correlation matrix number of aspects, average sleeps duration and current tiredness and vitality

	Variable	1	2	3	4	5
1	Number of aspects tiredness	-				
2	Number of aspects vitality	,305[*]				
3	Average sleep duration	,198	-,059			
4	Current tiredness	,179	-,020	,062		
5	Current vitality	-,054	,028	,073	-,851[**]	-

N between 41 and 46.

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Further analysis of the strong correlation between current tiredness and vitality in the participants revealed that the most participants' (n=19) sum of current tiredness and vitality was 10. As there was the possibility to indicate the current tiredness and vitality on a scale from 0 to 10, this sum means that for the majority of the participants (46%) tiredness and vitality are related. So, increasing tiredness means for them simultaneously a decrease in vitality. Consequently, these two states seem to be multidimensional for healthy individuals. The results are presented in table 5 underneath.

Table 5.
Sum of current tiredness and vitality

Sum of current tiredness and vitality	Frequency of selection	%
9	7	17.1
10	19	46.3
11	11	26.8
12	2	4.9
14	1	2.4
15	1	2.4

5. Discussion preliminary study

A central concern of the primary study was to investigate which words healthy individuals associate with the feeling of tiredness and vitality in order to use these words for an ABM-IAT. For this purpose a word association online survey with 46 participants was conducted. A total of 72 different word associations for tiredness and 77 word associations for vitality were found.

More specifically, for tiredness the most frequently elected word association in the physical aspect, which was the most elected aspect, were 'exhaustion,' feeling floppy' and 'listlessness'. In the mental aspect, which was least elected for tiredness, the most elected words were similar to the physical aspect, except that the given meaning had a mental content. Here, the most elected word association were 'listlessness', 'exhaustion' and 'lassitude'. And for the last aspect, the cognitive aspect, the most elected word association were 'deficiency in concentration', 'listlessness' and 'sluggishness'.

The results for vitality could also be clearly categorized to one of the three aspects. The most elected aspect was physical vitality. Here, the most elected word associations were 'being energetic', 'health' and 'fitness'. The second most often elected aspect for vitality was mental vitality with 'love/joy of life/life force', 'joy' and 'happiness' at the top. In the last aspect, cognitive vitality, the most chosen word association were 'being energetic' (in a cognitive way), 'motivation' and 'concentration'.

This study reveals further support for the hypothesis that tiredness and vitality both have multiple aspects. As hypothesized in the introduction, this study confirmed that tiredness and vitality both can be seen as having physical, cognitive and mental aspects (Gandevia, 2001; Bryant et al., 2004; Marcora et al., 2009). Particularly for the concept of tiredness it was already assumed that there are physical, cognitive and mental aspects of tiredness (Gandevia , 2001; Bryant et al., 2004). This was confirmed by this study. However, little was known about the concept of vitality. The most research about vitality was done by Ryan and Frederick (1997). But the results of this study contradict Ryan and Frederick's concept of subjective vitality partly. Because this study confirms for vitality that the elected word associations could be categorized to the three aspects, it is an indicator for the existence of these three aspects for vitality. Consequently, it follows from this research that vitality is more than that what Ryan and Frederick (1997) refer to. Ryan and Frederick (1997) seem, according to the compartment of the results of this study, to refer to the mental aspect of vitality and omit the physical and cognitive aspects of vitality. Collectively, these results

yielded evidence for the assumption that healthy individuals hold a concept of tiredness and vitality which consists of several aspects on an individual level.

Moreover, this study supports the hypothesis that tiredness and vitality are multidimensional for healthy individuals. Firstly, this study found, as stated above, word association for all three aspects for both, tiredness and vitality. This indicates that tiredness and vitality have the same threefold structure. Secondly, for the majority of the participants in this study tiredness and vitality lay on one dimension because the majority of the participants had a sum of current tiredness and vitality which matches the maximum for each state apart. Consequently, increasing tiredness means for the most participants simultaneously a decrease in vitality. This result is thus a support for the hypothesis that tiredness and vitality are multidimensional for healthy individuals.

The results of the preliminary study were for the greatest part in line with the used words in common questionnaires for tiredness/fatigue and vitality. For this purpose the word associations of healthy individuals in this study were compared with four different fatigue and vitality questionnaires, which were developed for unhealthy people. More specifically, it was searched for the given word associations and the meanings of these word associations in the items of the four questionnaires. The first questionnaire is the Checklist for Individual Strength (CIS) developed by Vercoulen et al.,(1994). The CIS quantifies subjective fatigue and related behavioural aspects in CFS patients. The majority of the 20 cue words which occur in the statement of the CIS were also given by the healthy participants of this study with only a few exceptions. Consequently, the conclusion of this comparison is that the found word associations regarding tiredness and vitality cover the great majority of the cue words in the statement of the CIS, which is developed for CFS patients. This indicates that the exact word association regarding tiredness and vitality of healthy individuals and CFS patients seem to be similar. This was also emphasized by Hewlett, Dures and Almeida (2011).

Furthermore, the results of this study are also for a great part in line with the FACIT-F questionnaire. The FACIT-F is developed to measure fatigue in oncology patients (Yellen, Cella, Webster, Blendowski, & Kaplan, 1997). The majority of the cue words of the 13 items of the FACIT-F was also elected in this study. In this comparison it was more obvious that not the exact cue word was elected as an association by healthy individuals rather that the given meaning of healthy individuals contained these words. For example, the content of the item "I am too tired to eat" from the FACIT-F was in this study also in a similar way given as a meaning of the association regarding the feeling of tiredness, not as the exact word association. Therefore, it seems that healthy individuals and oncology patients have the same

associations regarding tiredness and vitality. But this study revealed also that healthy individuals partly elect somewhat different words for the associations than oncology patients, which though have the same meaning.

The BRAF-MDQ questionnaire covers particularly the meaning of associations in healthy individuals. The third questionnaire which was compared with the results of this study was the BRAF-MDQ (Nicklin, Kirwan, Cramp, Urban, & Hewlett, 2009). The BRAD-MDQ was developed to assess the experience and impact of rheumatoid arthritis (RA) fatigue. Like in the comparison of the FACIT-F, for the BRAF-MDQ it appeared that the most part of the statement contains the elected word associations of healthy individuals in this study. The most statements cover particularly the given meaning of the healthy individuals in this study. However, there was one statement in the BRAF-MDQ regarding being embarrassed because of fatigue, which was not covered by the word associations or meanings of healthy individuals. This could be an indication for the stronger experience of tiredness in unhealthy individuals. But overall, the RA patients seem also to have very similar associations regarding tiredness and vitality. Consequently, it is concluded that healthy individuals partly elect somewhat different words for the associations than RA patients, which, however, have the same meaning.

The Subjective Vitality Scale (SVS) by Ryan and Frederick (1997) was completely covered by the word associations of healthy individuals. The SVS is is a questionnaire which explicitly measures vitality. The comparison with the word associations revealed that the elected word associations of healthy individuals covered all 7 items of the SVS. Above that, the items of the SVS cover the exact elected word associations and is was not necessary to compare the items with the given meanings.

It should also be noted that the preliminary study also had some limitations. Most notably, there was only one researcher who did the analysis and classification into the three aspects of the elected words. Although the participants also described what the meaning of the elected words for them was, a limitation of this procedure is clearly that no interrater reliability can be certified. Moreover, after a literature research it is assumed that there are three aspects of tiredness and vitality – physical, cognitive and mental. According to this assumption the elected word associations of the participants were categorized into these three aspects. But, it is not verified if there are more or less aspects or if there is an overlap between these aspects. However, the elected word associations could all be categorized into these aspects, and all aspects contained a certain amount of words. Consequently, it can be assumed

that there are at least three aspects of tiredness and vitality, but it is unclear if there are more aspects.

Grouped together, a comparison of the results of the preliminary study and the common used questionnaires for tiredness/fatigue and vitality revealed that there is a great overlap between the concepts healthy and unhealthy individuals have for tiredness and vitality. Overall, for a great part the concepts of healthy and unhealthy individuals come into the fore as the same expression. However, a part of the concepts is covered by the meaning healthy individuals give to their associations, so, healthy individuals use for a smaller part of the constructs different words which, however, have the same meaning to them.

To sum up, the preliminary study indicated that, firstly, the most questionnaires for individuals with certain tiredness-related diseases could probably also be used for healthy individuals because there are great overlaps between the word associations with tiredness and vitality in these individuals. Secondly, these results revealed that for the usage of an ABM-IAT the words are similar for healthy as well as for unhealthy individuals. Thus, questionnaires and also ABM-IAT's could probably be used for a broader audience, for healthy and unhealthy individuals, than it was done until now. Future research should aim to verify these findings in order to save recourses and probably use the same fatigue/vitality questionnaires for all individuals. This would also help to make the perception of tiredness and vitality more comparable between healthy and unhealthy individuals.

6. Study approach main study

The results of the preliminary study are used as cue words for an ABM-IAT because associations regarding tiredness and vitality of healthy individuals were lacking until today. Simply using words of individuals with CFS for the IAT with healthy individuals might have caused a mismatch of associations. This could have threaten the effect of the intervention. This is in line with the conclusion of Olson, Fazio, & Devine (2004) who stress that IAT has the potential to be contaminated by associations that although available in memory are irrelevant to one's evaluation of the object.

In connection with the research on tiredness/vitality and how to modify these states implicitly, little is known. In this study individuals are planned to be influenced implicitly in a way which changes their associations with tiredness or vitality implicitly. This is planned to be done with an ABM-IAT. The ABM-IAT is a double categorization reaction-time task that

measures, for example, the extent to which individuals associate certain attributes as part of their identity (e.g., ''me'' versus ''others'' and ''tired'' versus ''vital''). The underlying assumption of an IAT is that it is easier for participants to classify stimuli which are related or associated in memory with themselves and that it is more difficult for participants to classify with themselves unrelated or not associated stimuli. More difficult classification decisions should result in longer reaction times, whereas more easy classifications should result in lower response times (Grumm et al., 2008). This intervention procedure is comparable with evaluative conditioning in that it provides contingent pairings of two stimuli. In contrast to evaluative conditioning the ABM-IAT in this study requires participants to actively categorize the stimuli.

As until now an IAT was basically used to measure implicit associations this new possibility of usage of an IAT as an intervention to modify implicit associations is interesting and promising. For example, Wiers et al. (2010) modified implicit processes successful in modifying action tendencies. This showed that concentrating on implicit instead of explicit associations could have several advantages. Moreover, Haynes, Kemps and Moffitt (2015) used also a self-concept IAT intervention to change food evaluations implicitly. They concluded that an IAT intervention which retrains implicit food evaluations could be effective at reducing unhealthy eating. A third study which used an IAT for an intervention in the consumer choice domain found that individuals trained to pair one brand of candy with negative stimuli and another brand with positive stimuli, evaluated the negatively-paired brand more negatively than the comparison brand (Steffens, Stülpnagel, & Jelenec., 2009). Consequently, there are already some results which indicate an effectiveness of (self-concept) IAT's in modifying attentional biases. The most significant advantages of the implicit system, like permanent influence ability, low effort a large capacity (Kahneman, 2003), over the explicit system resulted in a decision for the self-concept IAT intervention for the purpose of this study.

In order to reduce work per participants a BIAT is used to measure the implicit effects. The BIAT is a brief implicit association test (BIAT). It can be completed in a little over a minute but retains the most important of the valuable design properties of the IAT. In this research the BIAT is used for the preliminary and final measurement (Nosek et al., 2014). For the ABM-IAT's for tiredness and vitality three blocks of the standard IAT are used. Moreover, two questionnaires were used for an explicit measurement of tiredness/vitality. Because of the lack of clarity about the consistency of measurement of implicit and explicit

measures (Grumm et al., (2011); Klavina et al., (2012)), this study uses both kinds of measurements to clarify this correlation for tiredness and vitality.

7. Method main study

7.1. Design main study

The study used a 2 (between-subject: tiredness-training, vitality-training) $\times$ 2 (within-subject: pre-intervention assessment, post-intervention assessment) mixed factorial design. Participants were randomized to either the tiredness or the vitality ABM-IAT. Moreover, participants were blinded to their intervention conditions. For a comparison with explicit measures the CIS and the Subjective Vitality Scale (SVS) were also filled in before and after the intervention.

7.2. Participants main study

In the main study in total 101 participants participated. From 101 only 63 participants completed the IAT training, from which 32 participants were in the tiredness condition and 31 in the vitality condition. In total 53 women and 10 completed the training. No participant was excluded because of exclusionary diseases. The exclusion criteria for the preliminary study were as follows: CFS (Chronical Fatigue syndrome), cancer, COPD, arthritis or other diseases which are strongly associated with tiredness; younger than 18 years and/or not capable of a sensible judgement of their own interest in this matter; no internet access; not able to read, speak and write in German. As already stated above, there was a huge dropout in this study (37.62%). To explore, if there was a systematic dropout, the demographic characteristics of completers and dropouts are compared with a χ^2-test for the nominal categories and a t-test for the quantitative categories. These results were also presented in table 6.

Table 6.
Demographic characteristics of the completers and dropouts in the main study

	Completers (n = 63)	Dropouts (n= 37)	χ 2/t-test completers and dropouts
Sex, n (%)			χ 2 (1, N = 99) = 0.328, p = .567
Women	53 (84)	31 (84)	
Men	10 (16)	4 (11)	
Missing	0 (0)	2 (5)	
Age			F (1,97) =.012, p = .914
M in years (SD), range	27 (7), 20-64	26 (7), 18-54	
School education, n (%) [+]			χ 2 (1, N = 99) = 0.152, p = .679
No/low	0 (0)	0 (0)	
Middle	5 (8)	2 (5)	
High	58 (92)	33 (89)	
Missing	0 (0)	2 (5)	
Professional education, n (%) [++]			χ 2 (1, N = 99) = 5.982, p = .112
No	15 (24)	15 (41)	
Middle	14 (22)	3 (8)	
High	34 (54)	17 (46)	
Missing	0 (0)	2 (5)	

Note. n = number of individuals; M = mean; SD = standard deviation.
[+]No/low school education: Volks- and Hauptschule; middle school education: Mittlere Reife, Realschulabschluss; high school education: Fachabitur, Abitur.
[++]No professional education; middle professional education: Berufsausbildung; high professional education: Bachelor, Master, Magister, Staatsexamen; unknown professional education.

The comparison of completers and dropouts, which is presented in table 6, revealed that there were no significant differences between the completers and dropouts. Moreover, there was no difference in condition between completers and dropouts $χ^2$ (1, N = 99) = .018, p = .892. Consequently, there was no systematic dropout which depended on the characteristics of the participants or on the condition.

7.3.   Procedure main study

A German online survey with included IAT was set up with the software "Soscisurvey" (www.soscisurvey.de). The study protocol was approved by the ethical commission of the University of Twente. The participants were required via the private network of the researcher and a group on Facebook called "Psychologische Studien für alle" for people who are interested in participating in studies (https://www.facebook.com/groups/psychostudien/). The link of the online survey was spread out on 28th of June 2016 and the end of the online survey was scheduled on 5th of July 2016. There were two conditions. The assignment was alternate. The only difference between the conditions was the ABM-IAT, which was either the vitality ABM-IAT or the tiredness ABM-IAT. Completing the task took about 15 minutes. The global topic of this research was outlined at the beginning of the survey. But the participants were blind to their condition to prevent cognitive biases. Respondents agreed to the informed

consent form assuming that all data will be processed in an anonymous manner and will not be made accessible to third parties by agreeing to continue the participation. Participation was voluntary and respondents could stop the survey at any time. After agreeing with the informed consent, the participants filled in the questions regarding chronic diseases. Like during the preliminary study, participants which had one or more of these diseases were excluded. Furthermore there was a possibility to fill in other diseases than the mentioned by the researcher which are associated with strong tiredness. After that the pre-measurement with the first BIAT was conducted. This premeasurement was for both conditions the same. Thereafter the participants filled in questions which assess the demographic data (age, sex, education level) and also the explicit measurement of tiredness and vitality which were measured by the German CIS and the SVS (Vercoulen, Swanink, Fennis, Galama, Van der Meer & Bleijenberg, 1994; Ryan & Frederick, 1997). This was done after the premeasurement BIAT in order to dissolve the monotony of (B)IAT's. During the intervention procedure, 50% of the participants did the "tiredness ABM-IAT", which aims to increase the level of tiredness implicitly by showing the tiredness items with "self" items. The other 50% did the "vitality ABM-IAT" which aims to increase the level of vitality implicitly by showing the vitality items with "self" items. After completing one of the two ABM-IAT's all participants filled in the explicit measures (CIS and SVS) again. This enabled the researcher to compare also the explicit states of tiredness and vitality before and after the intervention. After that the participants did the same version of final measurement via a BIAT, which measured the effect of the two ABM-IAT's. After completing three (B)IAT's per participant they were debriefed. In the tiredness intervention condition the participants get besides the recommendation to rest if they feel tired the possibility to do the vitality ABM-IAT in order to weaken the potential tiredness effect of the tiredness intervention IAT. After completing this survey the researchers email address was provided for further questions about the content and results of the study.

7.4. Materials main study

7.4.1. Checklist Individual Strength (CIS)

For the explicit measurement of tiredness the German version of the Checklist Individual Strength (CIS) from Vercoulen, Swanink, Fennis, Galama, Van der Meer and Bleijenberg (1994) was used. This questionnaire is a multidimensional self-report questionnaire and measures subjective tiredness and behavioral aspects. Although the CIS originally was

developed for patients with CFS and other tiredness-related diseases, there is evidence that it is also useable for healthy individuals (Hewlett et al., 2011). It consists of 20 questions and for the answer a 7 point Likert scale is used to declare in how far the statement applies for the participant in that moment. One example of a statement is: " Ich bin körperlich sehr aktiv"(in English: "I am physically very active"). The statements refer to four aspects: subjective fatigue, reduced motivation, reduced activity and reduced concentration. For the purpose of this study only the sum scores were used. An overview of all statements can be found in the appendix G: CIS. Regarding the scoring the CIS has a minimum of 1 and a maximum of 7 per statement. So, overall the CIS score vary from 20 to 140. The higher the score is the more tired is the participant. However, in order to analyze the scores, the following scores had to be recoded: 1, 3, 4, 9, 10, 13, 14, 16, 17, 18, 19. Individual scores for healthy individuals higher than 76 are associated with a high risk for an illness (Bültmann, de Vries, Beurskens, Bleijenberg, Vercoulen & Kant, 2000). Because there are no norms for the German version of the CIS, the norms of the English version are used in this study (Hewlett, Dures, & Almeida, 2011). Hewlett et al. (2011) acknowledge the CIS a good internal consistency, construct- and criterium validy. The internal validity for the CIS in this study was very good (Cronbach's Alpha was .94 at baseline and .97 after ABM-IAT).

7.4.2. Subjective Vitality Scale (SVS)

A German translation of the Subjective Vitality Scale, which was developed by Ryan and Frederick (1997), is a questionnaire which explicitly measures vitality as a self-report questionnaire. The SVS uses a 5 point Likert scale for seven statements. Statement two had to be recoded because it was formulated negatively. One example of a statement is: "Ich habe Energie und Schwung" (in English: I have energy and momentum"). An overview of all statements of the SVS can be found in the appendix H: SVS. The SVS has a minimum score of 1 and a maximum score of 5 per item. Overall the scores vary from 7 to 35. For this questionnaire a lower score means a higher explicit level of vitality. Unfortunately, there are until today only insufficient data regarding the norm groups. So, the raw scores were used. The internal validity for the SVS was very good in this study (.89 at baseline and .92 after ABM-IAT).

7.4.3. BIAT

For the preliminary and final measurement of implicit tiredness and vitality a 'Brief Implicit Association Test' (BIAT) was used. The BIAT's consisted of two blocks of trials with the same four categories and stimulus-response mappings as the intervention IAT (tiredness, vitality, self and other). The difference between the IAT and BIAT is that the BIAT has 1/3 the number of trials. Moreover, in the BIAT, participants focus on just two of the four categories. Items from these two focal categories are categorized with one response key (e.g., the "k" key), and any other items that appear on the screen (non-focal) are categorized with the other response key (e.g., the "d" key). This simplifies instructions and decreases the need for practice shortening total administration time (Nosek et al., 2014). Sriram and Greenwald (2009) demonstrated that that a good-focal attitude BIAT and a self-concept BIAT were psychometrically similar to standard IAT measures of the same constructs.

With the BIAT reaction times D-scores were calculated. Greenwald, Nosek and Banaji (2003) introduced the *D*-algorithm as a substantial improvement for scoring the IAT and BIAT. *D* is the difference between the average response latencies between contrasted conditions divided by the standard deviation of response latencies across the conditions (distinct from the pooled within-conditions standard deviation). Functionally, it is an individual effect size assessment that is similar to Cohen's *d*. *D* has a theoretical minimum of −2 and maximum of +2 when blocks of the same size are compared (Nosek et al.. 2014). To determine the D-score, some trials had to be excluded. These cases are reaction times faster than 300 ms because it is unrealistic for humans to process and to respond with the BIAT rules faster than 300ms. Likewise, taking more than 10.000 ms to process and react is also unrealistic with the BIAT rules. Consequently, these reaction times were excluded in the D-scores. Furthermore, the more positive the D-scores were in this study the more the participants associated words from the category "self" with words from the category tiredness. Consequently, a positive D-score means that the participants are implicitly more tired.

7.4.4. Modified ABM-IAT

For the intervention a modified self-concept IAT (ABM-IAT) was used. The ABM-IAT resembled a modified version of the first three blocks of a standard IAT. Therefore, the participants were alternate assigned to two conditions with two different ABM- IAT's. The

participants in both conditions completed three blocks which consisted of a standard IAT block 1 and 2 as practice trials and an ABM-IAT block 3 which depended on the condition. In the tiredness condition the tiredness related words were paired with "self" stimuli, while for participants in the vitality condition the vitality related words were paired with "self" stimuli. In block 3 in the vitality condition 100% of the trials were congruent (vitality +self), and none were incongruent (vitality+ others). Those in the tiredness condition completed the same task, except that the contingencies were reversed: 100% of trials were incongruent (tiredness + self), and none were congruent (tiredness + others). The validity of IAT's to measure and modify automatic associations is supported by several researchers (Banse, Seise, Zerbes, 2001; Gawronski, 2002; Wiers et al., 2010).

7.5. Analysis main study

As preparatory steps for the analysis, eleven items from the CIS (items 1, 3, 4, 9, 10, 13, 14, 16, 17, 18, 19) and one item from the SVS (item 2) were recoded. Further, with the BIAT reaction times D-scores were calculated (Greenwald, Nosek and Banaji, 2003). For this purpose, some cases had to be excluded in the D-scores. These cases are if 10% or more of the reaction times of a participant were faster than 300 ms or slower than 10.000 ms. Another exclusion criterion for the analysis was if participants didn't complete this study. These cases were also excluded. After that means, SD's and sum scores for the CIS and the SVS and the D-scores for the BIAT's were calculated. Moreover, Cronbach's Alpha was calculated for the CIS and SVS scores in order to determine the internal validity.

Independent sample t-tests were conducted to compare the two conditions on baseline variables of age, education, implicit and explicit tiredness and vitality. Moreover, the means and SD's were compared (with χ^2-test for the nominal categories and a t-test for the qualitative categories) between completers and dropouts in order to find a reason for the high dropout in this study. After that a 2 (between-subject: tiredness ABM-IAT, vitality ABM-IAT) $\times$ 2 (within-subject: pre-ABM-IAT assessment, post-ABM-IAT assessment) mixed model repeated measures ANOVA's with the D-scores, CIS scores and SVS scores was conducted in order to verify the first and second hypothesis. Moreover, to explore how the effects of the ABM-IAT for the two conditions apart are, paired sample t-tests were conducted with the implicit and explicit measures of tiredness and vitality.

In order to verify the third hypothesis, first for the CIS and the SVS and the D-scores for the BIAT's an upper and lower classification based on the median was calculated in order

to conduct a moderator analysis. More specifically, the following variables were used for the moderator analysis: The dependent variable in all models consisted of a subtraction of the baseline scores of the measures from the scores after ABM-IAT. Moreover, the independent variables were the condition, the median-split baseline level and an interaction term which was calculated from median-split baseline level x condition. These variables were analyzed with three models of a moderator analysis. Model 1 contained the condition, model 2 contained the condition and an upper and lower classification based on the median of the measure and model 3 contained condition, the median-split baseline level and an interaction term which was calculated from median-split baseline level x condition.

Finally, after running the ANOVA Q-Q plots of the residuals for the following measures were checked for normality assumption of the residuals: CIS score, SVS score and D-score of the BIAT's. A normal distribution of the residuals was found. For all analyses of the quantitative data SPSS version 23 was used.

8. Results main study

8.1.   Preliminary analyses

Descriptive analyses for the tested baseline variables are shown in table 7.

Table 7.
Descriptive statistics before training by training condition

Variable	Sample		Training condition			
	M (SD)	n	Tiredness M (SD)	n	Vitality M (SD)	n
BIAT D-score pre-training	-0.93564 (.59)	61	-.033876 (.59)	30	-.151326 (.59)	31
CIS pre-training	84 (22)**	63	87.44 (24.57)	32	80.45 (18.74)	31
SVS pre-training	24.02 (4.23)***	63	23.94 (4.54)	32	24.10 (3.96)	31
Age	26.68 (6.93)	63	25.94 (6.46)	32	27.45 (7.40)	31
Sex						
Female		53		29		24
Male		10		3		7
School education[+]						
Low		0		0		0
Middle		5		2		3
High		58		30		28
Professional education[++]						
Low		15		10		5
Middle		14		5		9
High		34		17		17

Note: P > .05 and 95% CI intervals
Note. n = number of individuals; *M* = mean; *SD* = standard deviation.
[+]No/low school education: Volks- and Hauptschule; middle school education: Mittlere Reife, Realschulabschluss; high school education: Fachabitur, Abitur.
[++] No professional education; middle professional education: Berufsausbildung; high professional education: Bachelor, Master, Magister, Staatsexamen; unknown professional education.
** Higher scores = more tiredness, range: 20-140.
***Lower scores = more vitality, range: 7-35.

The analysis of the baseline variables revealed slight differences between the two conditions, which, however, were not significant. As the D-scores minimum is −2 and maximum +2. This means positive D-scores mean more implicit tiredness. Assuming that 0 is the real neutral score, the mean of the D-score of -.0.93564 in this study indicate that the participants in this study were implicitly more vital than tired at baseline. Although the differences between the two conditions were not significant, the mean D-score at baseline was lower in the vitality condition, indicating slightly less tired participants in this condition. Overall, scores (close to) zero indicate here thus that no bias to either ends of the continuum exists in the tested population. The mean CIS score of 84 at baseline and also the mean CIS scores at baseline in the two conditions (87.44 in the tiredness condition and 80.45 in the vitality condition) revealed a relatively high explicit tiredness in participants at baseline. Bültmann et al. (2000) stated that scores higher than 76 are associated with a high risk for an illness. The last measure, the SVS, revealed that the participants had a high score on the SVS questionnaire at baseline. The lower the score, the more vital is the individual. The relatively high mean of 24.02 (maximum of 35 and minimum of 7) for the SVS means thus that the participants were explicitly relatively little vital at baseline.

Checking the data for outliers revealed one outlier. This outlier was detected in the tiredness condition with a low CIS score before ABM-IAT, which means that this participant wasn't tired at all. Deleting this outlier did not exert a significant effect on the results. This means, any significant result didn't change to not significant and vice versa. Moreover, this participant was in the tiredness condition and his CIS score increased after ABM-IAT, in line with the expected effects of becoming more tired after training. Therefore, this participant was retained for analysis.

Moreover, after running the ANOVA Q-Q plots of the residuals for the following measures were checked for normality assumption of the residuals: CIS score, SVS score and D-score of the BIAT. A normal distribution of the residuals was found.

8.2. Changes in implicit tiredness respectively vitality after ABM-IAT

To verify the first hypothesis, which is intended to find out if an ABM- IAT is suitable for a modification of implicit tiredness/vitality, the D-scores which indicate the implicit biases were compared. As already stated above, the more positive the D-scores are the more

implicitly tired an individual is and the more negative the D-scores are the more implicitly vital an individual is. *D* has a theoretical minimum of −2 and maximum of +2. The D-scores before and after the ABM-IAT, which show, consistent with the hypothesis, an increase in implicit tiredness in the tiredness condition and a slight decrease in vitality in the vitality condition, are presented in table 8:

Table 8.
BIAT D-scores before and after training by training condition

Condition	BIAT D-score	
	Before training M (SD)	After training M (SD)
Tiredness	-.033876 (.59)	.171097 (.51)
Vitality	-.151326 (.59)	-.194062 (.51)

Further, a 2 (between-subject: tiredness ABM-IAT, vitality ABM-IAT) × 2 (within-subject: pre-ABM-IAT assessment, post-ABM-IAT assessment) mixed model ANOVA with the D-scores of the BIAT's was conducted. A graphical overview of the effects of the ABM-IAT on implicit tiredness/vitality is presented in Figure 3:
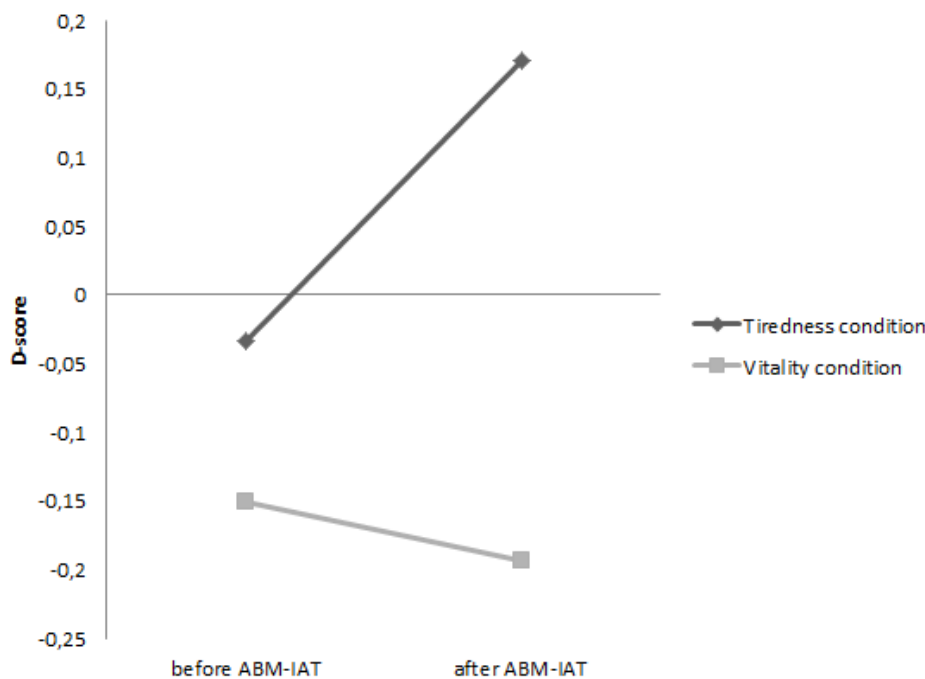

Figure 3.
D-scores of the BIAT's before and after IAT training per condition

As displayed in figure 3, for the tiredness condition the changes in *D*-scores were stronger than in the vitality condition. Moreover, figure 3 shows that for the vitality condition the D-scores slightly decreased after the ABM-IAT and for the tiredness condition the D-scores

increased after the ABM-IAT. The analysis with a 2x2 mixed model ANOVA revealed that there was no significant main effect of ABM-IAT on the implicit level $F(1,57) = 2.093$ $p = .153$. An also crucial result was that the time by condition interaction was marginally significant $F(1, 57) = 3.748$ $p = .058$. Because the time by condition interaction was marginally significant, the changes in implicit tiredness/vitality were analyzed apart for the two conditions with a paired sample t-test. Consistent with the hypothesis, revealed this test a significant increase in implicit tiredness after the ABM-IAT in the tiredness condition $t(28) = 2.164$ $p = .039$. However, in the vitality condition no significant increase in implicit vitality was found $t(30) = .384$ $p = .703$.

To sum up, the verification of the first hypothesis revealed that there was no significant main effect of the ABM-IAT on implicit tiredness/vitality. However, there is a marginal time by condition interaction effect in implicit changes in tiredness/vitality. A post-hoc analysis of the implicit effects of the ABM-IAT within the two conditions revealed a significant increase in implicit tiredness after the ABM-IAT in the tiredness condition but no significant increase in implicit vitality after ABM-IAT. The first hypothesis is thus partially confirmed. Furthermore, the effect size Cohen's d varied for the BIAT's between .414 and .554, indicating a small to medium effect size of the implicit measures of the ABM-IAT.

8.3. Changes in explicit tiredness respectively vitality after ABM-IAT

To verify the second hypothesis, which aims to find out if implicit modifications of tiredness/vitality by an ABM-IAT predict explicit changes in these states, the CIS and SVS scores in the two conditions were compared. The scores for these measures before and after the ABM-IAT for the two conditions are presented in table 9.

Table 9.
Descriptive statistics explicit measures before and after ABM-IAT by conditions

Condition	CIS *M (SD)*		SVS *M (SD)*	
	Before training	After training	Before Training	After training
Tiredness	87.44 (24.57)	93.31 (25.98)	23.94 (4.54)	25.46 (4.91)
Vitality	80.45 (18.74)	80.07 (25.46)	24.10 (9.96)	23.26 (5.25)

The means for the CIS scores show that the CIS scores increased after the training in the tiredness condition. As expected, the means for the CIS scores indicate an increase in explicit tiredness. However, the CIS scores in the vitality condition did not change after ABM-IAT.

The SVS scores increased after the ABM-IAT in the tiredness condition, which is an indication of less explicit vitality. In the vitality condition the SVS scores decrease slightly, which is an indication of slightly more explicit vitality after the ABM-IAT. Thus, these observed effects are consistent with the hypothesis.

Further, a 2 (between-subject: tiredness ABM-IAT, vitality ABM-IAT) × 2 (within-subject: pre-ABM-IAT assessment, post-ABM-IAT assessment) mixed model ANOVA with the CIS scores was conducted to assess the changes in explicit tiredness. For the CIS scores these analyses showed no main effect of the ABM-IAT on explicit tiredness $F (1, 61) = 2.081$ $p = .15$. Also crucial was that there was no significant time by condition interaction $F (1, 61) = 2.710$, $p = .11$. These results are visualized in Figure 4:
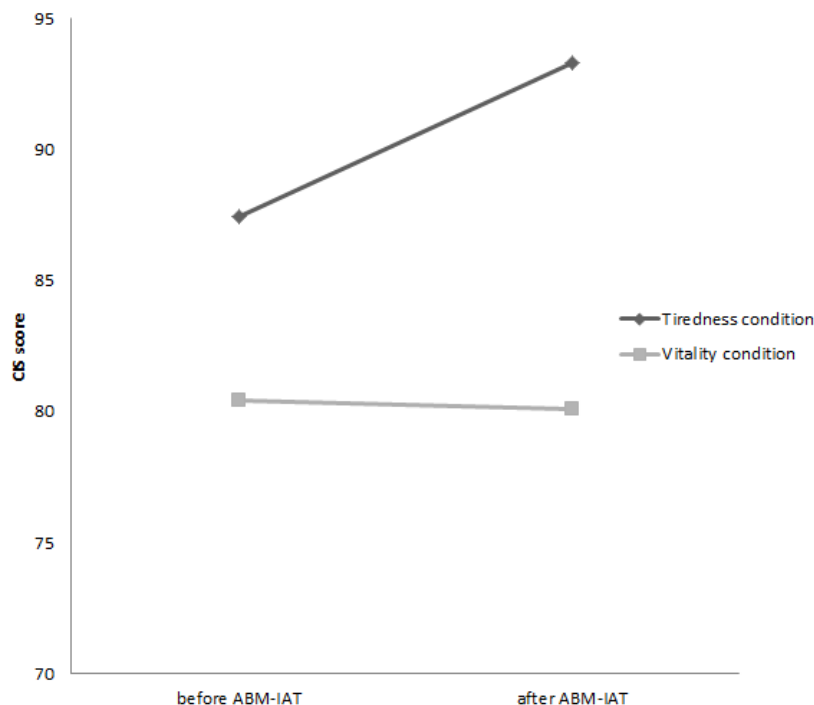

Figure 4.
CIS scores before and after IAT training per condition

Figure 4 shows that the CIS scores increased in the tiredness condition and stayed unchanged in the vitality condition. Thus, the CIS scores in the tiredness condition increased clearly stronger than in the vitality condition. Consequently, the effects of the ABM- IAT for the two conditions were analyzed apart. For this purpose a paired sample t-test for the two conditions apart was conducted. For the CIS scores this analysis revealed a significant increase in explicit tiredness in the tiredness condition $t(31)=2.148$, $p = .04$. However, the analysis for the CIS scores in the vitality condition showed, as expected based on the observed means, no significant changes in explicit tiredness due to ABM-IAT $t(31)= .147$ $p = .884$. Thus, the

changes in explicit tiredness in the tiredness condition were consistent with the hypothesis, however, the changes in the vitality condition not.

Furthermore, the exploration of the explicit changes also contained the analysis of the SVS scores, which are a measure for explicit vitality. For this purpose also a 2 (between-subject: tiredness ABM-IAT, vitality ABM-IAT) $\times$ 2 (within-subject: pre-ABM-IAT assessment, post-ABM-IAT assessment) mixed model ANOVA with the SVS scores was conducted. This analysis revealed no significant main effect of the ABM-IAT on explicit vitality F $(1, 61) = .899$ p $= .35$. However, there was a significant time by condition interaction effect on explicit vitality F $(1,61) = 10.534$, p $= .002$. This result is also visualized in figure 5:
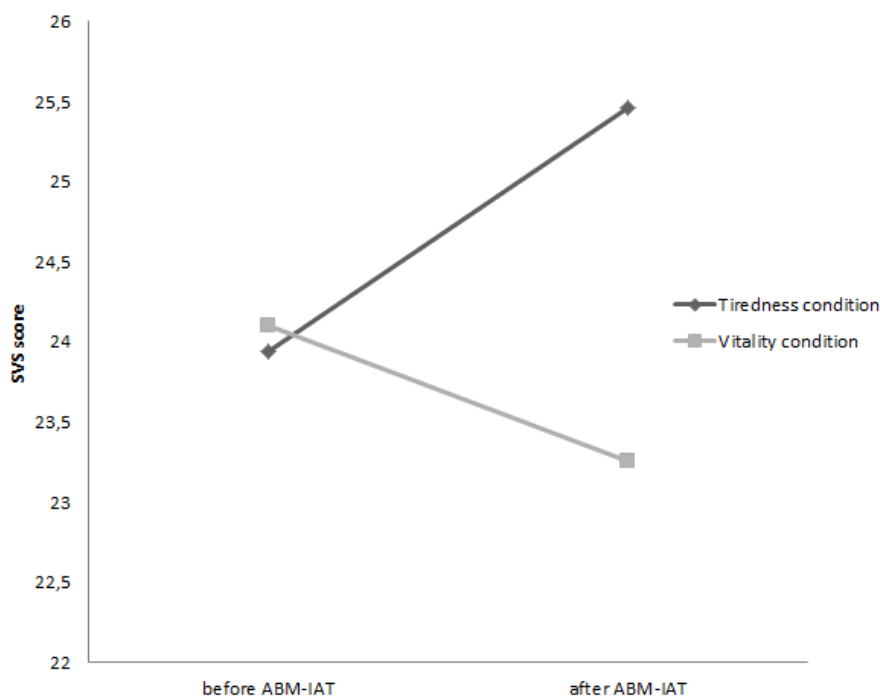

Figure 5.
SVS scores before and after IAT training per condition

Figure 5 shows that the scores on the SVS increase in the tiredness condition and decrease in the vitality condition. So, for the SVS scores a further analysis of the effects of the ABM-IAT within the two conditions was conducted with a paired sample t-test. For the SVS scores this analysis revealed, consistent with the hypothesis, a significant decrease in explicit vitality after ABM-IAT for the tiredness condition t(31)=-3.113, p $= .004$. However, the observed

changes in the means in the SVS scores after ABM-IAT in the vitality condition didn't reach significance (30) = 1.550. p = .132.

To sum up, the analysis of the second hypothesis revealed for the CIS scores no significant time by condition interaction, and no significant main effect of the ABM-IAT on the explicit tiredness. This is not consistent with the hypothesis. However, a separate post-hoc analysis revealed that although there is no significant decrease in explicit tiredness in the vitality condition there is a significant increase in explicit tiredness in the tiredness condition. Furthermore, the analysis of the SVS scores revealed no significant main effect of the ABM-IAT on explicit vitality. However, a significant time by condition interaction for explicit vitality was found. The separate analysis revealed that there was a significant decrease in explicit vitality in the tiredness condition, however, in the vitality condition were the observed means consistent with the hypothesis but did not reach significance. Thus, the second hypothesis is partially confirmed. Furthermore, the effect size Cohen's d varied for the CIS and SVS between .271 and .929, which indicates small to large effect sizes of the explicit measures of the ABM-IAT.

8.4. Dependence of the changes after ABM-IAT on baseline state of tiredness respectively vitality

To verify the third hypothesis, which aims to explore whether the ABM-IAT effects on implicit and explicit tiredness/vitality may be moderated by baseline levels of these measures, a moderator analysis was conducted. For this purpose the dependent variable consisted of a subtraction of the baseline scores of the measures from the scores after ABM-IAT. Moreover, the independent variables were the condition, the median-split baseline level and an interaction term which was calculated from median-split baseline level x condition.

Further, the upper half and the lower half of the baseline scores in explicit and implicit tiredness and vitality (BIAT, CIS and SVS) were determined. Table 10 shows the medians and which scores were used as indication of more or less implicit respectively explicit tiredness and vitality. Moreover, the medians show that the participants are initial relatively tired.

Table 10.
Means, upper and lower half of initial explicit and implicit states in tiredness and vitality

Measure	Median	Lower half	Upper half
Initial BIAT d-score	-,135351	≤ -,135351	≥-,135351
Initial CIS score	84	≤ 84	≥ 84
Initial SVS score	24	≤ 24	≥ 24

This analysis revealed no significant moderation of the baseline implicit and explicit tiredness/vitality on the effect of the ABM-IAT. Thus, the moderation analyses showed that in none of the tiredness measures a moderation of baseline levels of the tiredness measures on the condition effect could be found. Consequently, this means that the third hypothesis is rejected.

9. Discussion main study

A central concern of the main study was to investigate if implicit modification of the attentional bias regarding tiredness and vitality was effective in modifying implicit and explicit tiredness/vitality in healthy individuals and if tiredness and vitality at baseline have differential influence on the effect of the ABM-IAT. For this purpose a total of 63 healthy individuals participated in this ABM-IAT study.

Regarding the first and second hypothesis, the modification of implicit and explicit tiredness and vitality by an ABM-IAT, this study revealed that there was particularly an increase in implicit and explicit tiredness due to an ABM-IAT in the tiredness condition. This means that the participants felt implicitly and explicitly more tired after participating in the tiredness condition. However, the more favorable goal of the study was to increase implicit and explicit vitality in order to decrease tiredness. This goal could not be reached. Thus, it can be concluded that the first and second hypothesis are both partially confirmed because the ABM-IAT worked particularly in the tiredness condition, but not in a sufficient degree in the vitality condition.

It can be derived from this study that an ABM-IAT is suitable for an ABM in tiredness as described by Lee and Lee (2015). They stated that an ABM directs attention away from and to another preferential attention. However, the drawback of this is that the ABM seemed to work for tiredness but not sufficiently for vitality. This means that modifying implicit processes seems not to work as uniformly as Kahneman (2003) pronounced. Kahneman (2003) indicated that focusing on the implicit processes could have some significant

advantages because they are permanent influenceable because they are always active, need low effort and have a large capacity. Despite these advantages of the implicit processes, implicit processes seem to be differential influenceable, as it was shown in this study. Thus an ABM-IAT seems to work differential on tiredness and vitality with a stronger effect on tiredness than on vitality. Consequently, the question for the reasons arises. A possible explanation for the effectiveness of the ABM-IAT in increasing implicit and explicit tiredness but not increasing implicit and explicit vitality in the same extent could be that the participants of this study were initially relatively tired. Consequently, it should be easier to become more tired than vital because the participation in this study needs effort and concentration. These results were in line with Baumeister (2002). He assumed that depletion affects the explicit self-concept in individuals and they interpret this, according to this explicit self-concept that their energy level decreases. So, because the participants were initially relatively tired, their self-concept of being tired was confirmed by the ABM-IAT, consequently the ABM-IAT had a stronger effect in the tiredness condition.

Further, there is a second possible explanation which could have influenced the effect of the ABM-IAT. The ABM-IAT's in both conditions were in fact unipolar so that only one of the ends of the spectrum, thus tiredness or vitality, is retrained. This is not consistent with the BIAT measure. The BIAT measures bipolar, contains thus vitality and tiredness trials. A full, thus bipolar ABM-IAT with tiredness and vitality trials would be potentially more effective. However, the software which was used in this study could not implement a bipolar ABM-IAT. Thus, by comparing the tiredness condition with the vitality condition in this study, a contrast was made that is stronger than a positive versus a neutral condition, e. g. with a placebo ABM-IAT. This may have inflated the outcomes of this study.

Moreover, the participation in this study needed effort and concentration. This seems to be a central point because increasing implicit and explicit tiredness seems to be clearly easier because the needed effort and concentration increases tiredness already without the effect of the ABM-IAT, and the ABM-IAT in the tiredness condition strengthened this effect. Literature research revealed that this effect could also be strengthened by a negativity bias (Baumeister, Finkenauer & Vohs, 2001). A negativity bias refers to the notion that, even when of equal intensity, things of a more negative nature have a greater effect on one's psychological state and processes than do neutral or positive things. Consequently, because tiredness mostly is perceived as a negative state and additionally effort and concentration were needed, a negativity bias could have caused the stronger effect of the ABM-IAT on tiredness than on vitality.

Even though the more favorable goal of increasing vitality was not met in a degree like for tiredness, a slight modification in vitality was nevertheless found. Despite the fact that the participation costs effort and concentration, however, there were slight indications of an effect of the ABM-IAT on vitality. These effects resulted in a slight increase in implicit and explicit vitality due to ABM-IAT. This indicates that the ABM-IAT was at least effective in protecting against an increase in tiredness due to the needed effort and concentration and furthermore the negativity bias. This effect of concentration and effort due to the participation is expected to be temporary, whereas the effect of the ABM-IAT is expected to be more lasting. Consequently, to measure the effect of the ABM-IAT on vitality a solution for future research could be to enable participants to replete their energy after participation and then take the BIAT measure and the explicit measures. Further, to measure the true effect on vitality, it is advisable to integrate a neutral condition, as already stated above, with a placebo ABM-IAT. This enables the researcher to control for the effect an ABM-IAT has on tiredness and consequently to determine the true effect of an ABM-IAT on vitality.

On a more theoretical level, these results indicate that an ABM-IAT could be suitable in modifying an attentional bias regarding tiredness or, in certain degree, vitality. The assumption about the theoretical context in this study is as follows: A biased self-concept might be caused by an attentional bias (Lee & Lee, 2015), an ABM-IAT might influence the self-concept by modifying the attentional bias individuals have. It is thus assumed that an attentional bias precedes a biased self-concept. On a more practical level, individual's attention is directed away from tiredness and to vitality, or vice versa. It is assumed that this modification of this perception precedes the interpretation of ones state of being tired or vital. Consequently, first the attentional bias must be modified in order to modify the interpretation of one's state, thus the self-concept of being tired or vital. However, this theoretical context is an assumption made by the researcher. To the knowledge of the researcher there is until today no research about this specific topic. Consequently, it is unclear if an attentional bias precedes an interpretation of the self-concept and how the relation between attentional bias and self-concept is. So, it remains a topic where more research is needed.

Further, regarding the third hypothesis, this study revealed that the effect of the ABM-IAT did not depend on the baseline implicit and explicit tiredness respectively vitality. So, according to this study, the baseline level of tiredness or vitality seems to have no influence on the effects of the ABM-IAT. These results have therefore mixed consequence for the use of an ABM-IAT. On the one hand the ABM-IAT may have a greater scope of application if the effect is independent of the baseline tiredness. Consequently, every individual,

independent of the level of tiredness, may use an ABM-IAT in order to modify the level of tiredness respectively vitality. However, on the other hand this result contradicts the literature about tiredness and the consequences. For example, it is known from research that tired individuals function at a significantly lower level and have cognitive impairments (Bryant et al., 2004; Marcora et al., 2009; Jason et al., 2008). Consequently, this ABM-IAT was expected to have a different effect on more and less tired individuals. However, the individuals in this study were overall relatively tired, so this might be an explanation for the independence of the effect of the ABM-IAT from the baseline tiredness. Thus, from this research it remains unclear which reasons might have caused this unexpected result. Maybe an improved ABM-IAT and more participants in following research on this topic will be able to reveal more consistent results.

Beside the mentioned limitations above there were some other limitations. Most notable and specific for this study, there were no practice trials before the participants started the first BIAT, which measured the initial implicit tiredness and vitality. Thus, possibly the instructions were not completely understood and errors were made during this implicit premeasurement. This could have distorted the results for the implicit measurements. Moreover, a general limitation of the implication of this ABM-IAT is that it is a self-concept IAT. Consequently, it might work better for individuals from individualistic countries, e. g. for Europe. As a consequence of a collectivistic view this self-concept IAT's might probably not work e. g. in Asia very well because these individuals could have more problems to classify the stimuli regarding "self" and "others". So, for collectivistic countries a classification regarding "extended self" versus out-group might work better.

Further, a point of interest was, as stated in the introduction, that there is still lack of clarity about the validity of measurement of implicit and explicit processes. On the one hand there are researchers like Grumm, Hein and Fingerle (2011) who found a positive correlation between implicit and explicit measures of aggression. Contrary to this, Klavina, Schröder-Abé, & Schütz (2012) found for the most facets of self-esteem no correlation between implicit and explicit measures. Regarding this uncertainty this research revealed that the implicit and explicit measures for tiredness and vitality were, taken together, relatively consistent. For example, the ABM-IAT could modify tiredness and vitality in the same explicit and implicit direction. This means that if an individual became more vital after the ABM-IAT, this occurred on the explicit and implicit level. However, the participants were before the ABM-IAT implicit clearly less tired than explicit, if we assume that the neutral point of the BIAT is zero. So, this finding is based on the absolute scores of the BIAT. But because there is no

calibration of the BIAT scores it remains unclear from the absolute scores if this finding is inconsistent. Thus, from this research it can be assumed that for tiredness and vitality there are quite consistent results for implicit and explicit measures.

Finally, the work presented may have some implications for the handling of tiredness in our fast-paced world where tiredness results from a high performance pressure (Godard, 2001). Following the pioneering work of Greenwald and colleagues (Greenwald et al, 2000), and expanding his work in line with the basic idea of Wiers et al. (2010), there is a surge of interest in possibilities to interfere directly with implicit processes in Health Psychology. More specifically, this method focuses mainly upon modifying attentional bias regarding tiredness and vitality. To the knowledge of the researcher this is the first study which assessed word associations of tiredness and vitality in healthy individuals and used an ABM-IAT to modify an attentional bias regarding tiredness and vitality in healthy individuals. First promising effects have already been reported where implicit processes were used in order to modify alcohol related associations in hazardous drinkers (Wiers et al., 2010) or food tendencies (Haynes, Kemps and Moffitt, 2015). This study used these promising results from different topics and investigated the effects of an ABM-IAT on tiredness and vitality. It is theoretically interesting that the effects found here were clearly stronger for tiredness than for vitality. However, if one takes into account that the participation needs effort and concentration and a negativity bias could have occurred, it is interesting that there are still slight effects of this first prototype of an ABM-IAT on vitality by at least preventing the individuals from becoming tired due to participation. Moreover, implicit and explicit baseline tiredness and vitality had no influence on the effect of the ABM-IAT. Consequently, an ABM-IAT might work preventive in healthy individuals and also in individuals with tiredness-related diseases. Regarding this topic it is interesting for future research to test if tiredness and vitality can be modified similarly in "unhealthy" individuals, which have a disease which is associated with strong tiredness, e. g. individuals suffering from cancer, COPD, arthritis or CFS. There are first indications found in this study which support the hypothesis that ABM-IAT's might modify an attentional bias regarding tiredness/vitality in healthy and in "unhealthy" individuals. In the preliminary study was found that the word associations for tiredness and vitality were at a large extent identical for healthy individuals and individuals with tiredness-related diseases. This could possibly indicate that an ABM-IAT for tiredness and vitality might also work for "unhealthy" individuals.

Altogether, this could be, given recent internet-based techniques, an interesting possibility to carry out training with ABM-IAT at home or with a smartphone wherever a person is and

possibly reduce suffering because of a high level of tiredness (Jason et al., 2008; Bryant et al., 2004; Marcora et al., 2009). According to the researcher, it is conceivable that, after an improvement, this ABM-IAT prototype may become a useful tool in the treatment of tiredness in individuals – independent if healthy or "not healthy". However, before this can be fulfilled, more research on this topic is needed.

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Appendix

Appendix A: Questionnaire preliminary study

1. Sehr geehrte(r) Teilnehmer(in),

im Rahmen meiner Masterarbeit in dem Masterstudiengang Gesundheitspsychologie an der Universität Twente (NL) untersuche ich mit dieser Studie welche Wortassoziationen gesunde Menschen zu den Wörtern Müdigkeit und Vitalität haben. Bisher wurde dies nur mit Menschen durchgeführt, die an CFS (Chronisches Erschöpfungssyndrom) oder anderen Krankheiten leiden, die mit starker Müdigkeit einhergehen. Daher untersuche ich dies nun aus der Perspektive von gesunden Menschen. Dazu werden Sie gleich nach Wörtern gefragt, die Sie mit dem Gefühl von Müdigkeit und Vitalität verbinden.

Die Daten dieser anonymen Studie werden vertraulich behandelt. Die Ergebnisse dieser Studie werden darüber hinaus nur anonym für Dritte sichtbar gemacht. Die Teilnahme ist freiwillig und Sie können die Teilnahme jederzeit ohne Angabe von Gründen beenden.

Die Teilnahme dauert ca. 15 Minuten.

Herzliche Grüße,
Olga Klaus

2.
Einverständniserklärung

Titel der Studie: Wortassoziationen von gesunden Individuen zu den Wörtern Müdigkeit und Vitalität.

Verantwortlicher Untersucher: Olga Klaus

Ich bestätige hiermit, dass ich im Begrüßungstext genügend informiert wurde über die Art, die Methode und das Ziel dieser Studie.

Ich weiß, dass die Daten vertraulich behandelt werden und die Ergebnisse dieser Studie nur anonym für Dritte sichtbar gemacht werden.

Ich nehme freiwillig an dieser Studie teil. Dabei behalte ich mir das Recht vor die Teilnahme jederzeit ohne Angabe von Gründen zu beenden.

Ich habe keine weiteren Fragen.

3. .

○ Ich bin einverstanden und möchte teilnehmen. ○ Ich bin nicht einverstanden.

4. Zu Beginn der Studie möchte ich Sie bitten anzugeben, ob Sie derzeitig an einer oder mehrerer der unten genannten Erkrankungen leiden oder deswegen in den letzten 12 Monaten in Behandlung waren.

	ja	nein
CFS (Chronisches Erkrankungssyndrom)	○	○
Krebserkrankung	○	○
Rheumatische Erkrankung	○	○
COPD (Chronisch obstruktive Lungenerkrankung)	○	○
Eine andere Erkrankung, die mit starker Müdigkeit einhergeht	○	○

Q1. Bitte geben Sie hier an um welche Erkrankung, die mit starker Müdigkeit einhergeht, es sich bei Ihnen handelt:
Anzeige Q1 nur bei Antwort mit "ja" bei "Eine andere Erkrankung, die mit starker Müdigkeit einhergeht"

[   ]

5. Ich möchte Sie nun bitten noch ein paar Angaben zu sich selbst zu machen!

Q2. Geschlecht:

○ Weiblich

○ Männlich

Q3. Geburtsdatum (TT.MM.JJJJ):

[   ]

Q4. Was ist derzeitig Ihr höchster schulischer Bildungsabschluss?

[▼]

Q5. Was ist derzeitig Ihr höchster beruflicher Bildungsabschluss?

‹ ▲▼ ›

Q6. Nun geht es mit der eigentlichen Studie los. Dazu folgen Sie den Anweisungen. Vorab ist es noch wichtig zu erwähnen, dass es keine falschen Antworten gibt!

Mit welchen 5 Wörtern würden Sie das Gefühl von **Müdigkeit** beschreiben?
Bitte versuchen Sie insgesamt 5 Begriffe zu finden! Wenn dies nicht gelingt, brauchen nicht alle 5 Felder gefüllt zu werden.

1.
2.
3.
4.
5.

Q7. Und mit welchen 5 Wörtern würden Sie das Gefühl von **Vitalität** beschreiben?
Bitte versuchen Sie insgesamt 5 Begriffe zu finden! Wenn dies nicht gelingt, brauchen nicht alle 5 Felder gefüllt zu werden.

1.
2.
3.
4.
5.

8. Nun werden die von Ihnen genannten Wörter zu dem Gefühl von **Müdigkeit** noch einmal gezeigt. Bitte beschreiben Sie die Bedeutung des jeweiligen Wortes für Sie persönlich in 2-3 Sätzen!

Q8. "[*erste Antwort aus Q6*]"

Q9. *"[zweite Antwort aus Q6, soweit angegeben]"*

```




```

Q10. *"[dritte Antwort aus Q6, soweit angegeben]"*

```




```

Q11. *"[vierte Antwort aus Q6, soweit angegeben]"*

```




```

Q12. *"[fünfte Antwort aus Q6, soweit angegeben]"*

```




```

9. Und nun werden die von Ihnen genannten Wörter zu dem Gefühl von **Vitalität** noch einmal gezeigt. Bitte beschreiben Sie die Bedeutung des jeweiligen Wortes für Sie persönlich in 2-3 Sätzen!

Q13. "*[erste Antwort aus Q7]*"

Q14. "*[zweite Antwort aus Q7, soweit angegeben]*"

Q15. "*[dritte Antwort aus Q7, soweit angegeben]*"

Q16. "*[vierte Antwort aus Q7, soweit angegeben]*"

Q17. "*[fünfte Antwort aus Q7, soweit angegeben]*"

10. Zum Schluss möchte ich Sie bitten noch kurz ihren Schlaf und ihre eigene Müdigkeit und Vitalität einzuschätzen.

Q18. Ihre durchschnittliche Schlafdauer pro Nacht (in Stunden):

[　　　　　　]

Q19. Auf einer Skala von 0 (gar nicht müde) bis 10 (extrem müde): Wie müde fühlen Sie sich gerade? Bitte ziehen Sie den Regler so weit nach rechts bis er Ihrem Müdigkeitsgrad entspricht!

Q20. Auf einer Skala von 0 (gar nicht vital) bis 10 (extrem vital): Wie vital fühlen Sie sich gerade? Bitte ziehen Sie den Regler so weit nach rechts bis er Ihrem Vitalitätsgrad entspricht!

11. Geschafft! Vielen Dank für Ihre Teilnahme!

Haben Sie noch Anmerkungen oder Fragen über diese Studie? Dann schicken Sie eine E-Mail an: o.klaus@student.utwente.nl

Appendix B: Introduction main study to participants

UNIVERSITY OF TWENTE.

Sehr geehrte(r) Teilnehmer(in),

im Rahmen meiner Masterarbeit in dem Masterstudiengang Gesundheitspsychologie an der Universität Twente (NL) untersuche ich mit dieser Studie inwiefern Menschen unbewusst beeinflusst werden können in ihrem Gefühl von Müdigkeit oder Vitalität. Es gab bereits erste vielversprechende Versuche Menschen unbewusst zu beeinflussen. Es wurde jedoch bisher noch nicht versucht Müdigkeit und Vitalität zu beeinflussen. Zudem herrscht bisher Unklarheit darüber, ob unbewusste Beeinflussungen auch bewusst wahrgenommen werden. Daher versuche ich mit dieser Studie herauszufinden inwiefern gesunde Menschen bewusst und unbewusst in ihrer Müdigkeit und Vitalität beinflusst werden können. Dazu werden Sie gleich gebeten eine Art Computerspiel zu spielen bei dem Sie je nach dem was Sie auf dem Bildschirm sehen einen von zwei Tasten auf ihrer Tastatur drücken müssen. Außerdem werden Sie zwischendurch gebeten mehrere recht kurze Fragebögen auszufüllen.

In dieser Studie werden alle Teilnehmer außerdem nach einem Zufallsprinzip in zwei verschiedene Gruppen eingeteilt. Abhängig von dieser Gruppe werden verschiedene Aufgaben an Sie gestellt. Um Voreingenommenheit zu verhindern werden Sie erst am Ende dieser Studie erfahren in welcher Gruppe Sie persönlich teilgenommen haben.

Die Daten dieser anonymen Studie werden vertraulich behandelt. Die Ergebnisse dieser Studie werden darüber hinaus nur anonym für Dritte sichtbar gemacht. Die Teilnahme ist freiwillig und Sie können die Teilnahme jederzeit ohne Angabe von Gründen beenden.

Die Teilnahme dauert 15-25 Minuten.

Aus technischen Gründen ist die Teilnahme nur an einem PC/Laptop mit einer Computertastatur möglich.

Zudem gilt es zu beachten, dass diese Studie ihre Müdigkeit oder Vitalität beeinflussen könnte. Möglicherweise ist nach der Teilnahme eine kurze Ruhephase nötig bevor Aktivitäten ausgeführt werden, die ein hohes Maß an Konzentration oder Aufmerksamkeit benötigen.

Herzliche Grüße,
Olga Klaus

`Weiter`

Olga Klaus, Universiteit Twente, NL – 2016

Appendix C: Informed consent main study

UNIVERSITY OF TWENTE.

Einverständniserklärung

Titel der Studie: Implizite und/oder explizite Beeinflussbarkeit von gesunde Individuen in dem Gefühl von Müdigkeit oder Vitalität.

Verantwortlicher Untersucher: Olga Klaus

Ich bestätige hiermit, dass ich im Begrüßungstext genügend informiert wurde über die Art, die Methode und das Ziel dieser Studie.

Ich weiß, dass die Daten und Ergebnisse dieser Untersuchung nur anonym und vertraulich an Dritte weitergegeben werden können.

Zudem habe ich zur Kenntnis genommen, dass meine Müdigkeit/Vitalität beeinflusst werden könnte und dadurch möglicherweise eine Ruhepause nötig sein könnte bevor ich Aktivitäten ausführe, die ein hohes Maß an Konzentration oder Aufmerksamkeit benötigen.

Ich nehme freiwillig an dieser Studie teil. Dabei behalte ich mir das Recht vor die Teilnahme jederzeit ohne Angabe von Gründen zu beenden.

Ich habe keine weiteren Fragen.

[Bitte auswählen] ▼

`Weiter`

Olga Klaus, Universiteit Twente, NL – 2016

Appendix D: BIAT

Bitte drücken Sie für Wörter aus der **oben stehenden Kategorien** die Taste **K**.

Für **alles andere** drücken Sie die Taste **D**.

Ich

ich   mich   mein   mir   selbst

oder

Müdigkeit

erschöpft   unkonzentriert   lustlos   schlapp   träge
niedergeschlagen   kraftlos   energielos

Legen Sie Ihre Mittel- oder Zeigefinger auf die Tasten **D** und **K**. Wörter ("Items") werden nacheinander in der Mitte des Bildschirms erscheinen.

- Wenn das Item zu den oben stehenden Kategorien **Ich** oder **Müdigkeit** gehört, drücken Sie bitte die Taste **K**.
- Für alles andere, drücken Sie die Taste **D**.

Nach einer korrekten Zuordnung erscheint automatisch das nächste Item. Wenn Sie einen Fehler machen, erscheint ein rotes **X**. Korrigieren Sie den Fehler, indem Sie die andere Taste drücken.

Während dieser Zuordnungsaufgabe wird die Zeit gemessen. **REAGIEREN SIE SO SCHNELL SIE KÖNNEN** und machen Sie dabei so wenig Fehler wie möglich.

Bitte die **Leertaste** drücken, um anzufangen.

Olga Klaus, Universiteit Twente, NL – 2016

Bitte drücken Sie für Wörter aus der **oben stehenden Kategorien** die Taste **K**.

Für **alles andere** drücken Sie die Taste **D**.

Ich

oder

Müdigkeit

kraftlos

Wenn das rote X erscheint, drücken Sie die andere Taste, damit das rote X wieder verschwindet.

Falls die Tasten nicht funktionieren, klicken Sie bitte in den Rahmen, und versuchen Sie es erneut.

Olga Klaus, Universiteit Twente, NL – 2016

Appendix E: Explanation ABM-IAT

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Nun folgt eine etwas andere Version des Zuordnungstests. Die Kategorien hier sind: Müdigkeit und Vitalität.

Die Wörter, die gleich auf dem Bildschirm erscheinen werden und die Sie den beiden Kategorien zuordnen müssen sind die folgenden:

Müdigkeit: Erschöpft, unkonzentriert, lustlos, schlapp, träge, niedergeschlagen, kraftlos, energielos.

Vitalität: Energiegeladen, lebenslustig, gesund, fit, motiviert, freudig, sportlich, aktiv.

Sie brauchen sich diese Wörter nicht zu merken, die Auflistung dienst nur zu ihrer Information.

Das Grundprinzip ist gleich: Sie ordnen die Wörter ihren Kategorien so schnell Sie können zu. Bitte drücken Sie dabei **D für Müdigkeit** und **K für Vitalität**.

Legen Sie Ihre Mittel- oder Zeigefinger auf die Tasten D und K. Die Wörter werden nacheinander in der Mitte des Bildschirms erscheinen.
-Wenn das Item zu den oben genannten Kategorien "Müdigkeit" gehört, drücken Sie bitte die Taste D.
- Gehört das Wort zu Kategorie "Vitalität", drücken Sie die Taste K.

Nach einer korrekten Zuordnung erscheint automatisch das nächste Item. Wenn Sie einen Fehler machen, erscheint ein rotes X. Korrigieren Sie den Fehler, indem Sie die andere Taste drücken.

Während dieser Zuordnungsaufgabe wird die Zeit gemessen. **REAGIEREN SIE SO SCHNELL SIE KÖNNEN** und machen Sie dabei so wenig Fehler wie möglich.

Bitte denken Sie daran:
- Legen Sie Ihre Zeigefinger auf die Tasten "D" und "K", um schnell reagieren zu können.
- Der Hinweis oben wird Ihnen zeigen welche Tasten zu welchen Kategorien gehören.
- Jedes Wort hat eine korrekte Zuordnung. Meist sind diese sehr leicht.
- Der test wird kein Ergebnis rückmelden, wenn Sie zu langsam sind. Probieren Sie deshalb so schnell wie möglich zu reagieren!
- Rechnen Sie damit, dass Sie ein paar Fehler machen werden und ein rotes X aufleuchtet. Das ist kein Problem. Korrigieren Sie die Eingabe indem Sie die andere, richtige Taste drücken!
- Um ein genaues Ergebnis zu erzielen, meiden Sie Ablenkungen und bleiben Sie konzentriert!

<div style="text-align:right">Weiter</div>

Olga Klaus, Universiteit Twente, NL – 2016

Appendix F: ABM-IAT (example from the tiredness condition)

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Bitte drücken Sie **D für Kategorie „Ich oder Müdigkeit"** und **K für „Andere oder Vitalität"**!

ich oder Müdigkeit   andere oder Vitalität

aktiv

Appendix G: CIS questionnaire

Bitte klicken Sie bei jeder Aussage auf den entsprechenden Kreis rechts, welcher angibt inwiefern diese Aussage für Sie zutrifft.

Aussage	Ja, stimmt	○ ○ ○ ○ ○ ○ ○	Nein, stimmt nicht
1. Ich fühle mich jetzt gerade müde.	Ja, stimmt	○ ○ ○ ○ ○ ○ ○	Nein, stimmt nicht
2. Ich bin jetzt voll Aktivität.	Ja, stimmt	○ ○ ○ ○ ○ ○ ○	Nein, stimmt nicht
3. Nachdenken strengt mich jetzt gerade an.	Ja, stimmt	○ ○ ○ ○ ○ ○ ○	Nein, stimmt nicht
4. Körperlich fühle ich mich jetzt erschöpft.	Ja, stimmt	○ ○ ○ ○ ○ ○ ○	Nein, stimmt nicht
5. Ich habe jetzt Lust etwas Schönes zu unternehmen.	Ja, stimmt	○ ○ ○ ○ ○ ○ ○	Nein, stimmt nicht
6. Ich fühle mich jetzt fit.	Ja, stimmt	○ ○ ○ ○ ○ ○ ○	Nein, stimmt nicht
7. Ich wäre körperlich jetzt gerade in der Lage sehr aktiv zu sein.	Ja, stimmt	○ ○ ○ ○ ○ ○ ○	Nein, stimmt nicht
8. Wenn ich im Moment mit irgendetwas beschäftigt bin, kann ich meine Aufmerksamkeit gut darauf richten.	Ja, stimmt	○ ○ ○ ○ ○ ○ ○	Nein, stimmt nicht
9. Ich fühle mich jetzt gerade schlapp.	Ja, stimmt	○ ○ ○ ○ ○ ○ ○	Nein, stimmt nicht
10. Ich bin jetzt gerade körperlich nur wenig in der Lage aktiv zu sein.	Ja, stimmt	○ ○ ○ ○ ○ ○ ○	Nein, stimmt nicht
11. Ich kann mich in diesem Moment gut konzentrieren.	Ja, stimmt	○ ○ ○ ○ ○ ○ ○	Nein, stimmt nicht
12. Ich fühle mich jetzt gerade ausgeruht.	Ja, stimmt	○ ○ ○ ○ ○ ○ ○	Nein, stimmt nicht
13. Es kostet mich in diesem Moment viel Anstrengung meine Aufmerksamkeit auf etwas zu richten.	Ja, stimmt	○ ○ ○ ○ ○ ○ ○	Nein, stimmt nicht
14. Körperlich fühle ich mich jetzt gerade in einer schlechten Verfassung.	Ja, stimmt	○ ○ ○ ○ ○ ○ ○	Nein, stimmt nicht
15. Ich habe jetzt gerade viele Pläne.	Ja, stimmt	○ ○ ○ ○ ○ ○ ○	Nein, stimmt nicht
16. Ich bin im Moment schnell müde.	Ja, stimmt	○ ○ ○ ○ ○ ○ ○	Nein, stimmt nicht
17. Mein derzeit mögliches Niveau körperlicher Aktivitäten ist gering.	Ja, stimmt	○ ○ ○ ○ ○ ○ ○	Nein, stimmt nicht
18. Die Lust etwas zu unternehmen fehlt mir jetzt gerade.	Ja, stimmt	○ ○ ○ ○ ○ ○ ○	Nein, stimmt nicht
19. Meine Gedanken schweifen im Moment leicht ab.	Ja, stimmt	○ ○ ○ ○ ○ ○ ○	Nein, stimmt nicht
20. Körperlich fühle ich mich jetzt gerade in einer ausgezeichneten Verfassung.	Ja, stimmt	○ ○ ○ ○ ○ ○ ○	Nein, stimmt nicht

Appendix H: SVS questionnaire

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Auf dieser Seite finden Sie weitere 7 Aussagen mit derer Hilfe ich einen noch genaueren Eindruck darüber gewinnen möchte, wie Sie sich jetzt in diesem Moment fühlen.

Bitte klicken Sie bei jeder Aussage auf den entsprechenden Kreis rechts, welcher angibt inwiefern diese Aussage für Sie zutrifft.

1. Ich fühle mich in diesem Moment lebendig und vital.   trifft voll zu   ○ ○ ○ ○ ○   überhaupt nicht wahr

2. Ich fühle mich jetzt gerade nicht sehr energiegeladen.   trifft voll zu   ○ ○ ○ ○ ○   überhaupt nicht wahr

3. Jetzt bin ich so lebendig, dass ich platzen könnte.   trifft voll zu   ○ ○ ○ ○ ○   überhaupt nicht wahr

4. Ich habe jetzt gerade Energie und Schwung.   trifft voll zu   ○ ○ ○ ○ ○   überhaupt nicht wahr

5. Ich freue mich im Moment auf jeden neuen Tag.   trifft voll zu   ○ ○ ○ ○ ○   überhaupt nicht wahr

6. Ich fühle mich im Moment fast immer wach und aufmerksam.   trifft voll zu   ○ ○ ○ ○ ○   überhaupt nicht wahr

7. Ich fühle mich jetzt gerade energiegeladen.   trifft voll zu   ○ ○ ○ ○ ○   überhaupt nicht wahr

Weiter

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