MASTER

A moment of brightness
the effects of brief morning Bright Light Therapy on burnout related complaints

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A MOMENT OF BRIGHTNESS:
The effects of brief morning Bright Light Therapy on burnout related complaints.

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In partial fulfilment of the requirements for the degree of

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Since my start of being a student, I have always searched for a central role for people, in which I made sure that their needs were fulfilled. This search started within the field of architecture, but continued into the field of Human Technology Interaction. Finally this search to fulfil the needs of people has resulted into a growing passion of creating healthy and pleased people by the use of the environment and technology. Only establishing the needs of people was for me never enough, since I believe an environment or a product is only helpful when it can be incorporated into daily life. This thesis in front is a part of my passion and believes which I would like to share with you as a reader.

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Enjoy reading :)

Marlies
ABSTRACT

In the context of education, high stress levels can be experienced by teachers as well as students. An approaching deadline, the pressure to perform, or unsupportive colleagues or supervisors are only some of many examples which could increase daily stress levels. A prolonged experience of daily stress related to work and study might deplete one’s available resources, which over time could develop into a burnout (Bährer-Kohler, 2013; Demerouti, Bakker, Nachreiner, & Schaufeli, 2001). Burnout is a socio-economical problem. It is a social problems since it affects wellbeing. When a burnout becomes more severe it could lead to absenteeism, partial sick leave or even resignation or withdrawn from study. It is an economical problem since burnout directly and indirectly influences healthcare costs and costs in an organisation. People who are on partial sick leave need to be (temporarily) replaced.

Burnout is characterised with many complaints, such as severe exhaustion, cynicism, decreased personal efficacy, mood changes, sleeping problems, and psychosomatic complaints, among which neck pain, headaches, muscle pain and dizziness (Bährer-Kohler, 2013). These burnout complaints could become more severe in any specific order, however exhaustion is seen as a key complaint to start and sustain the vicious circle of exhaustion, insomnia and burnout (Bährer-Kohler, 2013; Ekstedt & Fagerberg, 2005; Saleh & Shapiro, 2008). Softening of these symptoms, which could prevent a severe burnout, could therefore be a solution for this socio-economical problem. Most solutions to prevent a burnout include organizational changes. However, research has shown that individual symptoms in non-burnout patients could improve by the use of BLT, among which exhaustion (e.g. Ancoli-Israel et al., 2012; Leppämäki, Partonen, & Lönnqvist, 2002; Partonen & Lönnqvist, 2000; Rüger, Gordijn, Beersma, de Vries, & Daan, 2006), mood (e.g. Aan Het Rot, Moskowitz, & Young, 2008; Avery et al., 1991; Avery, Kizer, Bolte, & Hellekson, 2001; Yamada, Martin-Iverson, Daimon, Tsujimoto, & Takahashi, 1995) and sleeping problems (e.g. Avery et al., 2001; Hubalek, Brink, & Schierz, 2010; Riemersma-van der Lek et al., 2008). Moreover, research by Meester and Waslander (2010) with burnout patients on sick leave has showed that fatigue, depression ratings and severity of burnout could be improved by the use of BLT. It might be expected BLT could also be helpful to reduce these symptoms in people with mild to moderate burnout related complaints, therefore possibly preventing burnout.

The current research therefore focused on a possible preventive strategy for burnout by the use of BLT. In comparison with BLT being used as a treatment, in this case BLT was used by students and teachers who experienced mild to moderate levels of exhaustion, but were still teaching or studying. Therefore, this research investigated if brief morning Bright Light Therapy (BLT) could help to reduce burnout related complaints among teachers and students with a sub-threshold exhaustion score. In which burnout related complaints were exhaustion, mood changes, sleep disturbances (higher sleep onset, non-refreshing sleep and wakefulness) and psychosomatic complaints. A sub-threshold exhaustion score in this case meant having a high score on the exhaustion dimension of a burnout measurement. Unique to other research related to burnout interventions was the usage in a population still focused on their work still actually working, and the use of an experienced sampling method (ESM) – frequent assessment of a questionnaire. This method allowed more detailed information throughout the research period, therefore giving deeper understanding of the complaints. To establish the effectiveness of BLT, a within subject design with two light conditions was used: Bright Light Therapy (BLT) versus a dim red lamp (DRL) placebo condition of 20-30 minutes. Each participant had a baseline week, an intervention week (BLT), and a placebo week (DRL), in which BLT and DRL were controlled for order. Duration of the light intervention was kept as short as possible to lower the burden of the intervention as much as possible. Questions were assessed with two mediums, a website for the screening test and the weekly questionnaires, and an app for the daily questionnaires using ESM. Questionnaires to answer the research questions were focused on the severity of burnout, exhaustion, (depressive) mood, sleep habits, psychosomatic complaints and user experience.

Findings of the current research showed that only a partial effect of BLT on the burnout related complaints was found. This partial effect of BLT was merely due to that we found no support for a beneficial effect of BLT over DRL on burnout related complaints, even when controlled for order of the lamps. Findings of the
Current research showed inconsistencies on the effectiveness of BLT, which in general fitted in either one of the three following situations. In the first situation, neither BLT nor DRL had an effect. This situation occurred for exhaustion, psychosomatic complaints, tension, and stress experience. The key component of burnout, exhaustion, did not improve with either BLT or DRL. This could mean that a vicious circle of exhaustion, sleep complaint and burnout had not been broken or that exhaustion levels were not that severe as intended, meaning no vicious circle was present to be broken. In the second situation, BLT as well as DRL had a significant effect, but the effectiveness of BLT was not significantly greater when compared to DRL. This situation occurred for improving the severity of burnout, depression, positive affect, alertness, sleep onset, and the easiness to fall asleep. In this situation either a placebo effect – the expectation an intervention has a certain effect while in reality it does not have an effect – might had occurred, or something else BLT and DRL have in common might had influenced results. It is less likely that a placebo effect occurred, since results from the user experience indicated that only a few people experienced effects from DRL. Results might be explained by people taking a moment for themselves in the morning, before the start of their workday, when using either BLT or DRL. Previous research showed that interventions based on relaxation or mindfulness are effective in lowering stress, thus relaxation might had improved resources in these studies (for an overview: Awa, Plaumann, & Walter, 2010; Bährer-Kohler, 2013, pp. 230–237). Participants who normally do not take a moment for themselves before a demanding working day, could already benefit from taking a brief moment for themselves in the morning, which in a certain manner is a form of relaxation. In the third situation only DRL compared to BLT had an effect. Compared to BLT, DRL had worse sleep quality, but improved refreshment after awakening and the easiness of awakenings. Results found in the current research are inconsistent with previous research, and might have been caused by several limitation in the design used. At first, exhaustion levels might not have been as severe as expected, which could have been due to a non-validated threshold for students. It is therefore suggested to increase the threshold for exhaustion if student will be used. Secondly, BLT was used in a field experiment, meaning that daylight light levels could have influenced results. In future research it will be suggested to additionally use a light sensors to test whether bright light levels beside BLT usage might influence results. Besides the limitation it is important to note that the experienced burden of BLT and DRL was found to be high. Decreasing the burden nature of the intervention would be less demanding and therefore also less depleting. The burden nature of the intervention can be lowered by changing the moment of using BLT or by presenting bright light in a more automatic manner, which can be referred to as ambient lighting – lighting that is part of the environment. Possibilities for ambient lighting might be the use of increased brightness in ceiling illumination, since this will not require one to wake up earlier, and would therefore less obstruct people in their daily life.

To conclude, we only found partial effects of BLT on burnout complaints. On the complaints where BLT did had an effect, also DRL had an effect. The effectiveness of BLT was however not significantly greater than DRL. On the contrary, DRL worsened sleep quality, but improved refreshment after awakening and the easiness of awakenings. The key component of burnout, exhaustion, however did not improve with either BLT or DRL. This could mean that a vicious circle of exhaustion, sleep complaint and burnout has not been broken or that exhaustion levels were not that severe as intended, meaning no vicious circle was present to be broken. We therefore cannot conclude whether a moment of brightness by the use of BLT is suggested when burnout complaints are present. Limitations of the current research should first be overcome in order to draw more reliable conclusions for the use of BLT. Relaxation and a reduction in fatigue and exhaustion may already be achieved by reflection on personal wellbeing due to the frequent questionnaires, or by taking a moment for oneself in the morning. Burnout related complaints may therefore be improved by a moment of brightness; whether it be by light, consciousness or taking a moment for oneself.
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1. INTRODUCTION

Daily life can be very demanding. Many activities and responsibilities are simultaneously present, for example having to combine one’s personal life with one’s work life. When work is too demanding and one experiences stress for a prolonged time, this could cause a burnout. A burnout is characterized by several complaints, such as severe exhaustion, cynicism, decreased personal efficacy, depressive mood, sleeping problems, and psychosomatic complaints (Bährer-Kohler, 2013). When people experience these complaints due to a burnout, their wellbeing is affected and it decreases their functioning related to their work. This makes burnout, besides a personal burden, also a socio-economical problem.

Light might be a source to lower the burnout complaints exhaustion, depressive mood, sleeping problems, and psychosomatic complaints. Research by Meester and Waslander (2010) has shown that people with a burnout improved on levels of exhaustion, depressive mood, and the severity of burnout by exposing them to Bright Light Therapy (BLT). Current research focuses on whether complaints related to burnout could also improve when people are at risk for a burnout, meaning that they do not suffer from a burnout yet. Participants will be sampled in the context of education, namely teachers (from elementary school till university) and students (polytechnic school and universities). It has been shown that in the Netherlands, teachers form the most vulnerable group for getting a burnout (Driessen & Hooftman, 2011). However, currently students are also vulnerable to burnout (e.g. Kaebisch, 2011).

1.1. WHAT IS A BURNOUT?

A general well-accepted definition of burnout does not yet exist. Therefore, many descriptions of what a burnout is are being mentioned in literature. Some of these description are broad definitions, for example that it is ‘a state of total exhaustion’ (Z.73.0: WHO, 1992). When all descriptions are taken together, the general consensus is that burnout concerns a prolonged experience of daily stress related to work which might deplete one’s available resources (Bährer-Kohler, 2013; Brenninkmeijer & van Yperen, 2003; Demerouti et al., 2001; Hoogduin, Schaafeli, Schaap, & Bakker, 2001; Wilmar B. Schaafeli, Leiter, & Maslach, 2009). Over time this could develop into a burnout, which is characterized by exhaustion and additionally by cynicism or decreased personal efficacy. This definition incorporates four core aspects of burnout, namely that it is a work related condition, it is due to demands predominating resources, it is a dichotomous state of wellbeing, and that at least exhaustion needs to be present.

1.1.1. Work related condition

The first core aspect of burnout states that burnout is work related. Among Dutch employees estimated burnout rates range from 4% (Bakker, Schaafeli, & Van Dierendonck, 2000) to 7.2% (Zijlstra & De Vries, 2001). These values could depend on the type of professions included. Each job has its own characteristics, which could be stressful. Some jobs have even more stressful characteristics than others. For example, work with a high degree of repetitiveness or contact with other people could be more stressful (Bährer-Kohler, 2013). In the Netherlands, based on results in 2011 from the Centraal Bureau voor Statistiek (CBS), teachers belong to the job category most vulnerable for a burnout, 17% of them are burnout sufferers (Driessen & Hooftman, 2011). These burnout rates among teachers are high due to large groups of pupils, high workload and repetitiveness in teaching the same subject (Bährer-Kohler, 2013; Bauer et al., 2006). Other professions more vulnerable for a burnout are for example nurses, cops and blue collar workers (Bährer-Kohler, 2013; Driessen & Hooftman, 2011).

Although this first core characteristic dictates that burnout is work related, it is suggested that unpaid work could also introduce a burnout (Bastaanssen et al., 2011; Hoogduin et al., 2001; Verschuren et al., 2011). Work in relation to burnout means a systematic, structural and goal oriented task or activity with an certain obliging nature (Wilmar B. Schaafeli, 2007; Verschuren et al., 2011). Groups with unpaid work who could experience burnout are for example informal caregivers (Nederlands Instituut voor Zorg en Welzijn, 2005), volunteers (Verschuren et al., 2011), and students (Bolwerk, 2011; Frese, 2009; Hackelberg, 2012; Kaebisch, 2011). In relation to students, no statistics are known on burnout rates. Despite this, there is a growing interest of research in burnout among students. A study by Broenink, Gorter and Woers (2001 in: Bolwer,
2011) shows that in the Netherlands roughly 5.9% of the students experience psychological complaints related to severe stress experience. This stress experience might be mainly caused by a high workload. Although this does not show actual burnout rates among students, it indicates that work related stress experiences in students could be a severe problem in relation to a burnout.

1.1.2. Work demands predominating resources
The second aspect of burnout states that job demands predominate resources over a prolonged period of time. In this case, work demands can be described as ‘physical, psychological, social or organizational work aspects that require sustained physical or mental effort’ (Bakker, Demerouti, & Euwema, 2005, p. 170). These work demands could also be described as work stressors, since they are work aspects that could increase stress levels. Some general work demands for example could be role-conflicts, work pressure and physical workload. On the other hand resources can be described as ‘physical, psychological, social or organizational aspects of work that are functional in reaching work-related goals, reducing work demands and stimulating personal growth’ (Bakker et al., 2005, p. 170). Some general resources, for example, could be social support from colleagues, feedback, work control, and reward. Although Bakker and colleagues (2005) mainly describe organizational resources, which refer to resources one can only find at work, resources could also be found outside the organization. For example, support from family and friends, sports and activities providing relaxation. Resources could therefore also be described as energy sources available, which do not necessarily need to be work related. Having energy sources available is related to feelings of subjective vitality, which can be described as ‘one’s conscious experience as possessing energy and aliveness’ (Ryan & Frederick, 1997, p. 530). Increased vitality could help to replenish resources, meaning it could help to increase the resources available (Muraven, Gagné, & Rosman, 2008).

Resources are shown to be able to buffer work demands (Bakker et al., 2005). Meaning that when work demands are high, resources could lower the stress experience of these work demands. When resources however are not sufficient to decrease stress, work demands outweigh resources. When work demands predominate resources over a prolonged time, one’s energy levels become depleted, which eventually could lead to a burnout (Bakker et al., 2005; Bakker, Schaufeli, & Demerouti, 1999; Demerouti et al., 2001). Therefore, increasing levels of vitality might prevent work demands to predominate resources and thus prevent the development of a burnout. A single stress moment will thus not result in a burnout. Instead, frequent or almost chronic work related stress must be experienced. According to Dutch guidelines, a burnout could take over 1 year to develop (van der Klink & van der Putten-Driessen, 2000).

Work demands and work resources differ between different professions, since work characteristics differ. Work demands which could cause stress in teachers include having to give the same lecture each year thereby causing a lack of diversity, the size of the school class, the behaviour of difficult pupils, and high work pressure (Bährer-Kohler, 2013; Bauer et al., 2006). Work resources for teachers can include the joy to teach a pupil something new, the idea that teaching a pupil something could make them successful, and the bond with the pupils. Note that demands and resources might somewhat differ in teachers from primary schools, secondary schools, vocational education, polytechnic schools, and universities. Work demands which could cause stress in students on polytechnic schools and universities include work pressure, physical workload, deadlines, and the pressure to succeed (Kaebisch, 2011). Work resources for these students include good grades, good contact with a teachers or supervisor, and social support from fellow students.

1.1.3. Burnout as and dichotomous state of wellbeing
The third aspect of burnout is that burnout in most cases is seen as a dichotomous state of wellbeing, meaning one can have either a burnout or not (e.g. Bährer-Kohler, 2013; Hoogduin et al., 2001). In the Netherlands however, the Royal Dutch Medical Association suggests there are different levels of stress related disorders, namely distress, nervous breakdown and burnout (van der Klink & van Dijk, 2003 in: Schaufeli et al., 2009). Burnout is in this case seen worst in final form of stress related disorder, described as work-related neurasthenia accompanied by long-term loss of the occupational role. Distress and nervous breakdown have less severe symptoms compared to burnout and they only lead to partial or temporal loss of the occupational role. Self-administered burnout questionnaires, such as the Maslach Burnout Inventory (Maslach, Jackson, & Leiter, 1986), the Oldenburger Burnout Inventory (OLBI: Demerouti, 1999) and the
Shirom-Melamed Burnout Questionnaire (SMBQ: Melamed, Kushnir, & Shirom, 1992), distinguish between very low, low, average, high and very high risk on a burnout.

1.1.4. Exhaustion as core dimension

The fourth aspect of burnout is that at least exhaustion needs to be present (e.g., Brenninkmeijer & van Yperen, 2003; Hoogduin et al., 2001; Maslach, Leiter, & Schaufeli, 2008; Schaufeli et al., 2009). When work demands continually predominate resources, it starts to deplete one’s energy levels, leading to severe feelings of exhaustion. People, for example, feel that they do not have enough energy to get through their working day or feel they have no energy left to do any non-work related activities besides work. Moreover, when having a burnout, people feel exhausted the entire day, with in general no differences in exhaustion between working days and the weekend (Bährer-Kohler, 2013). Still, some fluctuation in exhaustion in one individual during the week might be present in burnout. Exhaustion has therefore also been described as wearing out, loss of energy, depletion, debilitation, and fatigue (Maslach et al., 2008). Although exhaustion is seen as a precondition for a burnout, it in itself is not sufficient for a burnout. Otherwise it could be labelled as chronic fatigue.

Besides exhaustion, either cynicism or low personal efficacy needs to be present before a burnout could be diagnosed. Brenninkmeijer and van Yperen (2003) label this statement as the exhaustion + 1 criterion. Cynicism refers to a negative attitude people have towards their work, meaning people with a burnout have distanced themselves from work objects, work content, or their work role or that they have lost their idealisms (Hoogduin et al., 2001; Maslach et al., 2008). For example, teachers could distance themselves from their colleagues, students, and the importance of their work. Students on the other hand could distance themselves from fellow students, their future role after graduating, the lecture content, or their field of study in general. Low personal efficacy refers to a negative attitude towards feelings of one’s own competence and achievement at work (Hoogduin et al., 2001; Maslach et al., 2008). For example, teachers could feel that they do not support their students enough.

1.1.5. Burnout conceptualised in the WEB-model

There are several models that have tried to conceptualise what a burnout is, however most of these models describe only a part of burnout. The Work-stressors Energy-sources Burnout model (WEB-model: Bakker et al., 1999) has tried to combine most models into one general model and is shown in Figure 1.1. The WEB-model takes into account three out of four core aspects of burnout, namely that it is a work related condition, is due to demands predominating resources, and that at least exhaustion needs to be present. The model describes that work-stressors to a large extent are accompanied by organizational characteristics. The model does not incorporate differences in coping strategies between individuals. These could, however, be considered important to determine whether a person experiences specific work characteristics stressful (Bährer-Kohler, 2013).

In addition to the core aspects of burnout, the WEB-model shows the outcomes when a burnout can be experienced. When in a burnout, an individual’s wellbeing is affected (Bährer-Kohler, 2013; Hoogduin et al., 2001) and their functioning related to their work decreases (Bakker et al., 1999, 1999; Demerouti et al., 2001). A decreased functioning due to stress experience in students has also been shown; this caused students to skip lectures and perform worse on exams and, therefore, could cause students to discontinue their study (Law, 2007). In employees, high turnover could also be an outcome of a burnout (Bakker et al., 1999). Lower productivity, absenteeism, and turnover can severely affect the organization. This makes burnout a socio-economical problem. Moreover, a spill-over effect might occur to direct colleagues due to increased work pressure (Bährer-Kohler, 2013). Although exact costs related to burnout are hard to predict, in the Netherlands long-term absence and disability due to work-related stress and burnout were estimated to cost 4 billion Euros a year (Bährer-Kohler, 2013).
1.2 Burnout complaints besides exhaustion, cynicism and low personal efficacy

Although exhaustion is seen as a core element in burnout, and that this is accompanied with either cynicism or personal efficacy, these are not the only complaints related to burnout. In the development from low risk to high risk to an actual burnout, more complaints are experienced. A burnout can cause depressive mood, sleeping problems, and psychosomatic complaints (Bährer-Kohler, 2013). These complaints are suggested to be helpful in determining the need for and specificity of the required interventions to help recovering from burnout (Bährer-Kohler, 2013).

1.2.1. Depressive mood

Burnout has been linked to depressive mood (e.g. Bährer-Kohler, 2013; Hoogduin et al., 2001). This means that people with a burnout could feel sad, frustrated, angry, unhappy, irritated, and hopeless (Bährer-Kohler, 2013; Hoogduin et al., 2001). Burnout and depression show much overlap. In a review paper, Lacovides Fountoulakis, Kaprinis, and Kaprinis (2003) compare burnout with depression, and reported that the complaints have an estimated shared variance of 20%. Individuals suffering from depression as well as those suffering from burnout, for example, experience fatigue, sadness, and the inability to concentrate (Wilmar B. Schaufeli & Buunk, 2003). However, people with a burnout are not depressed (Bährer-Kohler, 2013). There are four key differences between a person having a burnout and people having a depression.

First, a depressed person still has the energy to do enjoyable activities, but does not enjoy these activities. On the contrary, a person with burnout does not have the energy to do these enjoyable activities, although one could enjoy them (Hoogduin et al., 2001). Second, weight loss is unlikely in burnout, while it is more likely in depression (Hoogduin et al., 2001). Third, frustration is not experienced in depression, but it is in burnout (Bährer-Kohler, 2013). Fourth, suicidal thoughts are common in depression, but are absent in burnout (Hoogduin et al., 2001).

1.2.2. Sleeping problems

Burnout has been linked to sleeping problems (Bährer-Kohler, 2013). Several studies have investigated sleeping problems in burnout (Ekstedt, Söderström, & Åkerstedt, 2009; Söderström, Ekstedt, Akerstedt, Nilsson, & Axelsson, 2004; Sonnenschein, Sorbi, van Doornen, Schaufeli, & Maas, 2007). The studies found mixed results on which sleeping problems are related to burnout. These studies agree that these include, not feeling refreshed in the morning, not recovering from sleep, experiencing sleepiness in the morning, and having a longer sleep latency onset (Ekstedt et al., 2009; Söderström et al., 2004; Sonnenschein et al., 2007). Disagreement, however, exist for whether sleep fragmentation, time of awakening, and sleep duration are related to burnout. The differential results on time of awakening and sleep duration might depend on whether the burnout group was on partial or full sick leave, compared to the healthy population who is still...
healthy employees probably still need to set their alarm, while people in partial or full sick
leave do not. Therefore, control of sleeping as long as desired and rise when desired might mediate these
results.

1.2.3. Psychosomatic complaints
Burnout has been linked to psychosomatic complaints, which can be described as inexplicable complaints or
bodily manifestations of psychological factors such as stress or anxiety (Hoogduin et al., 2001; Verbraak,
Kleyweg, van de Griendt, & Hoogduin, 2008). Psychosomatic complaints in burnout consist of headaches,
muscular pain in the neck, arms and shoulders, and dizziness (Ekstedt & Fagerberg, 2005; Maslach & Leiter,
2008; Verbraak et al., 2008). It is suggested that these psychosomatic complaints are atypical stress related
complaints (Verbraak et al., 2008), meaning that a psychological factor such as stress could lead to negative
physical experiences such as headaches, muscle pain and dizziness. Since burnout is a work related stress
condition, these complaints can be linked to burnout.

1.3. Dynamic interplay between complaints and the development of burnout
The development of burnout is seen as a dynamic process, meaning that burnout complaints can influence
each other. Although the WEB-model describes the core elements of a burnout, it does not show how the
other complaints (sleep, psychosomatic complaints, and depression) are involved and what the dynamic
interplay between these complaints is. It is still uncertain how the dynamic process of burnout exactly
evolves. Research for example is contradictory about the development of the core characteristics of
burnout: exhaustion, cynicism, and low personal efficacy. Some suggest exhaustion is the first burnout
symptom, followed by cynicism (Lee & Ashforth, 1996) or low personal efficacy (Leiter & Maslach, 1988).
Others suggest it starts with cynicism followed by exhaustion (Gil-Monte, Peiró, & Valcárcel, 1998). This
difference might be due to different professions, or due to culture; how burnout is being experienced or
described might differ between countries and professions (Bährer-Kohler, 2013).

Several models have tried to describe the dynamics between burnout complaints (e.g. Ekstedt & Fagerberg,
2005; Freudenberger and North, 2006 in: Bährer-Kohler, 2013, p. 52; Saleh & Shapiro, 2008). The 12-stage
burnout cycle from Freudenberger and North (2006 in:Bährer-Kohler, 2013, p. 52), suggests that there is no
specific order for each stage. The cycle states that there are different stages each person with a burnout will
experience; the duration, order, and how many stages are present simultaneously is suggested to differ
between persons (Freudenberger & North, 2006 in:Bährer-Kohler, 2013, p. 52). However, in depth
interviews (n=2) might express a possible structure of people’s experience when developing a burnout (see
Figure 1.2) (Ekstedt & Fagerberg, 2005). This structure starts with a motivation for life, called the inner
incentive. This motivation is cause to continue with the work demands and ignore the need for resources.
Next, guilt will be experienced, due to feeling of them neglecting partners, relatives or other relationships.
In order to cope with this guilt, people start to cut off their emotions and inner communication, meaning
the sensibility to feel anything at all (pain, joy, happiness, love, empathy) is damaged. At that moment
psychosomatic complaints and fatigue are experienced. This fatigue is experienced as impossible to ‘sleep
off’. Then a vicious circle starts, since not enough resources are available and the work demands are not
diminished. Successively, a bottom line is reached, people feel work has no point and the state of burnout
is reached (Ekstedt & Fagerberg, 2005).

Figure 1.2: Lived experience of time preceding burnout (Ekstedt & Fagerberg, 2005)
Other literature also supports a vicious circle, in which fatigue and insomnia are considered key elements in both the development and recovery of burnout (Brand et al., 2010; Saleh & Shapiro, 2008; Söderström, Jeding, Ekstedt, Perski, & Akerstedt, 2012; Sonnenschein et al., 2007). Saleh and Shapiro (2008) point this vicious circle to a bidirectional relationship (see Figure 1.3). More specific, sleeping problems are shown to predict burnout (Söderström et al., 2012), while a reduction of sleeping problems is related to the recovery from burnout (Sonnenschein et al., 2007). Besides, exhaustion is generally seen as a core component in burnout, which can predict a burnout (Bährer-Kohler, 2013; Hoogduin et al., 2001). Besides, fatigue is related to the recovery from burnout (e.g. Ekstedt & Fagerberg, 2005). Therefore, reducing levels of fatigue and insomnia, or preventing fatigue and insomnia to occur are therefore highly recommended to prevent a burnout to endure or to develop a burnout. Although it is uncertain how the dynamic process of burnout exactly evolves, burnout complaints seem related to each other. Light might be a solution for these complaints in burnout.

![Figure 1.3: Bi-directional relationship between fatigue, sleep disturbances, and burnout (Saleh & Shapiro, 2008).](image)

### 1.4. Biology path behind the influence of bright light exposure

Light projecting on the rods and cones enables sharp and a coloured vision. Besides enabling vision, light has additional capacities that are not related to vision, known as Non-Image Forming (NIF) effects of light. These NIF effects are biological effects of light, which are to a large extend caused by a third type of photoreceptor that is found in the retina besides the traditional rods and cones. This third photoreceptor is referred to as intrinsically photosensitive retinal ganglion cell (ipRGC), which is a light sensitive ganglion cell. Light exposure on ipRGC’s starts a biological process by sending information to various brain areas, involved in the regulation of sleep and wakefulness, alertness and mood (Vandewalle, Maquet, & Dijk, 2009). This biological process, is visualised in Figure 1.4. This regulation of sleep and wakefulness concern internal processes and external processes, in which the influence of light is an external process. Before going into depth on the external process, first the internal process will be explained. The internal process of sleep and wakefulness is regulated with two core components, referred to as the circadian component and a homeostatic component (e.g., Dijk & Czeisler, 1995). The homeostatic component refers to an hourglass oscillator, increasing sleep pressure while awake, and decreasing while asleep. This transition between sleep and wakefulness resembles the turning of an hourglass (e.g. Romeijn et al., 2012). The circadian component, derived from the latin ‘circa diem’ (‘approximately one day’), refers to an endogenous process, which contrary to the homeostatic component is independent of the amount of preceding sleep or wakefulness (Sinton & McCarley, 2004). Instead the circadian component derives information from a central clock in our brain, located in the suprachiasmatic nucleus (SCN) in the hypothalamus, which drives many physiological and behavioural rhythms in advance of activities throughout the day (Foster & Kleitzman, 2005 in Smolders, 2013). One of these rhythms is the sleep and wakefulness (Dijk & Lockley, 2002; van Someren, 2000).

Besides these internal processes, external factors such as light can influence the biological process. When light reaches the retina, the ipRGC’s express the photopigment melanopsin. The production of melanopsin is seen as a primary cause for the NIF effects of light (Hankins, Peirson, & Foster, 2008). However, this melanopsin driven response is suggested to require higher light intensities compared to the rods and cones.
photopsin-expressing responses (Vandewalle et al., 2009). It is important to note that there are two different types of NIF effects of light, one concerning long-term effects of light, and the other concerning direct effects of light. First, long term effects of light will be explained. Long term effects of light involve regulation of the biological clock. High concentrations of melatonin by exposure through high intensity light can entrain the biological clock, due to feedback on the SCN (Sack, Brandes, Kendall, & Lewy, 2000; Wu & Swaab, 2007). Therefore, light can introduce a phase shifting effect — ability to adjust the biological clock (Lewy, Sack, Miller, & Hoban, 1987; Vandewalle et al., 2009). This means that on the longer term light might help to overcome sleeping problems such as sleep fragmentation, trouble falling asleep, and help extreme morning or evening persons to adjust their biological clock. Second, direct effects of light will be explained. In contrast to the long term effects of light, direct effects of light can be observed during or immediately after the light exposure. These direct effects of light include improvement of alertness, performance on several cognitive tasks, and affective responses (Vandewalle et al., 2009).

![Figure 1.4: NIF effects of light: long term and direct effects (Foster, 2011).](image)

### 1.5. Previous Research of Bright Light Exposure and Burnout Related Complaints

High intensity light can thus influence human physiology and well-being. This suggests light could be used to overcome burnout related complaints, in particular: exhaustion, depressive mood, and sleeping problems (i.e., non-refreshing sleep, sleep latency onset, and sleepiness in the morning). Indeed, high intensity light exposure has been used in people suffering from seasonal affective disorders, and in those having troubles with alertness and cognitive performance. In these cases high intensity light exposure is called Bright Light Therapy (BLT). In research concerning BLT and burnout related symptoms, timing of BLT varied between morning or evening exposure, intensity of BLT varied between 1500 and 10,000 lux, and duration varied between 20 minutes and 4 hours. Other research has tried to find a relationship between the direct effects of bright light exposure and complaints such as fatigue, work related strain, and personal accomplishment. Examples on previous research will be discussed in the following sections and are divided in research specifically focused on burnout and on previous research with no focus on burnout. In each section an overview of all literature will be presented in a table.
1.5.1. Treatment of burnout with light

Research into the influence of light exposure on burnout is scarce. Three studies have investigated the relation between light exposure and burnout (Alimoglu & Donmez, 2005; Meesters & van Velzen, 2010; Meesters & Waslander, 2010). Alimoglu and Donmez (2005) investigated whether daylight exposure might be a predictor of burnout among nurses. They reported that more than three hours of subjective daylight exposure at work positively influenced work-related strain and job satisfaction, while it did not influence burnout. Note that results of this study should be interpreted with care, since confounding variables such as the amount of nightshifts or whether people worked in windowless spaces is not reported and not controlled for. Nightshift and the presence of windows influence the amount of daylight people are exposed to. Furthermore, measurements depended on subjective interpretations of daylight exposure and not actual light measurements.

<table>
<thead>
<tr>
<th>Author (year), country</th>
<th>Participant sample</th>
<th>Field/lab</th>
<th>Intervention/prediction</th>
<th>Results found</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alimoglu &amp; Donmez (2005), Turkey</td>
<td>141 nurses</td>
<td>Field</td>
<td>Self-reported daylight exposure (0-1, 1-3, &gt;3 hour) at work as predictor of burn-out among nurses</td>
<td>No direct effect of daylight exposure on burnout.</td>
</tr>
<tr>
<td>Meester &amp; Waslander (2009), Netherlands</td>
<td>30 burnout</td>
<td>Field</td>
<td>BLT (full spectrum, without UV, 10,000 lux) between 8.00-8.45 on weekdays for 2 weeks vs. a waiting list control condition.</td>
<td>Severity of burnout, exhaustion, and depression significantly decreased.</td>
</tr>
<tr>
<td>Meester &amp; van Velzen (2010), Netherlands</td>
<td>76 burnout (BLT 16, waiting list 14, 46 CBT)</td>
<td>Field</td>
<td>Investigate two treatments: ligh and CBT. For the light treatment: BLT (full spectrum, without UV, 10,000 lux) between 8.00-8.45 on weekdays for 2 weeks vs a waiting list control condition.</td>
<td>Significant improvement of exhaustion by BLT and CBT</td>
</tr>
</tbody>
</table>

The influence of 45 minutes morning BLT in people with burnout has been investigated in two studies relatively similar to each other (Meesters & van Velzen, 2010; Meesters & Waslander, 2010). The studies differed in that Meester and van Velzen (2010) also report result from solely using CBT for one year. Results on burnout complaints of both studies will be reported together. In people diagnosed with burnout, a week of morning BLT (10,000 lux) of 45 minutes lowers severity of burnout related complaints (Meesters & Waslander, 2010). Burnout severity was in this case measured with subjective unrest, exhaustion, and psychosomatic complaints. However, BLT showed no improvements on different burnout questionnaire, with the dimensions exhaustion, cynicism and low personal efficacy (Meesters & van Velzen, 2010; Meesters & Waslander, 2010). That no effects were found on the second burnout measurement might have been due to the sensitivity of the scale for the time interval used. More specifically, the burnout scale was assessed every week, while the scale also included answer possibilities such as once a year and once a month.

Depressive mood and has shown to improve by the 45 minute morning BLT in one study (Meesters & Waslander, 2010), but not in the other (Meesters & van Velzen, 2010). Both studies however showed that BLT improved exhaustion levels (Meesters & van Velzen, 2010; Meesters & Waslander, 2010). Although a week of BLT is not enough to completely recover from burnout, and exhaustion levels were still relatively high, Meester and Waslander (2010) suggest BLT might improve resources and help to recover from burnout faster. Note that normal recovery of burnout could take half a year or ever longer (Bährer-Kohler, 2013). Normally, burnout sufferers receive Cognitive Behaviour Therapy (CBT) or relaxation training, which are both proven techniques which could lower stress experience and help people to cope with stress, and therefore help burnout (Awa et al., 2010; Cohen-Katz, Wiley, Capuano, Baker, & Shapiro, 2005). Although Meester and van Velzen (2010) also investigated the use of solely CBT, their research did not compare the effectiveness between BLT and CBT. Moreover, it is unknown if people while receiving BLT also received CBT. As far as known, no research has directly investigated the influence of BLT on psychosomatic complaint such as muscle pains, headaches and dizziness. However, research by Meester and Waslander (2010) indicates BLT might improve psychosomatic complaints in burnout patients, due to the overall improvement on a severity scale of burnout, which includes a dimension of bodily manifestations. Although uncertain, this could suggest psychosomatic complaints as a separate dimension might improve by the use of BLT.
A critical point in previous research on BLT and burnout is the control condition that was being used, namely a waiting list condition. This waiting list condition means that the control group is given the opportunity to benefit from BLT after the research has ended. Light research might be affected by psychological effects (placebo effect), which requires a good control condition. Since light is visible for people to experience, a waiting list condition might influence effect sizes (Specia, Carlson, Goodey, & Angen, 2000).

Besides these studies investigating the efficacy of light exposure on burnout specifically, other research has found beneficial effects of light on individual symptoms related to burnout, which will be discussed in the following sections.

### 1.5.2. Exhaustion

Light exposure has been investigated in women undergoing breast cancer chemotherapy, who experience high levels of exhaustion. A positive correlation between exhaustion and light exposure above 1000 lux during chemotherapy has been found (Liu et al., 2005). Despite this correlation, results must be interpreted carefully, since the chemo itself might also be exhausting. Another study with women undergoing breast cancer chemotherapy has found that 30 minutes of morning BLT, compared to a dim red control condition did not improve overall exhaustion (Ancoli-Israel et al., 2012). However, BLT did prevent overall exhaustion levels from increasing further, while overall exhaustion levels in the dim red control condition did increase (Ancoli-Israel et al., 2012). Unfortunately, the amount of light exposure during BLT were not reported. Effects were not mediated by sleep.

<table>
<thead>
<tr>
<th>Table 1.2: Overview studies on light exposure and BLT on Exhaustion and Vitality</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Author (data), country</strong></td>
</tr>
<tr>
<td>Liu et al. (2005), USA</td>
</tr>
<tr>
<td>Ancoli-Israel et al. (2012), USA</td>
</tr>
<tr>
<td>Rüger et al. (2006), USA</td>
</tr>
<tr>
<td>Leppämäki, et al. (2002), Finland</td>
</tr>
<tr>
<td>Partonen &amp; Lönnqvist (2000), Finland</td>
</tr>
<tr>
<td>Smolders, De Kort, &amp; Van den Berg (2013), Netherlands</td>
</tr>
</tbody>
</table>

In healthy people it has been shown that four hours BLT (5,000 lux), compared to four hours of dim light exposure (< 10 lux) could improve the overall level of exhaustion (Rüger et al., 2006). Moreover, BLT improved exhaustion independent of the moment of exposure, either at noon or at midnight. It is suggested...
this the reduction of exhaustion might have been partly due to the sleep instructions participant were given, especially since the measurement period was relative short, namely 1.5-2.5 days (Rüger et al., 2006). Besides, a light exposure of less than 10 lux is extremely dark and not comparable with light exposure during daily life.

Vitality is a concept closely related to exhaustion, since it assesses one’s energy and aliveness (Ryan & Frederick, 1997). Moreover, vitality has also has been investigated in relation to bright light exposure (De Kort & Smolders, 2010; Leppämäki et al., 2002; Partonen & Lönnqvist, 2000; Smolders, De Kort, & Van den Berg, 2013). Hourly bright light exposure (>1000 lux) was found to be related to hourly measured feelings of vitality, even if controlled for moment of day (Smolders et al., 2013). This study suggested a causal relationship between bright light, but cannot solidly confirm a causal relationship between vitality and bright light due to its correlational structure. At least an hour of Bright Light in a gym (2500-4000 lux at eye level) had shown to increase feeling of vitality when only exposed 2 till 3 times a week for a period of 4 weeks (Leppämäki et al., 2002). Moreover, BLT (2500 lux at eye level) of at least one hour for 4 weeks has shown to increase feeling of vitality in healthy individuals (Partonen & Lönnqvist, 2000). Note however that the latter study had not used a placebo lamp, but instead a cross over design (ABAB), which might have influenced conclusions. Moreover, the study was performed during the winter in Finland, meaning overall the amount of daylight was 1-1.5 hour less compared to the Netherlands.

1.5.3. Mood & depressive mood

Much research has focused on the effectiveness of BLT on depressive mood, especially in people having a Seasonal Affective Disorder (SAD) - a condition in which people feel more depressed in the winter. BLT has shown to lower depression in SAD (Avery et al., 1991, 2001; Gordijn, Meesters, & others, 2012; Lingjaerde, Føreland, & Dankertsen, 1998) and non-SAD (Kripke, Mullaney, Klauber, Craig Risch, & Christian Gillin, 1992; Martiny, Lunde, Unden, Dam, & Bech, 2005; Yamada et al., 1995). The majority of studies used BLT by sitting in front of an artificial light source (1500-10.000 lux), except in the study by Kripke and colleagues (1992), in which BLT (2000-3000 lux) was given by increasing ceiling illumination. Note that most studies did not note if lux levels represent measurements at the eye’s location.

Most of these study used solely morning BLT in both SAD (Avery et al., 1991, 2001; Gordijn et al., 2012; Lingjaerde et al., 1998) and non-SAD (Martiny et al., 2005), while others compared the effectiveness between morning and evening BLT in both SAD (Avery et al., 1991) and non-SAD (Yamada et al., 1995). Yamada and colleagues (1995) show no difference between the effectiveness of timing, while Avery and colleagues (1991) show that although both were effective, morning BLT was slightly better compared to evening BLT. This difference might have depended on people having SAD or non-SAD. This does however not mean that morning BLT will be suitable for everybody, since it is suggested that the optical timing of BLT might depend on chronotype (individuals’ inclined time to sleep during a 24 hour period) (Terman, Terman, Lo, & Cooper, 2001). The duration of BLT differs between 20 minutes till 90 minutes between studies. It was shown there is no difference between the effectiveness of 20 or 30 minutes BLT of 9.000 lux on depression (Gordijn et al., 2012). Although not being compared with 90 minutes, it suggest that 20-30 minutes of morning BLT might be enough, when using at least 9.000 lux, to improve depressive mood.

Research has also focused on the effectiveness of bright Light on mood in general (Aan Het Rot et al., 2008; Avery et al., 2001; Leppämäki et al., 2002; Smolders et al., 2013), meaning that the focus was not on depressive mood, but rather on positive and negative affect in general. Daily light exposure (>1000 lux) has been found to have a positive relation with mood when measured frequently during the day (Aan Het Rot et al., 2008). However another study did not found a relationship between mood and light exposure (Smolders et al., 2013). Differences could be based on when daily measures were assessed, since on study measured based on time intervals (hourly) (Smolders et al., 2013), while the other measured based on the happening of an event (social interactions) (Aan Het Rot et al., 2008). Both studies however could only confirm a correlation, since no causal relationship between bright light and mood could be drawn. However, research has shown that the use of BLT (2500 lux at eye level) in healthy individuals could improve mood, since it increased positive affect (Avery et al., 2001; Leppämäki et al., 2002). Note however that both these studies did not had an actual placebo lamp, meaning effects could have been somewhat overestimated.
<table>
<thead>
<tr>
<th>Author (data), country</th>
<th>Participant sample</th>
<th>Field/ lab</th>
<th>Intervention/ prediction</th>
<th>results found</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avery et al. (1991), USA</td>
<td>19 SAD</td>
<td>field</td>
<td>morning (6:00-8:00) VS evening (19.00-21.00) BLT (full spectrum 2.500 lux) for 7 days</td>
<td>Depression improved in both morning and evening exposure, improvement in depression was significantly greater in the morning.</td>
</tr>
<tr>
<td>Avery et al. (2001), USA</td>
<td>30 SAD</td>
<td>field</td>
<td>BLT (2500 lux) vs. no extra light exposure for 2 hours for 2 weeks in either the morning (between 7:00 and 12:00) or afternoon (between 12:00 and 17:00.)</td>
<td>Depression improved, mood improved, higher alertness and higher energy levels in the morning and afternoon</td>
</tr>
<tr>
<td>Gordijn et al. (2012), Netherlands</td>
<td>52 SAD</td>
<td>field</td>
<td>2 week of 30 minutes BLT (lux not reported, full spectrum) vs 30 minutes BLT Blue enriched (9000 lux, 17.000k) vs 20 minutes BLT blue enriched (9000 lux, 17.000k)</td>
<td>Depressive symptoms diminished in all conditions, with no significant differences between conditions.</td>
</tr>
<tr>
<td>Lingjaerde et al. (1998), Denmark</td>
<td>61 SAD</td>
<td>field</td>
<td>BLT field, DDS lab (hospital)</td>
<td>BLT and DDS both improved depression.</td>
</tr>
<tr>
<td>Kripke et al., (1992), USA</td>
<td>51 non-SAD veterans</td>
<td>lab (hospital)</td>
<td>Ceiling BLT (2000-3000lux) vs dim light control (&lt;50 Lux) in the morning (5.00-6.00) and evening (21.00-22.00) for 1 week. After one week switch to 3hour in the evening (20.00-23.00)</td>
<td>Trend for BLT on decreasing depressive symptoms. Sleep did not predict treatment response.</td>
</tr>
<tr>
<td>Martiny et al. (2005), Denmark</td>
<td>102 non-SAD</td>
<td>field</td>
<td>5 weeks of BLT (10.000lux, 1 hour) vs control dim red (50lux, 30min), as soon as awake, but no later than 10.00. Early BLT with an antidepressant (serotonin) as prevention of depression</td>
<td>Reduction in depression scale significantly larger in BLT compared to dim red.</td>
</tr>
<tr>
<td>Yamada et al. 1995, Canada</td>
<td>27 non-SAD, 16 control</td>
<td>lab (hospital)</td>
<td>7 days full spectrum BLT (2500 lux) vs DLT (500 lux) as a function of timing: morning (6.00-8.00) vs evening (18.00-20.00). Strict bedtimes and restrictions on not going outside.</td>
<td>BLT (morning and evening) significantly improved severity of depression, while DLT did not.</td>
</tr>
<tr>
<td>Partonen &amp; Lönnqvist (2000), Finland</td>
<td>160 office workers</td>
<td>field</td>
<td>AABAB design. BLT (2500 lux at eye level), at least one hour in 5 days per week. An intervention (B) period was 4 weeks, in the control (A) period, no light was present.</td>
<td>Improvement of vitality and decrease in depressive symptoms.</td>
</tr>
<tr>
<td>Aan Het Rot et al. (2008), Netherlands</td>
<td>48 mildly seasonal</td>
<td>field</td>
<td>examined possible links between bright light exposure &gt; 1000 and social interaction using naturalistic data for 20 days</td>
<td>More agreeable behaviours and better mood when exposed to high but not low levels of bright light, independent of season, day, time, and location.</td>
</tr>
<tr>
<td>Leppämäki et al. (2002), Finland</td>
<td>80</td>
<td>field</td>
<td>Bright ceiling illumination (&gt;2.500, measures eye level) for at least one hour 2-3 times in one week at gym vs normal illumination</td>
<td>Increase in vitality positive affect, decrease in depressive symptoms for BLT compared to ordinary lighting.</td>
</tr>
<tr>
<td>Avery et al. (2001) , USA</td>
<td>30 SAD</td>
<td>field</td>
<td>BLT (2500 lux) vs. no extra light exposure for 2 hours for 2 weeks in either the morning (between 7:00 and 12:00) or afternoon (between 12:00 and 17:00.)</td>
<td>Depression improved, mood improved, higher alertness and higher energy levels.</td>
</tr>
<tr>
<td>Smolders, De Kort, &amp; Van den Berg (2013), Netherlands</td>
<td>42</td>
<td>field</td>
<td>Investigated daily light exposure and its relation with vitality in everyday settings on an hour-to-hour basis.</td>
<td>Hourly light exposure was significantly related to feelings of vitality. Hourly light exposure did not correlate significantly with feelings of tension, positive affect and negative affect.</td>
</tr>
</tbody>
</table>
1.5.4. Sleeping problems

Sleep disturbed complaints have been investigated in relation to BLT. In healthy people BLT of 5.000 lux, compared to <10 lux, for four hours at noon and midnight can directly effect sleepiness (Rüger et al., 2006). People felt less sleepy when using BLT. Alertness, which can be best be interpreted as the opposite of the dimension of sleepiness, has also been investigated in relation to bright light. Exposure to bright light (>7000lux) has shown to enhance subjective alertness (Vandewalle et al., 2006). Moreover, 30 minutes of morning BLT (10.000 lux) has shown to increase alertness (Avery et al., 2001). This study however did not report how much light the eye approximately received. Contradictory findings on alertness were found in another study which uses dynamic office lighting (500-700 lux), since this study did not found effect on alertness (De Kort & Smolders, 2010). This difference could either have depending on the difference in light intensity (10.000 lux vs 500-700), or on the participant sample (SAD vs office employees). Moreover, bright light exposure has also been investigated in relation to sleep quality (Hubalek et al., 2010; Riemersma-van der Lek et al., 2008). In office employees, light exposure to higher light levels is correlated with higher sleep quality (Hubalek et al., 2010). Moreover, BLT could improve severe sleeping problems in dementia (Riemersma-van der Lek et al., 2008). All-day ceiling illumination of 1000 lux has shown to improve sleep duration and sleep quality in dementia. This study however failed to improve sleep onset, which is also a common problem in dementia.

Although sleeping problems in burnout might not be as severe as in dementia, results of BLT with individuals suffering from dementia, SAD and healthy individuals are promising. BLT could improve alertness and sleep quality in general. Effect of BLT on sleep onset and refreshment at awakenings are as far as known not reported. Moreover, sleep has not yet been assessed in relation to burnout in combination with BLT. However, Meester and Waslander (2010) found evidence in the right direction, since a single question on the depression scale, which assesses sleep, showed improvement.

| Table 1.4: Overview studies on light exposure and BLT on sleep |
|------------------|------------|------------|---------------------------------|------------------|
| Author (data), country | Participant sample | Field/lab | Intervention/prediction | Results found |
| Avery et al. (2001), USA | 30 SAD | field | BLT (2500 lux) vs. no extra light exposure for 2 hours for 2 weeks in either the morning (between 7:00 and 12:00) or afternoon (between 12:00 and 17:00.) | Depression improved, mood improved, higher alertness and higher energy levels in the morning and afternoon |
| De Kort & Smolders (2010), Netherlands | 142 office workers | field | Light condition (dynamic vs static lighting) and group (a-b-a and b-a-b). dynamic (500-700 lux at eye level, 3000-4000k), static (500 lux at eye level, 3000 k | No effect on vitality, mental health, alertness, global sleep quality and subjective performance. |
| Hubalek et al. 2010, Switzerland | 23 office workers | field | effect of light exposure on sleep quality, mood and arousal alertness | Correlation light exposure and sleep quality. Light exposure is regular, but varies on days off. |
| Riemersma-van der Lek et al. (2008), Netherlands | 189 demented people | field | Bright ceiling illumination (~1000 lux at eye, 9.00-18:00) vs Dim light condition (no additional light) for 2 weeks. | Increased sleep quality, decline in depressive symptoms. |
| Rüger et al. (2006), USA | 24 healthy | lab | Counterbalanced design. effectiveness of morning (12.00-16.00) and evening (0.00-4.00) BLT (5.000lux) versus control condition (<10lux), with a measurement period for 1.5 day (morning) and 2.5 day (evening) | BLT improved sleepiness and fatigue, independent of timing. Trend for energy. |
| Vandewalle et al. 2006, Netherlands | 16 healthy | lab | Bright light (> 7000 lux) vs. no additional light (21 min) on cognitive performance while in fMRI. | Improvement on subjective alertness. |

1.6. SCOPE OF CURRENT RESEARCH

Until now, it was shown that BLT can positively influence burnout related complaints such as exhaustion, depressive mood, and sleeping problems (sleep onset, wakefulness, non-refreshing sleep). Moreover, BLT could possibly also positively influence psychosomatic complaints. However, in most studies people knew where they were treated for. Moreover in the study related to burnout most participants were on partial or full sick leave, since they were already diagnosed with a burnout (Meesters & van Velzen, 2010; Meesters &
Waslander, 2010). It is suggested to better prevent a burnout compared to treating a burnout, meaning to prevent or delay the onset of a burnout or otherwise to mitigate its consequences (Bährer-Kohler, 2013). Current research will therefore focus on a possible preventive strategy for burnout by the use of BLT. In comparison with BLT being used as a treatment, in this case BLT will be used by students and teachers who experience a mild to moderate level of exhaustion, but are still teaching or studying. Therefore, BLT should be kept as brief as possible to suit their busy life. Moreover, BLT in this case will be seen as an intervention to increase resources, which could either help as a buffer for work demands, or which could break the vicious cycle of exhaustion, sleeping problems, and burnout. Therefore current thesis will try to answer the following research question: Can brief morning Bright Light Therapy help to decrease burnout-related complaints in teachers and students with a sub-threshold exhaustion score? Burnout related complaint in this case are exhaustion, depressive mood, sleeping problems (sleep onset, wakefulness, non-refreshing sleep), and psychosomatic complaints (headaches, muscular pain in the neck, arms and shoulder, and dizziness). In which sleeping problems and psychosomatic complaints are seen as more long term effects of light, while others are more direct effect of light. A sub-threshold exhaustion score in this case means having a high score on the exhaustion dimension of a burnout measurement.

1.6.1. Hypotheses

Although research on burnout in relation to BLT is scarce, it was shown that BLT lowers severity of burnout (Meesters & Waslander, 2010). Although this research was conducted in persons diagnosed with burnout, current research suggest that: Brief morning BLT can help teachers and students scoring high on the exhaustion dimension on a burnout scale to lower severity of burnout (hypothesis 1).

BLT has shown to lower levels of exhaustion in non-burnout (e.g. Ancoli-Israel et al., 2012) and burnout (Meesters & van Velzen, 2010; Meesters & Waslander, 2010). Therefore, it is expected that: Brief morning BLT can help teachers and students coring high on the exhaustion dimension on a burnout scale to lower exhaustion (hypothesis 2).

BLT has shown to be able to improve mood (e.g. Aan Het Rot et al., 2008; Smolders et al., 2013), and is often used to treat depressive mood in SAD and non-SAD (e.g. Avery et al., 1991; Lingjaerde et al., 1998). Depressive mood and plain emotions are also present in burnout. Moreover, BLT has shown to lower depressive mood in burnout (Meesters & van Velzen, 2010; Meesters & Waslander, 2010). Therefore, it is expected that: Brief morning BLT can help teachers and students coring high on the exhaustion dimension on a burnout scale to improve (depressive) mood (hypothesis 3).

Although the influence of BLT on sleeping problems is less well supported compared to depressive mood, and might include long term effects of light, there are indicators BLT might help sleep disturbances (e.g. Avery et al., 2001; Meesters & Waslander, 2010; Riemersma-van der Lek et al., 2008). Therefore, it is expected that: brief morning BLT might help teachers and students coring high on the exhaustion dimension on a burnout scale to improve the following sleep disturbances: wakefulness, sleep onset, no refreshing sleep (hypothesis 4).

No research has directly linked BLT to psychosomatic complaints. However, results from an overall burnout severity scale, which includes the dimension of psychosomatic complaints, indicates psychosomatic complaints might also improve (Meesters & Waslander, 2010). Therefore, it is expected that: brief morning BLT can help people coring high on the exhaustion dimension on a burnout scale to improve psychosomatic complaints (hypothesis 5).

An attempt will be made to answer this research question by using a within subject counterbalanced design with two light conditions: Bright Light Therapy (BLT) versus a dim red lamp (DRL) placebo condition of 20-30 minutes. Each participant will have a baseline week, and intervention week (BLT), and a placebo week (DRL), in which BLT and DRL will be controlled for order. Duration of the light intervention was kept as short as possible to lower the burden of the intervention as much as possible. Exhaustion, sleep, depressive mood, and psychosomatic complaints are assessed in weekly and daily measures. Daily measures will be assessed four times a day, in order to provide insight in the dynamics of mood, exhaustion, and sleep during the day and between days. These daily measures will help to established possible fluctuation during the day and whether BLT is more effective on a specific moment of the day.
2. Method

2.1. Design

The experiment consisted of a within subject counterbalanced design with two light conditions; an intervention and a placebo condition. One experimental period lasted 3 weeks, starting with a baseline week (B), followed by an intervention week (I) and a placebo condition week (P) in counterbalanced order (BIP or BPI). The intervention consisted of 20-30 minutes Bright Light Therapy (BLT) in the morning, while the placebo condition consisted of 20-30 minutes exposure to Dim Red Light (DRL) in the morning. The dependent factors were fatigue, mood, sleep and psychosomatic complaints, which were assessed with daily and weekly repeated measures. In total 3 experimental periods took place, from 9 March till 29 March, 6 April till 26 April and from 20 April till 10 May 2015. Sunrise during the experimental periods varied from 7.09 am till 5.55 am. The research design was evaluated and approved by the ethical commission board from the department Human Technology Interaction.

2.2. Participants

2.2.1. Screening of participants

Before the start of the actual experiment participants were screened on their levels of burnout. Both students and teachers were approached for this study. Participants had to score higher than a set norm on the exhaustion scale of the UBOS; For the UBOS see section 1.4.1 “burnout screening questionnaire”. Teachers had to score above 2.0, based on results of previous research (Meesters & Waslander, 2010; Söderström et al., 2004). Student had to score above 2.2, based on results of previous research (Bolwerk, 2011; Frese, 2009; Hackelberg, 2012; Kaebisch, 2011).

2.2.2. Participant sample

In total 29 participants (10 males, 19 females) aged between 19 and 63 (M=28.85 and SD=14.10) participated in this experiment. From this total 23 were student aged between 19 and 28 (M=21.70 and SD=2.47) and 6 were teacher aged between 35 and 63 (M=52.67 and SD=9.90). An overview of the participants’ characteristics can be found in table 2.1. Only one person had to discontinue the experiment after week 2. All participants had Dutch as their native language.

### Table 2.1: characteristics of the participants

<table>
<thead>
<tr>
<th></th>
<th>UBOS (exhaustion)</th>
<th>Age</th>
<th>Pre knowledge BLT</th>
<th>Familiarity BLT</th>
<th>Wake up light</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>3.50</td>
<td>21.70</td>
<td>1.85</td>
<td>3.39</td>
<td>0</td>
</tr>
<tr>
<td>SD</td>
<td>0.89</td>
<td>2.47</td>
<td>0.36</td>
<td>3.12</td>
<td></td>
</tr>
<tr>
<td>Teachers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>2.90</td>
<td>52.67</td>
<td>1.83</td>
<td>4.15</td>
<td>1</td>
</tr>
<tr>
<td>SD</td>
<td>0.65</td>
<td>9.90</td>
<td>0.38</td>
<td>1.89</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>-</td>
<td>28.28</td>
<td>1.85</td>
<td>3.97</td>
<td>1</td>
</tr>
<tr>
<td>SD</td>
<td>-</td>
<td>14.10</td>
<td>0.36</td>
<td>1.96</td>
<td></td>
</tr>
</tbody>
</table>

Teachers were recruited by writing >75 schools, approaching >150 university teachers individually, via flyers, social media, and the snowballing technique. Inclusion criteria were that teachers currently worked on a primary-secondary school, vocational education, polytechnic school, or university for at least 4 working days per week and live or work around Nijmegen or Eindhoven, the Netherlands. In total 14 teachers filled in the screening questionnaire, and 9 met the requirements. Students were recruited by using the J.F. Schouten participant database (JFS database) from the TU/e, through which over 575 students were invited to take part in the experiment. Inclusion criteria for the students were that they were enrolled in fulltime education. In total 52 students filled in the screening questionnaire, and 31 met the requirements.

Before participating in the experiment, participants were informed that the study aimed to find a relation between light intensity and light colour on participants’ daily mood and stress experience. The experimental duration was 3 weeks, for which participant received 30 euro, a micro living colour light (7001831PH) and
additionally feedback about their wellbeing. This wellbeing score represent the exhaustion score from the UBOS during the screening. At the start of the experiment participants were not informed that they would receive the micro living colour light, instead they were told they would receive a present worth around 35 euros.

2.3. MATERIALS AND SETTING

Two different light sources were used, an intervention lamp and a placebo lamp. The placebo lamp was used to control for potential placebo-effects, which is the expectation an intervention has a certain effect while in reality it does not has an effect. Participants were told that current research investigates the role of light colour and light intensity on mood and stress experience, to keep participants as naïve as possible about the aims and purposes of the study. Both light manipulations were used in the morning, starting at 9.00 am at the latest, on weekdays for 20-30 minutes. Participants could choose to use the light manipulation at home or at their own office. Participants were instructed to place both lamp at a distance of 50 centimetres (arm length) of their visual field, to switch on additional lighting when using the experimental lamp, and to not directly look into the light. Participants were informed they could continue most of their daily activities, such as working behind their laptop or PC, reading and eating during the light exposure. Typical settings while using one of the lamps are presented in Figure 2.1.

![Typical settings while using the lamps, with left BLT and right DRL. Activities are unrelated to the type of lamp used.](image)

2.3.1. Bright Light Therapy (BLT): intervention

Brief Bright Light Therapy (BLT) was used as light intervention. The lamp used for this intervention is the Energy Up light from Philips (HF3419/01, see Figure 2.2), with a full colour spectrum (without UV), at 10.000 lux. At the participants’ position, the eye received approximately 984 LUX with a CCT of 4590\(^1\). Dimensions of this lamp are 29,4 x 37,5 x 4,1 cm (l x w x h). Light intensity settings were pre-set; participants were told not to change the settings.

![Energy up light for BLT condition. (Retrieved from www.philips.nl)](image)

\(^1\) Measurement only include the lamp, meaning no additional lighting was present, since this could have fluctuated between participants. Light measurement were conducted in a completely dark room without windows. When conducted with average office lighting on, the eye should receive approximately 1088 LUX in the BLT condition and 253 in the DRL condition.
2.3.2. Dim Red Light (DRL): control condition

Dim red light (DRL) exposure was used as placebo condition. The lamp used for this condition is the micro living colours table light from Philips (7001831PH, see figure 2.3), with a reddish colour. At the participants’ position, the eye received approximately 20.5 LUX with a $\lambda$ of 651 nm$^1$. Dimensions of this lamp are 11 x 12 x 10 cm (l x w x h). Light colour settings were the pre-factory settings. Participants were told not to change the settings.

Figure 2.3: Micro living colour light for DRL condition. Colour represent the factory setting colour as used in the experiment. (Retrieved from www.philips.nl)

2.4. Measures

2.4.1. Burnout screening questionnaire

Participants were selected based on the Dutch version of the Maslach Burnout Inventory (MBI), namely the Utrechtse Burnout Schaal (UBOS) (Wilmar Bernardus Schaufeli & van Dierendonck, 2000). The UBOS assesses job related burnout complaints on three dimension: emotional exhaustion, depersonalization and lack of personal accomplishment. Each dimension is assessed with multiple questions, which use a 7 point Likert scale varying from Never till Every day (0 = never, 1 = a few times a year or less, 2 = once a month or less, 3 = a few times a month, 4 = once a month, 5 = a few times a week, 6 = every day). Scores were calculated per component (emotional exhaustion, depersonalisation and personal accomplishment) by averaging the sum of the items per dimension.

Several versions of the UBOS have been developed to address different types of jobs. The teachers were given the UBOS specifically developed to assess burnout levels in teachers (UBOS-L) (Wilmar Bernardus Schaufeli & van Dierendonck, 2000), which contains 22 questions. With 8 questions concerning fatigue, 7 for depersonalisation, and 7 for lack of personal accomplishment. The authors of the UBOS (Wilmar Bernardus Schaufeli & van Dierendonck, 2000) have also developed a UBOS specific for students (UBOS-S). Contrary to the UBOS-L, the UBOS-S is not yet available by Pearson, but was received after personal contact with the author, W.B. Schaufeli. The students were given the UBOS-S, which contains 16 questions. With 5 questions concerning fatigue, 5 for depersonalisation, and 6 for lack of personal accomplishment. Other research has already used the UBOS-S (e.g. Bolwerk, 2011; Frese, 2009), or adapted versions of the general survey UBOS-A suitable for students instead of employees (e.g. Hackelberg, 2012; Kaebisch, 2011).

2.4.2. Weekly questionnaires

Weekly questionnaires were administered through an online survey, at the end of every experiment week on Sundays. Different versions of the online survey have been developed, one for every week. These different versions were required since the measures for each week differed from each other. Participants received an e-mail with the link for each website on the day the weekly questionnaire needed to be filled out. An overview of the measures and how these measures were administered is visualised in Figure 2.4. All questionnaire used, except for the ones with restriction to publish, can be found in Appendix A, B, and C.

Fatigue

Fatigue was assessed with the Fatigue Assessment Scale (FAS) (Michielsen, De Vries, & Van Heck, 2003). The FAS is a 10 item questionnaire, which assesses how fatigued people usually feel; for current research ‘how you usually feel’ has been replaced with ‘how you felt last week, including today’. Each item uses a 5 point
Likert scale varying from Never to Always (with 1 = never, 2 = sometimes, 3 = regularly, 4 = often, 5 = always). The score on the FAS was calculated by summing all items (α =0.676).

**DEPRESSIVE MOOD**

Depression was assessed with a validated Dutch version of the *Beck Depression Inventory* (Beck, Steer, Brown, & others, 1996), namely the BDI-II-NL (Van der Does, 2002). The BDI-II-NL is a 21 item questionnaire, which assesses affection, cognition and somatic symptoms. Each item had 4 or 6 answer possibilities, with answer possibilities ranging from 0 till 3. Although depression and burnout differ, depressive elements and mood changes could be present in a burnout. Scores of the BDI-II-NL were calculated by summing all items (α =0.887), scores could range from 0 till 63. In which scores of 0 –13 represented non-depressed, 14 –19 mildly depressed, 20– 28 moderately depressed, and 29-63 higher severely depressed.

**SEVERITY OF BURNOUT RELATED COMPLAINTS**

Severity of burnout related complaints was measured with the *Burnout- Neurasthenia Complaints Scale* (BurnOut-Neurasthenie Klachten Schaal) (BO-NKS), which is a Dutch validated measurement for complaints related to burnout (Verbraak et al., 2008). The BO-NKS consists of 15 questions, which measures three dimensions; unrest, exhaustion, and physical complaints. The questions referring to physical complaints were used to explain possible psychosomatic complaints such as neck pain, headaches, muscle pain and dizziness. Although the BO-NKS was first developed to act as an measurement for severity of burnout, Verbraak and colleagues (2008) conclude that rather than being a clinical measurement for burnout the BO-NKS measures the related physical complaints. On a 5 point Likert scale (0 = no burden, 1 = slightly burdened, 2 = somewhat burdened, 3 = quite a lot of burden 4 = severely burdened), the BO-NKS assessed the severity of complaints over the last week. Scores of BO-NKS were calculated by summing all items in total (α =0.857), for the dimension physical complaints (α =0.542).

**2.4.3. Daily questionnaires**

Daily measures were assessed using an Experience Sampling Methodology (ESM). This is a repeated assessment to capture momentary thoughts, feelings and actions over the course of time, all while participants can maintain their daily routines (Barrett & Barrett, 2001; Scollon, Prieto, & Diener, 2003). Compared to the weekly questionnaire, ESM enables capturing thoughts, feelings, and actions in more depth. Short questions were presented four times a day for three weeks on pre-set moments (known as signal-contingent sampling), participant received a notification every moment a daily questionnaire had to be filled in.

These moments were morning (5.30-11.00), around noon, (12.00-15.00), late afternoon (17.30-19.00), and before going to bed (21.30-2.00). The app Metricwire (www.metricwire.com) was used both to prompt participants and to fill-in the questions. Metricwire is an app suitable for iOS and Android which enables automatic data collection. In the absence of a smartphone (iOS or Android) a paper diary was used, in total 2 participants used the paper diary, and 27 participants used Metricwire . Participants were given the same time intervals as with the app. To avoid measuring any direct alerting effects of the light exposure on the participants, participants were instructed to fill in the morning questions before using the lamp in the weeks with the lamp. An overview of all the measures and how these measures were administered is visualised in Figure 2.4. All questionnaire used, except the one with restrictions to publish, can be found in Appendix D till H.

**FATIGUE**

Fatigue was assessed with the *Shortened Fatigue Questionnaire* (Verkorte Vermoeidheids Vragenlijst; VVV), which is a short, validated Dutch questionnaire with four questions measuring peoples’ bodily fatigue (Alberts, Smets, Vercoulen, Garssen, & Bleijenberg, 1997). How people felt ‘during the last two weeks’ was replaced with how they felt ‘at this moment’. Three questions were selected. On a 7 point scale (1 = yes, that is true, 7 = no, that is not true), participants answered ‘I feel tired’, ‘I feel fit’, and ‘I feel physically exhausted’. Item I feel fit and I feel physically exhausted were reverse coded, scores were then calculated by summing the selected items of the VVV (α =0.850). Higher scores indicate higher levels of fatigue.
Mood
Mood was assessed with a composition of questions from the Thayer’s Activation Deactivation Adjective Checklist (AD ACL) (Thayer, 1967) and the UWIST Mood Adjective CheckList (UMACL) (Matthews, Jones, & Chamberlain, 1990). Only questions from the tense and hedonic tone dimensions were included, since energy is covered with the VVV for fatigue. On a 7 point Likert scale (1 = not at all, 7 = very much) it was assessed how people currently felt. Items for Hedonic tone included: sadness (verdrietig), happiness (blij), cheerfulness (vrolijk), gloominess (neerslachtig), degree of irritation (prikkelbaar), low-spiritedness (futloos). Items for Tense tone included: tenseness (gespannen), calmness (kalm), peacefulness (rustig). Items sadness, gloominess, degree of irritation, low spiritness, calmness and peacefulness were reverse coded. Hedonic tone (α = 0.821) and Tense tone (α = 0.767) were calculated by summing the items per dimension. High scores on hedonic tone represent positive affect, high scores on tense tone represent more tenseness.

Mood was also assessed with a composition of mood related questions. On a 7 point Likert scale (1 = not at all, 7 = very much) it was assessed how people currently felt. Question included: the amount of over stimuli (er zijn te veel prikkels), ability to concentrate (hoe goed kun je je op dit moment concentreren) and the amount of experienced stress (hoeveel stress ervaar je op dit moment). Reliability of this mood composition was -0.089, indicating reliability was low. Therefore these questions will not be combined, but will be reported separately.

Sleepiness
Sleepiness was assessed with the Karolinska Sleepiness Scale (KSS), which is a single question on how alert or sleepy one feels at the current moment (Åkerstedt & Gillberg, 1990). The response options ranged from (1) ‘extremely alert’ to (9) ‘extremely sleepy–fighting sleep’.

Sleep Habits
Sleep habits were assessed with the Karolinska Sleep Diary (KSD) (Åkerstedt, Hume, Minors, & Waterhouse, 1994), which is a validated sleep diary that is supposed to be administered in the morning. The KSD consists of 12 questions which are focused on bedtimes, quality of sleep, feelings of refreshment after a night of sleep, easiness of sleep, and calmness of sleep. All questions, except for the bedtimes, use a 5 point Likert scale with different answer possibilities. The KSD has been used since it is the only validated sleep diary assessing refreshment after a night of sleep could be related to burnout and its recovery (Söderström et al., 2004; Sonnenschein et al., 2007).

Besides the KSD, sleep habits were also assessed with additional questions for the evening. These questions were derived from the Consensus Sleep Diary (CSD) (Carney et al., 2012). The CSD is a relative new sleep diary, which combines different validated sleep diaries such as the KSD (Åkerstedt et al., 1994) and the Pittsburgh Sleep Diary (PSD) (Monk et al., 1994). The questions selected from the CSD were about the quantity of caffeinated drinks and alcohol beverages, including the moment when the last caffeinated drink and alcohol beverage was taken. These questions are from now on referred to as Diary evening.

2.4.4. Control questionnaires
Control questionnaires were filled out once or twice, together with the weekly questionnaires. These control questions were administered since it was expected that these could act as a control variable in the current experiment. An overview of all the measures and how these measures were administered is visualised in Figure 2.4. All questionnaire used, except for the ones who had restrictions to publish, can be found in Appendix G, H, and I.

Chronotype
Chronotype – whether a person is morning or evening type– was assessed with the Munich Chronotype Questionnaire (MCTQ) (Roenneberg, Wirz-Justice, & Merrow, 2003). This questionnaire was included, since the effect of Bright Light Therapy (BLT) could depend on peoples’ chronotype. The MCTQ consists of multiple questions which assess individuals’ sleep times, self-reported light exposure, and self-assessed chronotype. Chronotype was deduced from midpoint sleep, which is the midpoint of the difference between bedtime
and rise time. Mean and standard deviation for chronotype can be found in Table 2.2. The MCTQ was administered at the end of the baseline week.

<table>
<thead>
<tr>
<th>Table 2.2: mean and standard deviation of chronotype</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
</tr>
<tr>
<td>------</td>
</tr>
<tr>
<td>Total</td>
</tr>
<tr>
<td>Students</td>
</tr>
<tr>
<td>Teachers</td>
</tr>
</tbody>
</table>

**SEASONAL PATTERN**

Seasonal patterns were assessed with the *Seasonal Pattern Assessment Questionnaire* (SPAQ: Rosenthal, Bradt, & Wehr, 1987). SPAQ can be used to analyse whether people have seasonal changes in mood, appetite, weight, sleep, energy and socializing, which is also known as a Seasonal Affective Disorder (SAD). Therefore, SPAQ can be used to assess whether SAD could explain possible differences between persons and between research periods. SPAQ assessed three components: Global Seasonality (GS), summer/winter SAD, problematical degree of seasonality. Together these components can verify a SAD.

Global seasonality was calculated by summing the scores for the measure for change across the seasons of mood, social activities, appetite, sleep, weight and energy. The total scale ranges from 0 to 24, a score above 11 is a criteria for SAD. Summer and winter SAD type were derived from asking in which month’s participant felt worse or best. Feeling worse in December and/or January and/or February represent winter SAD, feeling worse in June and/or July and/or August represent summer SAD. Finally, a problematical degree of seasonality was assessed with one questions about whether seasonal changes are considered as a problem. With a possible score of 0 till 5 (0 = no problem to 5 = a disabling problem), a score of at least 2 is a criteria of SAD. Mean and standard deviation for SPAQ can be found in table 2.3 The SPAQ was administered at the end of the baseline week.

<table>
<thead>
<tr>
<th>Table 2.3: Mean and standard deviator of SPAQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
</tr>
<tr>
<td>------</td>
</tr>
<tr>
<td>Total</td>
</tr>
<tr>
<td>Global Seasonality</td>
</tr>
<tr>
<td>Problematical degree</td>
</tr>
<tr>
<td>SAD (winter)</td>
</tr>
<tr>
<td>Students</td>
</tr>
<tr>
<td>Global Seasonality</td>
</tr>
<tr>
<td>Problematical degree</td>
</tr>
<tr>
<td>SAD (summer)</td>
</tr>
<tr>
<td>Teachers</td>
</tr>
<tr>
<td>Global Seasonality</td>
</tr>
<tr>
<td>Problematical degree</td>
</tr>
<tr>
<td>SAD (winter)</td>
</tr>
</tbody>
</table>

**LIGHT EXPERIENCE**

The experience with using the lights was assessed with the *Net Promoter Score* (NPS) (Reichheld, 2011), which is a single question assessing product loyalty. After the end of the intervention week and the control week, participants were asked on a scale of 0 to 10 (0 = very unlikely, 10 = very likely) ‘Would you recommend this lamp to friends/colleagues’. At the end of the last week participants were also asked ‘Would you recommend light therapy to friends/colleagues?’. Scores of 9-10 are seen as promoters, 7-8 as passives and 0-6 as detractors. NSP was calculated by subtracting the percentage of detractors from the percentage of promoters.

Besides the NPS, light experience was also assessed with questions concerning beliefs about both lamps, physical properties of the lamps, and the burden of light therapy in their daily life. Part of these questions was assessed at the end of each lamp period, (Weekly Light Experience Questionnaire: WLEQ), the rest was
assessed as part of the final questionnaire at the end of the last (third) week (Final Lamp Experience questionnaire: FLEQ).

The WLEQ (Weekly Light Experience Questionnaire) used 7 questions about physical properties of the lamp, the effect of the lamp and the usage of the lamp. Some questions used a 7 point Likert scale, such as: ‘How did the product appear to you?’ (1=beautiful, 7=not beautiful), ‘How did you experience the lamp?’ (1 = unpleasant, 7 = pleasant), ‘How have you experienced the moments of usage?’ (1 = not comforting, 7 = very comforting), ‘What was the effect of the lamp on you?’ (1= rather comforting, 7= rather activating). Open questions included: ‘Explain in your own words your experience of the light properties (light colour and light intensity)’ and ‘Would you like to add anything else?’

The FLEQ (Final Light Experience Questionnaire) used questions for each lamp, and some general questions about using light and light therapy. Questions for each lamp were all open answer format questions and included: ‘In your opinion, what was the effect of the lamp?’; ‘Which aspect of the lamp did you find important (please explain why)?’, ‘Are there any additions you would like to make to the lamp?’; ‘If you had the possibility, would you like to continue using the lamp?’; and ‘What would convince, or more convince, you to continue to use this lamp every morning?’

General questions included two 7 point Likert scale, closed questions and open format questions. The question using a 7 point scale asked ‘To which degree have you experienced sitting in front in the light source for 20-30 minutes as a burden?’ (1 = high burden, 7 = no burden at all) and ‘Before the start of the experiment, to which degree were you familiar with light therapy?’ (1= very unfamiliar, 7= very familiar). Open questions administered were: Where there any moments you could not use the lamp (If yes, please list how much and explain why), Where there any moments you used the lamp for a shorter amount of time than required (If yes, please list how much shorter and explain why), and If you could choose one lamp to continue using, which lamp would this be (please explain why). Closed questions included: ‘Do you use a wake up light?’ (yes/no) and ‘Have you ever used light therapy before?’ (yes/no).

Figure 2.4: Schematic overview of all the measures used and how these measures were collected.

2.5. PROCEDURE

A schematic overview of all the measures used and how these measures were collected is shown in Figure 2.4. An overview of the experimental period can be found in Figure 2.5. Participants who scored above the threshold on the exhaustion scale of UBOS were e-mailed to schedule an intake session before the start of their experimental period. In this appointment the procedure of the experiment was briefly explained, the app Metricwire was tested and the informed consent was signed. If the app Metricwire did not work on their mobile phones, or participants did not own a smartphone running on iOS or Android, they were given a paper diary.
The experimental period lasted three weeks. Participants started the experiment on a Monday and finished on a Sunday three weeks later. The experimental period always started with a week of baseline (B) measurements. In this week participants filled out their daily questionnaire on all days of the week. The daily questionnaire were administered four times a day. The first daily measurement was administered in the morning, directly after waking up (5.30-11.00). It included the questionnaires KSD, KSS, VVV and MOOD. The second daily measurement was administered around noon (around 12.00-15.00), which included the questionnaires KSS, VVV and MOOD. The third daily measurement was administered in the late afternoon (around 17.30-19.00), which included the questionnaires KSS, VVV and MOOD. The fourth and final daily measurement was administered in the evening just before the participant went to bed, which included the questionnaires KSS, VVV, MOOD and EVENING DIARY.

Before the baseline week ended, participants were given their first lamp, either the intervention lamp or the control lamp. The lamps for the teachers were delivered by the researcher, while students picked up the lamp on Friday at the researcher’s office. At the end of the baseline week, on Sunday, participants received an e-mail with a link for the weekly questionnaire. The weekly questionnaire included FAS, BDI-II-NL, BO-NKS, MCTQ and SPAQ.

In the second week, either the control week or the intervention week started, depending on the order the participant was assigned to. The daily and weekly measurements were similar to the baseline week. Only the questionnaires in the weekly measurement differed, since these now included FAS, BDI-II-NL, BO-NKS, NPS (lamp) and WLEQ. Additionally to the procedure followed in the baseline week, participants would sit in front of the light source at a distance of 50 cm (either the intervention lamp or the control lamp) for 20-30 minutes in the morning. Participant were clearly instructed to fill in the morning questionnaires before using the lamp. Before week two ended, the first lamp was exchanged with the second lamp.

In the third week, participants who first had the control week, started the intervention week, while participants who first had the intervention week, started the placebo week. The third week was similar to week two for using the lamp and the daily and weekly questionnaires. Additionally, the weekly questionnaire additionally included NSP (light therapy) and FLEQ. After the experimental period had ended, participants were thanked for their participation and received 30 euros and the micro living colour light that was used in the placebo condition.

2.6. DATA ANALYSIS
Hierarchical Linear Modeling (HLM) was used to analyses the data. HLM allows data to be clustered or nested within other variables. In this research multiple measurements were clustered within participants, making participant a level variable. Compared to an ordinary repeated measures, HLM can cope with missing data, which is common when data is being collected at multiple moments, for example with using ESM. In total 5 out of 78 weekly measurements were missed and 472 out of 2436 daily measurements were missed.
Note that there was one person who missed 59 out of 84 measurement, and that there was one person who had to stop after two weeks, and therefore missed the third week.

HLM models were build step by step. Two main models were run for each outcome variable (fatigue, depressive mood, severity of burnout, sleep, psychosomatic complaints). The first model had baseline as reference and Bright Light Therapy (BLT) and Dim Red Lamp (DRL) as core predictors. This model tested possible differences of both lamps compared to the baseline. The second model directly compared BLT and DRL. This model could compare the difference in effectiveness between BLT and DRL, and therefore test for, for example, placebo effects. The results of the second model will only be reported if changes compared to the model with baseline as reference are present, or if one or both lamps showed significant effects. Both models were tested with and without possible outliers. Outliers were based on Z-scores (standardized predictors score) of above 3 or below -3.
3. RESULTS PART 1: EFFECTS OF LIGHT ON BURNOUT COMPLAINTS

This part of the results will cover the effect of light on burnout related complaints, and therefore try to answer the research question and test the hypotheses. Moreover, this part of the results will only include quantitative analysis. Results on user experiences are reported in ‘results part 2: user experience’ in the next chapter, and will contain both quantitative as qualitative analysis. The effect of light on burnout complaints were analysed with Hierarchical Linear Modelling (HLM) as described in ‘2.6. data analysis’.

3.1. PRELIMINARY ANALYSIS

To ensure no effect of order was present it was tested if the order could had influence on the results. In all models the order was not a significant predictor, nor did it improve the model fit as tested with a chi-square likelihood ratio test. This indicated that order had no influence on the results found. A t-test of differences in chronotype between order groups showed that groups were equal in chronotype ($t(26) = -0.733, p = 0.472$). This indicated that no extreme differences in chronotype could have influenced results. Allowing random intercepts between participants showed a significant variance in intercept between participants.

3.2. HYPOTHESIS 1: SEVERITY OF BURNOUT

BASELINE VS. BLT & DRL. The severity of burnout was weekly measured with the BO-NKS. The mean scores and standard deviation of the BO-NKS for baseline, BLT and DRL are displayed in Table 3.1. Result of the final models are displayed in Table 3.2. With the baseline as reference, DRL significantly influenced severity of burnout ($F(1, 53.296) = -2.049, p = 0.045$). DRL lowered ($b = -2.511$) the severity of burnout compared to the baseline. Surprisingly, only a trend was found for BLT compared to the baseline ($F(1, 53.445) = -1.982, p = 0.053$). This trend indicates a lowered ($b = -2.461$) severity of burnout by the use of BLT when compared to the baseline. Z-scores of BO-NKS indicated one outlier, this model was therefore rerun without this outlier. Without this outlier DRL still significantly influenced severity of burnout ($F(1, 53.180) = -10.947, p = 0.002$) and BLT now also significantly influenced severity of burnout ($F(1, 53.180) = -10.947, p = 0.002$). Both DRL ($b = -2.511$) and BLT ($b = -2.461$) lowered the severity of burnout.

<table>
<thead>
<tr>
<th>Table 3.1: Mean and standard deviation for BO-NKS per week</th>
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<tbody>
<tr>
<td>n</td>
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<tr>
<td>BASELINE</td>
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<tr>
<td>BLT</td>
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<tr>
<td>DRL</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 3.2: Statistics of predictors for severity of burnout measured with BO-NKS</th>
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<tbody>
<tr>
<td>F</td>
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<tr>
<td>----</td>
</tr>
<tr>
<td>BLT</td>
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<tr>
<td>DRL</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>DRL as reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>BASELINE</td>
</tr>
<tr>
<td>BLT</td>
</tr>
</tbody>
</table>

Note: one outlier was removed for this model

BLT VS DRL. BLT did not significantly influence severity of burnout as compared to DRL, $F(1, 52.569) = 0.377, p = 0.542$. These results show that both lamps lowered severity of burnout, but that there was no difference between de intervention lamp (BLT) and the placebo lamp (DRL). Hypothesis 1, which states that brief morning BLT can help teachers and students scoring high on the exhaustion dimension on a burnout scale to lower severity of burnout, was therefore not supported.
### 3.3. Hypothesis 2: Fatigue

Fatigue was weekly measured with the FAS and daily measured with the VVV. Separate models were run for FAS and VVV. First, results of the FAS will be reported, followed by the VVV.

#### 3.3.1. FAS

**BASELINE VS. BLT & DRL.** The mean scores and standard deviation of the FAS for baseline, BLT and DRL are displayed in Table 3.3. Results of the final models for FAS are displayed in Table 3.4. With the baseline as reference, DRL showed a trend in lowering fatigue ($F(1, 53.314) = 3.068, \ p = 0.086, \ b = -1.041$). However, surprisingly, BLT had a non-significant influence on fatigue as compared to the baseline ($F(1, 53.404) = 2.416, \ p = 0.126$).

BLT VS. DRL. BLT did not significantly influence fatigue when compared to DRL ($F(1, 53.230) = 0.029, \ p = 0.865$). Against expectations, results indicate that although BLT and DRL did not differ from each other, when compared to the baseline only DRL follows a trend in improving fatigue on the weekly measurements.

#### 3.3.2. VVV

**BASELINE VS. BLT & DRL.** The mean scores and standard deviation of the VVV for baseline, BLT and DRL are displayed in Table 3.5. Results of the final models for VVV are displayed in Table 3.6. With the baseline as reference, BLT had a non-significant effect on fatigue, ($F(1, 1941.717) = 0.939, \ p = 0.531$). DRL as well had a non-significant effect on fatigue when compared to the baseline ($F(1, 1940.605) = 1.018, \ p = 0.313$).

Results of both FAS and VVV show that BLT had no effect on fatigue, since fatigue was not reduced after the baseline, nor did it differ from the placebo lamp (DRL). Hypothesis 2, which states that brief morning BLT can help teachers and students scoring high on the exhaustion dimension on a burnout scale to lower fatigue, was therefore not supported.
3.4. **Hypothesis 3: (Depressive) Mood**

Depressive mood was weekly measured with BDI, and daily measured with the UMACL (hedonic- and tense tone) and mental wellbeing. Separate models were run for BDI, hedonic tone, tense tone and mental wellbeing. First, results of the BDI will be reported. Followed by hedonic- and tense tone and mental wellbeing.

3.4.1. **BDI**

**BASELINE VS. BLT & DRL.** The mean scores and standard deviation of the BDI for baseline, BLT and DRL are displayed in Table 3.7. Results of the final models for BDI are displayed in Table 3.8. With the baseline as reference, BLT significantly influenced depressive mood \( (F(1, 53.069) = 11.709, p = 0.0010) \). BLT lowered \( (b = -3.409) \) depressive mood. DRL significantly \( (F(1, 52.925) = 11.344, p = 0.001) \) influenced depressive mood as well in a similar fashion. DRL lowered \( (b = -3.310) \) depressive mood. Both lamps therefore had lowered depressive mood.

BLT VS. DRL. BLT did not significantly differed in influencing depressive mood as compared to DRL \( (F(1, 52.837) = 0.010, p = 0.922) \). Combined with the previous, these results showed that both lamps had lowered depressive mood as weekly measured with BDI, but that there was no difference between the intervention lamp (BLT) and the placebo lamp (DRL).

<table>
<thead>
<tr>
<th>Table 3.7: Mean and standard deviation for BDI per week</th>
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<tbody>
<tr>
<td>n</td>
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<tr>
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</tr>
<tr>
<td>BASELINE</td>
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<tr>
<td>BLT</td>
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<tr>
<td>DRL</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 3.8: Statistics of predictors for depressive mood measured with BDI</th>
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<td>F</td>
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<tr>
<td><strong>Baseline as reference</strong></td>
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<td>BLT</td>
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<tr>
<td>DRL</td>
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<tr>
<td><strong>DRL as reference</strong></td>
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<tr>
<td>BASELINE</td>
</tr>
<tr>
<td>BLT</td>
</tr>
</tbody>
</table>

3.4.2. **Hedonic tone**

**BASELINE VS. BLT & DRL.** The daily mood measure hedonic tone consists of the amount of positive or negative affect. The mean scores and standard deviation of hedonic tone for baseline, BLT and DRL are displayed in Table 3.9. Results of the final models for hedonic tone are displayed in Table 3.10. With baseline as reference, DRL significantly improved hedonic tone \( (F(1, 1901.628) = 7.289, p = 0.007) \). DRL increased \( (b = 0.635) \) positive affect. However, only a trend was found for BLT, compared to the baseline \( (F(1, 1902.308) = 3.261, p = 0.071) \). This trend indicated an increased positive affect \( (b = 0.426) \) by the use of BLT when compared to the baseline.

BLT VS. DRL. BLT had a non-significant effect on hedonic mood when compared to DRL \( (F(1, 1897.805) = 0.808, p = 0.363) \). This indicated, against expectations, that BLT was not significantly better in improving hedonic mood than DRL, but that DRL and BLT did improve from the baseline.

<table>
<thead>
<tr>
<th>Table 3.7: Mean and standard deviation for Hedonic Tone per week</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
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<tr>
<td>---</td>
</tr>
<tr>
<td>BASELINE</td>
</tr>
<tr>
<td>BLT</td>
</tr>
<tr>
<td>DRL</td>
</tr>
</tbody>
</table>
Table 3.8: Statistics of predictors for depressive mood measured with Hedonic Tone

<table>
<thead>
<tr>
<th></th>
<th>F</th>
<th>Df</th>
<th>p</th>
<th>b (SE)</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline as reference</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BLT</td>
<td>3.261</td>
<td>1, 1902.308</td>
<td>0.071</td>
<td>0.426 (0.236)</td>
<td>(-0.037, 0.888)</td>
</tr>
<tr>
<td>DRL</td>
<td>7.289</td>
<td>1, 1901.628</td>
<td>0.007</td>
<td>0.635 (0.235)</td>
<td>(0.174, 1.096)</td>
</tr>
<tr>
<td>DRL as reference</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BASELINE</td>
<td>7.289</td>
<td>1, 1901.628</td>
<td>0.007</td>
<td>-0.635 (0.235)</td>
<td>(-0.096, -0.174)</td>
</tr>
<tr>
<td>BLT</td>
<td>0.808</td>
<td>1, 1897.805</td>
<td>0.363</td>
<td>-0.209 (0.229)</td>
<td>(-0.659, 0.241)</td>
</tr>
</tbody>
</table>

3.4.3. Tense tone

BASELINE VS. BLT & DRL. The daily measure tense tone consists of the amount of experienced tension. The mean scores and standard deviation of tense tone for baseline, BLT and DRL are displayed in Table 3.11. Result of the final models for tense tone are displayed in Table 3.12. With baseline as reference, the effect of DRL was non-significant on tense tone ($F(1, 1933.963) = 0.256, p = 0.631$). Moreover, the effect of BLT on tense tone was non-significant as well ($F(1, 1933.378) = 0.000, p = 0.988$).

Table 3.11: Mean and standard deviation for Tense Tone per week

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>BASELINE</td>
<td>657</td>
<td>8.228</td>
<td>2.493</td>
</tr>
<tr>
<td>BLT</td>
<td>648</td>
<td>8.366</td>
<td>2.842</td>
</tr>
<tr>
<td>DRL</td>
<td>654</td>
<td>8.083</td>
<td>2.576</td>
</tr>
</tbody>
</table>

3.4.4. Mental wellbeing

Mental wellbeing was measured with a set of three questions: stress experience, concentration and amount of stimulation. Each will be reported separately. First stress experience will be reported, followed by concentration and then amount of stimulation.

**STRESS EXPERIENCE**

BASELINE VS. BLT & DRL. The mean scores and standard deviation of tense tone for baseline, BLT and DRL are displayed in Table 3.13. Results of the final models for stress experience are displayed in Table 3.14. With baseline as reference, BLT significantly influenced stress experience ($F(1, 1936.519) = 5.692, p = 0.017$). BLT lowered ($b = -0.114$) stress experience. DRL had a significant influence on stress experience as well ($F(1, 1935.801) = 15.231, p = 0.000$). In the same direction, DRL as well lowered ($b = -0.187$) stress experience. Z-scores of stress experience indicated 58 outliers, this model was therefore rerun without these outliers. After removing these outliers, DRL still significantly lowered stress experience ($F(1, 1878.039) = 4.270, p = 0.039, b = -0.083$). However, BLT now had a non-significant effect on stress experience ($F(1, 1848.566) = 1.327, p = 0.249$).

BLT VS. DRL. Result show that when compared to DRL, BLT was non-significant on stress experience ($F(1, 1932.227) = 2.330, p = 0.127$). Therefore, results indicate that BLT was not significantly better in improving stress experience, but that DRL and BLT did improve stress compared to the baseline.

Table 3.13: Mean and standard deviation for Stress experience per week

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>BASELINE</td>
<td>648</td>
<td>2.06</td>
<td>1.15</td>
</tr>
<tr>
<td>BLT</td>
<td>655</td>
<td>1.89</td>
<td>0.94</td>
</tr>
<tr>
<td>DRL</td>
<td>648</td>
<td>1.84</td>
<td>0.90</td>
</tr>
</tbody>
</table>

Note: outliers were present, but included in the model
Table 3.14: Statistics of predictors for depressive mood measured with Stress experience

<table>
<thead>
<tr>
<th></th>
<th>F</th>
<th>Df</th>
<th>p</th>
<th>b (SE)</th>
<th>95% CI</th>
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<tbody>
<tr>
<td>Baseline as reference</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BLT</td>
<td>5.692</td>
<td>1, 1936.519</td>
<td>0.017</td>
<td>-0.114 (0.048)</td>
<td>[-0.208, -0.020]</td>
</tr>
<tr>
<td>DRL</td>
<td>15.231</td>
<td>1, 1935.519</td>
<td>0.000</td>
<td>-0.187 (0.048)</td>
<td>[-0.280, -0.093]</td>
</tr>
<tr>
<td>DRL as reference</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>BASELINE</td>
<td>15.231</td>
<td>1, 1935.519</td>
<td>0.000</td>
<td>-0.187 (0.048)</td>
<td>[-0.280, -0.093]</td>
</tr>
<tr>
<td>BLT</td>
<td>2.330</td>
<td>1, 1932.227</td>
<td>0.127</td>
<td>0.072 (0.047)</td>
<td>[-0.021, 0.165]</td>
</tr>
</tbody>
</table>

Note: outliers were present, but included in the model

Concentration

The mean scores and standard deviation of concentration for baseline, BLT and DRL are displayed in Table 3.15. Results of the final models for concentration are displayed in Table 3.16. With baseline as reference, DRL had a non-significant influence on concentration \((F(1, 1877.640) = 0.013, p = 0.910)\). In a similar fashion, BLT had a non-significant influence on concentration \((F(1, 1878.164) = 1.005, p = 0.316)\).

Table 3.15: Mean and standard deviation for Concentration per week

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>BASELINE</td>
<td>655</td>
<td>2.72</td>
<td>1.296</td>
</tr>
<tr>
<td>BLT</td>
<td>658</td>
<td>2.81</td>
<td>1.239</td>
</tr>
<tr>
<td>DRL</td>
<td>648</td>
<td>2.74</td>
<td>1.278</td>
</tr>
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</table>

Table 3.16: Statistics of predictors for depressive mood measured with Concentration

<table>
<thead>
<tr>
<th></th>
<th>F</th>
<th>Df</th>
<th>p</th>
<th>b (SE)</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline as reference</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BLT</td>
<td>1.005</td>
<td>1, 1878.164</td>
<td>0.316</td>
<td>-0.060 (0.060)</td>
<td>[-0.177, 0.57]</td>
</tr>
<tr>
<td>DRL</td>
<td>0.013</td>
<td>1, 1877.640</td>
<td>0.910</td>
<td>0.007 (0.060)</td>
<td>[-0.110, 0.123]</td>
</tr>
</tbody>
</table>

Amount of Stimulation

BASELINE VS. BLT & DRL. The mean scores and standard deviation of over stimulation for baseline, BLT and DRL are displayed in Table 3.17. Results of the final models for over stimuli are displayed in Table 3.18. With baseline as reference, BLT showed a trend on the amount of over stimuli \((F(1, 1877.316) = 2.728, p = 0.099)\). This indicated, BLT might had lowered \(b = -0.105\) the amount of over stimuli. DRL had a non-significant effect on the amount of over stimuli \((F(1, 1876.869) = 2.406, p = 0.121)\).

Table 3.17: Mean and standard deviation for Over Stimuli per week

<table>
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<tr>
<th></th>
<th>n</th>
<th>M</th>
<th>SD</th>
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<tbody>
<tr>
<td>BASELINE</td>
<td>648</td>
<td>4.06</td>
<td>1.37</td>
</tr>
<tr>
<td>BLT</td>
<td>655</td>
<td>4.03</td>
<td>1.45</td>
</tr>
<tr>
<td>DRL</td>
<td>658</td>
<td>4.20</td>
<td>1.34</td>
</tr>
</tbody>
</table>

Table 3.18: Statistics of predictors for depressive mood measured with Over Stimuli

<table>
<thead>
<tr>
<th></th>
<th>F</th>
<th>Df</th>
<th>p</th>
<th>b (SE)</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline as reference</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BLT</td>
<td>2.728</td>
<td>1, 1877.316</td>
<td>0.099</td>
<td>-0.105 (0.063)</td>
<td>[-0.229, 0.020]</td>
</tr>
<tr>
<td>DRL</td>
<td>2.406</td>
<td>1, 1876.869</td>
<td>0.121</td>
<td>-0.098 (0.063)</td>
<td>[-0.222, 0.026]</td>
</tr>
</tbody>
</table>

Taking all results from depressive mood into account, the results showed that there were some inconsistencies. DRL and BLT both lowered BDI (rate of depression) and improved hedonic tone (rate of positive-negative affect), but that the effectiveness of BLT was not different from DRL. In sum, stress experience showed to be lowered by DRL and BLT, but this effect of DRL on stress experience does not differ from BLT. Moreover no effects of BLT nor DRL were found on tense tone, concentration and the amount of over stimuli. Against expectations, it can therefore be concluded that that BLT as a solo therapy against burnout did not relieve depressive mood. Hypothesis 3, which states that brief morning BLT can help teachers and students scoring high on the exhaustion dimension on a burnout scale to lower depressive mood, was therefore not supported.
3.5. Hypothesis 4: Sleep Complaints

Sleep was measured daily with the Karolinska Sleepiness Scale (KSS) and the Karolinska Sleep Diary (KSD). Results will be reported separately. First the KSS will be reported, followed by the KSD.

3.5.1. KSS

BASELINE VS. BLT & DRL. The Karolinska Sleepiness Scale (KSS) is a measurement of sleepiness and alertness. The mean scores and standard deviation of KSS for baseline, BLT and DRL are displayed in Table 3.19. Results of the final models for KSS are displayed in Table 3.20. With baseline as reference, BLT had a significant effect on the KSS (F(1, 1949.988) = 5.793, p = 0.016). BLT lowered (b = -0.295) feelings of sleepiness. In a similar fashion DRL had a significant effect on KSS (F(1, 1948.336) = 9.27, p = 0.002). In the same direction, DRL lowered (b = -0.234) feelings of sleepiness.

BLT VS. DRL. BLT had a non-significant effect on KSS when compared to DRL (F(1, 1936.070) = 0.345, p = 0.557). This indicates, against expectations, that BLT was not significantly better in improving alertness and decreasing sleepiness, but that DRL and BLT did improve from the baseline.

3.5.2. KSD

This KSD addressed questions around several topics: bedtimes, quality of sleep, feelings of refreshment after a night of sleep, easiness of sleep, and calmness of sleep. It was assessed in the morning. The mean scores and standard deviation of the aspects of the KSD for baseline, BLT and DRL are displayed in Table 3.21. Results of the final models for KSD are displayed in Table 3.22 and Table 3.23. Based on the main sleep complaints related to burnout, topics of main interest are sleep latency onset and feelings of refreshment after awakening. These will at least be reported, furthermore only remarkable results will be reported, all others can be found in Table 3.22 and Table 3.23.

BASELINE VS. BLT & DRL With baseline as reference, DRL had a non-significant effect on sleep onset (F(1, 2152.909) = 0.110, p = 0.740), while DRL significantly improved refreshment after awakening (F(1, 2057.351) = 7.152, p = 0.008, b = -0.118) and a trend was found for DRL worsening sleep quality (F(1, 2049.213) = 3.233, p = 0.072, b = 0.087). In a similar fashion BLT had a non-significant effect on sleep onset (F(1, 2155.278) = 1.825, p = 0.177). Surprisingly BLT had an non-significant effect refreshment in the morning (F(1, 2058.625) = 0.323, p = 0.630), and quality of sleep (F(1, 2052.232) = 1.017, p = 0.313) as well. This indicated DRL was effective in improving feeling of refreshment, while BLT was not. Z-scores of sleep onset indicated 2 days as outliers, this model was therefore rerun without these outliers. Removing these outliers resulted in an significant effect on sleep onset of BLT (F(1, 2142.56) = 7.205, p = 0.007). BLT lowered (b = 4.208) sleep onset. However, now DRL as well had a significant effect on sleep onset (F(1, 2140.622) = 4.499, p = 0.034). DRL as well lowered (b = -3.343) sleep onset. This model without outliers indicated both lamps were effective in decreasing sleep onset. Besides sleep onset, BLT significantly worsened easiness of awakenings (F(1, 2040.359) = 18.837, p = 0.000, b = 0.233) and improved easiness of falling asleep (F(1,
BLT VS DRL. BLT had a non-significant effect on sleep onset when compared to DRL for sleep onset \( (F(1, 2142.987) = 0.312, p = 0.577) \) and easiness of falling asleep \( (F(1, 2053.318) = 1.329, p = 0.249) \). This indicated, against expectations, that BLT was not significantly better in improving sleep onset and easiness of falling asleep, but that DRL and BLT did improve from the baseline. BLT significantly differed from DRL on refreshment in the morning \( (F(1, 2054.409) = 4.867, p = 0.0027) \) and quality of sleep \( (F(1, 2049.213) = 3.233, p = 0.072) \), while only a trend was found on a difference of BLT compared to DRL of easiness of waking up \( (F(1, 2037.833) = 3.228, p = 0.073) \). Against expectations, DRL was more effective than BLT in increasing feelings of refreshment in the morning \( (b = 0.097) \) and improving easiness of waking up \( (b = 0.094) \). Surprisingly DRL lowered sleep quality \( (b = -0.078) \). It is against expectations that DRL would improve the easiness of waking up and feelings of refreshment in the morning. Even more against expectations is that DRL suggested to worsen sleep quality. These finding are against expectations, since the placebo condition was not supposed to be more effective than BLT, nor was it expected that it lowered quality of sleep, even if this was only a trend.

Taking all results from sleep complaints together, the results showed that there were some inconsistencies. Results from easiness of awakening showed that at DRL and BLT both had an effect, but that there was a trend on BLT being significantly worse compared to DRL. This indicated BLT might had been be worse in improving easiness of awakening, but that this is still unsure since only a trend was found. Results from KSS,
sleep onset and easiness of falling asleep showed that DRL and BLT both had an effect, but that the effect of BLT was not different from DRL. Refreshment after awakening and quality of sleep shows that only DRL had an effect when compared to baseline, and that this effect of DRL on stress experience was higher than BLT. DRL improved sleep quality but decreased refreshment after awakening. Against expectations, it can therefore be concluded that overall BLT had no effect on sleep complaints. Instead, BLT only might have had a negative effect on easiness of awakenings, but this effect was only a trend. Hypothesis 4, which states that brief morning BLT can help teachers and students scoring high on the exhaustion dimension on a burnout scales to lower sleep complaints, was therefore not supported.

Table 3.22: Statistics of predictors for sleep complaints measured with KSD and baseline as reference

<table>
<thead>
<tr>
<th></th>
<th>F</th>
<th>Df</th>
<th>p</th>
<th>b (SE)</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sleep Onset latency</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BLT</td>
<td>7.205</td>
<td>1, 2142.56</td>
<td>0.007</td>
<td>-4.208 (1.568)</td>
<td>[-7.282, -1.344]</td>
</tr>
<tr>
<td>DRL</td>
<td>4.499</td>
<td>1, 2140.622</td>
<td>0.034</td>
<td>-3.343 (1.576)</td>
<td>[-6.433, -0.252]</td>
</tr>
<tr>
<td>Sleep quality</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BLT</td>
<td>1.017</td>
<td>1, 2052.232</td>
<td>0.313</td>
<td>-0.044 (0.044)</td>
<td>[-0.130, 0.041]</td>
</tr>
<tr>
<td>DRL</td>
<td>0.072</td>
<td>1, 2049.213</td>
<td>0.072</td>
<td>0.078 (0.044)</td>
<td>[-0.007, 0.163]</td>
</tr>
<tr>
<td>Refreshment after awakening</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BLT</td>
<td>0.323</td>
<td>1, 2058.625</td>
<td>0.630</td>
<td>-0.021 (0.044)</td>
<td>[-0.109, 0.066]</td>
</tr>
<tr>
<td>DRL</td>
<td>7.152</td>
<td>1, 2057.351</td>
<td>0.008</td>
<td>-0.118 (0.044)</td>
<td>[-0.205, -0.032]</td>
</tr>
<tr>
<td>Calmness of sleep</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BLT</td>
<td>1.652</td>
<td>1, 2058.826</td>
<td>0.199</td>
<td>-0.058 (0.045)</td>
<td>[-0.147, 0.031]</td>
</tr>
<tr>
<td>DRL</td>
<td>0.631</td>
<td>1, 2057.592</td>
<td>0.427</td>
<td>-0.036 (0.045)</td>
<td>[-0.124, 0.052]</td>
</tr>
<tr>
<td>Easiness of awakening</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BLT</td>
<td>18.837</td>
<td>1, 2040.359</td>
<td>0.000</td>
<td>0.233 (0.054)</td>
<td>[0.128, 0.338]</td>
</tr>
<tr>
<td>DRL</td>
<td>6.757</td>
<td>1, 2039.044</td>
<td>0.009</td>
<td>0.138 (0.053)</td>
<td>[0.034, 0.243]</td>
</tr>
<tr>
<td>Easiness of falling asleep</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BLT</td>
<td>18.821</td>
<td>1, 2063.187</td>
<td>0.000</td>
<td>-0.228 (0.053)</td>
<td>[-0.331, -0.125]</td>
</tr>
<tr>
<td>DRL</td>
<td>10.383</td>
<td>1, 2060.101</td>
<td>0.001</td>
<td>-0.168 (0.052)</td>
<td>[-0.271, -0.066]</td>
</tr>
<tr>
<td>Amount of dreams</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BLT</td>
<td>45.536</td>
<td>1, 2054.633</td>
<td>0.000</td>
<td>-0.332 (0.049)</td>
<td>[-0.429, -0.236]</td>
</tr>
<tr>
<td>DRL</td>
<td>21.351</td>
<td>1, 2057.592</td>
<td>0.000</td>
<td>-0.229 (0.0450)</td>
<td>[-0.327, -0.132]</td>
</tr>
<tr>
<td>Number of awakenings</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BLT</td>
<td>0.054</td>
<td>1, 1903.823</td>
<td>0.816</td>
<td>0.015 (0.064)</td>
<td>[-0.111, 0.140]</td>
</tr>
<tr>
<td>DRL</td>
<td>1.362</td>
<td>1, 1904.977</td>
<td>0.243</td>
<td>0.074 (0.064)</td>
<td>[-0.051, 0.199]</td>
</tr>
</tbody>
</table>

Note: 3 outliers were removed in number of awakenings, since these were influence by contextual factors.

Table 3.23: Statistics of predictors for sleep complaints measured with KSD and DRL as reference

<table>
<thead>
<tr>
<th></th>
<th>F</th>
<th>Df</th>
<th>p</th>
<th>b (SE)</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sleep Onset latency</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BASELINE</td>
<td>4.499</td>
<td>1, 2140.622</td>
<td>0.034</td>
<td>3.343 (1.576)</td>
<td>[0.252, 6.433]</td>
</tr>
<tr>
<td>BLT</td>
<td>0.312</td>
<td>1, 2142.987</td>
<td>0.577</td>
<td>-0.865 (1.550)</td>
<td>[-3.904, 2.174]</td>
</tr>
<tr>
<td>Sleep quality</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BASELINE</td>
<td>3.233</td>
<td>1, 2049.213</td>
<td>0.072</td>
<td>-0.078 (0.043)</td>
<td>[-0.163, 0.007]</td>
</tr>
<tr>
<td>BLT</td>
<td>8.014</td>
<td>1, 2047.333</td>
<td>0.005</td>
<td>-1.222 (0.043)</td>
<td>[-0.207, -0.038]</td>
</tr>
<tr>
<td>Refreshment after awakening</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BASELINE</td>
<td>7.152</td>
<td>1, 2057.351</td>
<td>0.008</td>
<td>0.118 (0.044)</td>
<td>[0.315, 0.205]</td>
</tr>
<tr>
<td>BLT</td>
<td>4.867</td>
<td>1, 2054.409</td>
<td>0.003</td>
<td>0.097 (0.044)</td>
<td>[0.011, 0.182]</td>
</tr>
<tr>
<td>Easiness of awakening</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BASELINE</td>
<td>6.757</td>
<td>1, 2039.436</td>
<td>0.009</td>
<td>-0.138 (0.053)</td>
<td>[-0.243, -0.034]</td>
</tr>
<tr>
<td>BLT</td>
<td>3.228</td>
<td>1, 2037.833</td>
<td>0.073</td>
<td>0.094 (0.053)</td>
<td>[-0.009, 0.198]</td>
</tr>
<tr>
<td>Easiness of falling asleep</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BASELINE</td>
<td>10.383</td>
<td>1, 2060.101</td>
<td>0.001</td>
<td>0.168 (0.052)</td>
<td>[0.066, 0.271]</td>
</tr>
<tr>
<td>BLT</td>
<td>1.329</td>
<td>1, 2053.318</td>
<td>0.249</td>
<td>-0.060 (0.052)</td>
<td>[-0.162, 0.042]</td>
</tr>
<tr>
<td>Amount of dreams</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BASELINE</td>
<td>45.536</td>
<td>1, 2054.633</td>
<td>0.000</td>
<td>0.332 (0.049)</td>
<td>[0.236, 0.429]</td>
</tr>
<tr>
<td>BLT</td>
<td>4.430</td>
<td>1, 2053.623</td>
<td>0.035</td>
<td>0.103 (0.049)</td>
<td>[0.007, 0.199]</td>
</tr>
</tbody>
</table>

3.6. HYPOTHESIS 5: PSYCHOSOMATIC COMPLAINTS

BASELINE vs. BLT & DRL Psychosomatic complaints were weekly measured with one dimension of the BO-NKS, namely physical complaints. Mean scores and standard deviation of the dimension physical complaint from BO-NKS for baseline, BLT and DRL are displayed in Table 3.22. Results of the final models are displayed...
in Table 3.23. With the baseline as reference, DRL showed a trend in influencing psychosomatic complaints ($F(1, 52.521) = 2.885, p = 0.095$). DRL lowered ($b = -0.791$) the experienced psychosomatic complaints. However, surprisingly, BLT did not significantly influence psychosomatic complaints as compared to the baseline ($F(1, 52.766) = 1.366, p = 0.248$).

BLT VS. DRL. BLT did not significantly influence the experienced psychosomatic complaints when compared to DRL ($F(1, 52.488) = 0.249, p = 0.620$). Against expectations, results indicated although BLT and DRL did not differ from each other, when compared to the baseline only DRL followed a trend in improving psychosomatic complaints. Hypothesis 5, which states brief morning BLT can help teachers and students scoring high on the exhaustion dimension on a burnout scale to recover from psychosomatic complaints, was therefore not supported.

| Table 3.22: Mean and standard deviation for the dimension physical complaints from BO-NKS per week |
|---|---|---|
| n   | M   | SD  |
| BASELINE | 29  | 3.793 | 2.470 |
| BLT | 26  | 2.923 | 2.607 |
| DRL | 27  | 3.037 | 2.793 |

| Table 3.23: Statistics of predictors for psychosomatic complaints measured with physical complaint from BO-NKS |
|---|---|---|---|---|
| Baseline as reference |  |  |  |  |
| BLT | $1.366$ | 1, 52.766 | 0.248 | -0.551 (0.472) | [-1.497, 0.395] |
| DRL | $2.885$ | 1, 52.521 | 0.095 | -0.791 (0.465) | [-1.724, 0.143] |
| DRL as reference |  |  |  |  |
| BASELINE | $2.885$ | 1, 52.521 | 0.095 | 0.791 (0.465) | [-0.144, 1.724] |
| BLT | $0.249$ | 1, 52.488 | 0.620 | 0.239 (0.479) | [-0.722, 1.201] |
4. RESULTS PART 2: USER EXPERIENCE

The results reported in the previous part showed limited support for beneficial effects of light exposure on symptoms related to burnout. A mix of qualitative and quantitative analyses were performed on light experience of both lamps to gain insight in the user experience. User experience was assessed with several closed and open questions, among which NSP, experienced effect of the lamp, usage of the lamp, continuing the use of the lamp and the burden of sitting in front of the lamp. Note that names in this report do not reflect actual participant names, but are fictive names.

4.1. NET PROMOTER SCORE (NPS)

The Net promotor score (NPS) shows whether there is loyalty for a product or service, therefore it can show whether the lamps used in BLT, DRL or that light therapy in general are all likely to be accepted. Since all participants used both lamps, NPS of the lamps can be compared. NPS for BLT was -57.69%, which indicates that product loyalty as used in current setting was low and moreover negative. This means that there were relatively more detractors than promoters. The lamp used in BLT was therefore not rated as a positive product. The NPS for DRL was -71.43%, which indicated that product loyalty as used in the current setting was low and negative. The lamp used in DRL was therefore also not rated as a positive product. When compared, NPS of the lamp from BLT was higher than NPS of the lamp from DRL, which indicates that participants were more positive about the lamp used in BLT compared to the lamp used in DRL. NPS was also assessed for light therapy, which was -50.38% and thus also indicates an overall negative evaluation. Although NPS gives a rough idea of product loyalty, it does not explain why more people are detractors instead of promoters. Next paragraphs will cover possible reasons of why people could have been detractors or promoters.

![Figure 4.1: Visual representation of percentage of detractors passives and supporters for BLT, DRL and lighttherapy](image)

4.2. CONTINUING THE USE OF THE LAMP

Participants were asked after a week of using the lamp whether they would like to continue using the lamp, to explain their choice and what could convince them to continue using the lamp. Half of the participants who filled in the questionnaire reported they would like to continue using the micro living colour lamp (see Figure 2.2 in Method) as used during the DRL condition. Quite similar, half of the participants who filled in the questionnaire report they would like to continue using the Energy Up lamp (for lamp see Figure 2.3 in Method) as used during the BLT condition. Participants who said they would like to continue to use one lamp did not necessarily like to continue to use the other lamp. A small minority of participants would like to continue using both lamps. Moreover, a minority of participants would not like to continue using either one of the lamps.
Different reasons were given for either or not continuing the use of the lamps. From the people who reported to like continuing the energy up lamp (BLT), a minority reported that the size was unpleasant and large. In this case a smaller device, which is more practical to put away after usage could more convince this minority to continue using this lamp. The majority of people who would like to continue using the energy up lamp, mentioned that it would more convince them to continue using the energy up light when proven effects of this lamp are known. From the participants who would not like to continue using the energy up lamp, the majority of participants reported that knowing about scientifically proven effects of the lamp could convince them to use the lamp. Only a minority of the people who would not like to continue using the lamp mentioned that it would convince them to continue using the energy up if the lamp would have been smaller and not as bright.

“I experienced the usage of the lamp not as unpleasant, but I do not necessarily have the feeling the lamp had a noticeable effect. If so, it would be a stimulant to continue using the lamp” (Sofia, reason for more convincing usage energy up)

“More practical to put away after usage” (Elise, reason for more convincing usage energy up)

From the people who reported to like continuing the micro living colour (DRL), the majority reported that knowing about scientifically proven effects of the lamp could convince them to use the lamp. Moreover, some of these participants reported that they at least should notice an effect themselves. A minority of participants reported that they found the red colour uncomfortable, or that nothing could convince them. One individual mentioned that if colours were allowed to be changed it would be more convincing to continue to use the micro living colour lamp.

Just as with the other lamp, if research proves a positive effect. With me this is not the case, but perhaps one week is too short to notice something. (Dory, reason for more convincing usage micro living colour lamp).

“Scientific proof establishing a positive (long term) effect on the human body.” (Harry, reason for more convincing usage micro living colour lamp).

4.3. Choice of One of Both Lamps

Whether participants actually favoured one lamp over the other lamp cannot be concluded based on knowing whether participants would like to continue using either of the lamps. Participants were therefore forced to choose the lamp they liked most. Notice that it was not possible to choose no preference for one of both lamps. Opinions were equally divided, half of the participants preferred the energy up over the micro living colour lamp, while the other half preferred the micro living colour lamp over the energy up. Almost all who preferred the energy up over the micro living colour lamp also liked to continue using the energy up lamp. Reason for choosing the energy up over de micro living colour lamp was that the majority of participants experienced a positive effect by using the lamp, among which the majority mentioned that they found the energy up activating. One individual mentioned that the naturalness of the energy up was more preferred compared to the micro living colour lamp.

“Wake up nicely and being activated. The red lamp did not have an effect on me that much” (Chantal, reason for choosing the energy up)

“The colour of the light was activating and natural at the same time” (Katie, reason for choosing the energy up)

More than half of the participants who choose the micro living colour lamp over de the energy up would also like to continue using that lamp. The main reasons for choosing the micro living colour lamp were that...
they found the other lamp too bright, or found the other lamp unpleasant or irritating. Although these reasons are focused on negative aspects of the other lamp, participants also reported positive characteristics about the micro living colour lamp for their choice. Half of them reported choosing this lamp, since they liked that it had the option of choosing another colour. The majority had chosen the micro living colour lamp over the energy up because they found the micro living colour lamp more usable due to its size.

“The lamp on the left [Energy up] was too bright and inconvenient. De second lamp [micro living colour lamp] was convenient, intensity and light colour were fine.” (Ben, reason for choosing the micro living colour lamp)

“The lamp [Energy Up] looks like a building site lighting luminaire or a medical surgery lamp, highly unpleasant.” (Eva, remark energy up)

“The smaller lamp was easier to place on your table, and also looks more beautiful. I did found the red colour somewhat unpleasant, but normally you can adapt the colour.” (Wilma, reason for choosing the micro living colour lamp)

“More compact, thus it fits better on the desk, plus it is less dominant.” (Bob, reason for choosing the micro living colour lamp).

4.4. Expected Effect

As stated, some participants mentioned they felt more activated. Indeed, participants were asked what kind of effect the lamp had on them and the majority of participants mentioned that the energy up activated them, gave them more energy or it made them wake up more energized. Note that these expected effects are contrary to results found in the quantitative analysis. Especially since the effect of BLT on exhaustion was not shown to be significant. A minority of the participants reported a negative effect or feelings of agitation when using the energy up. When participants were asked to which degree the lamp made them calm (1 = not calming, 7 = calming), results show an average of 4.31 (SD = 1.46) (see Figure 4.2). This indicates people believe it had a slightly more calming effect. When participants were asked to which degree the lamp made them active (1 = rather calming, 7 = rather activating), results show an average of 4.73 (SD = 1.25) (see Figure 4.2). This indicates participants believed the energy up had a more activating than calming effect. A t-test revealed that level of calmness (t(52) = -1.282, p = 0.205) in DRL and BLT did not differ significantly, while levels of activation (t(50.66) = 2.68, p = 0.010) did differ significantly. BLT was related to a higher expectation of activation than DRL.

![Figure 4.2: Graphical representation of the mean and 95% CI error bars for calmness and activeness.](image)
“The light made me more awake or awoke me quicker as I would without the use of the lamp. The light project something like a new day has come and that makes you awake.” (Wilma, expected effect of energy up)

Participants were also asked what they believed the effect of the micro living colour lamp was on them. In contradiction to the energy up, answers fluctuated. Some did not report any effect of the lamp, some experienced a better mood, some experienced more calmness, and some experienced agitation or a negative effect. When participants were asked to which degree the lamp made them calm (1 = not calming, 7 = calming), results show an average of 3.79 (SD = 1.52) (see Figure 4.2). This indicates people believe it had a slightly less calming effect. When participants were asked to which degree the lamp made them active (1 = rather calming, 7 = rather activating), results show an average of 3.86 (SD = 1.15) (see Figure 4.2). This indicates participants believed the energy up had a slightly more calming than activating effect.

“Ambience lighting, a bit calming, but not extreme. Not as activating as the other lamp” (Peter, expected effect of the micro living colour lamp)

“I do not know that well what this lamp did. In my opinion it gave less light, and the red colour was at least not activating. Perhaps it is not activating at all?” (Sofia, expected effect of the micro living colour lamp)

4.5. Burden of sitting in front of the artificial light source

It might have been a burden to participants to sit in front of an artificial light source for 20-30 minutes in the morning. This might have influenced results. Participants were asked to which degree they experienced sitting in front of this light source as a burden (1 = very much burden, 7 = no burden at all). Results show a mean of 4.48 (SD = 1.4), which indicates it was experienced as quite a burden. High or low experiences of burden were not related to which lamp participants preferred, nor to whether they would like to continue using either the energy up or the micro living colour lamp. Although not reported in the online questionnaire, after the experiment had ended some students mentioned they found it sometimes hard to get up to use the lamp.
The development of a burnout can be accompanied by several physical and mental symptoms, including fatigue, depressive mood, sleeping problems and psychosomatic complaints. Reducing the severity of these complaints could be a preventive strategy for the development of an actual burnout (Bährer-Kohler, 2013). Especially lowering the severity of fatigue lowers the possibility of developing a burnout, since exhaustion is seen as a key element in burnout (Bährer-Kohler, 2013; Ekstedt & Fagerberg, 2005; Saleh & Shapiro, 2008).

The aim of the current research was to investigate whether brief morning Bright Light Therapy (BLT), as compared to a dim red placebo lamp (DRL), could improve these burnout related complaints.

5.1. FINDINGS OF THE CURRENT RESEARCH

In general, we found no support for a beneficial effect of BLT over DRL on burnout related complaints. Findings of the current research showed inconsistencies on the effectiveness of BLT, which fitted in either one of the three following situations. In the first situation, neither BLT nor DRL had an effect. This situation occurred for exhaustion, psychosomatic complaints, tension, and stress experience. In the second situation, BLT as well as DRL had a significant effect, but the effectiveness of BLT was not significantly greater when compared to DRL. This situation occurred for improving the severity of burnout, depression, positive affect, alertness, sleep onset, and the easiness to fall asleep. In this situation either a placebo effect – the expectation an intervention has a certain effect while in reality it does not have an effect – might have occurred, or a shared component in BLT and DRL might have influenced the results. In the third situation only DRL compared to BLT had an effect. Compared to BLT, DRL worsened sleep quality, but improved refreshment after awakening and the easiness of awakenings. Before going into detail on theoretical clarifications of the effects found and on limitation of the design, first, findings for each burnout complaint will be discussed. We will come back to possible explanations for these controversial findings in later sections.

5.1.1. BLT EFFECTS ON SEVERITY OF BURNOUT

We suggested that BLT could lower the severity of burnout (hypothesis 1). Only a trend was found on BLT improving the severity of burnout, while DRL significantly lowered the severity of burnout. When compared, the effectiveness of BLT was not different from DRL. Hypothesis 1 was therefore not supported. Findings were somewhat inconsistent with previous research in which severity of burnout lowered in people with an actual burnout by the use of brief morning BLT (Meesters & Waslander, 2010). This difference might have been due to a longer exposure in the morning (45 minutes for 2 weeks), compared to our 20-30 minutes exposure for 1 week. Effect were not likely to be due to the light intensity, since the field study by Meester and Waslander (2010) also reported to used a lamp that emitted 10.000 lux, unknown is how much light actually had reached the eye. The study by Meester and Waslander (2010) used a waiting list control condition, instead of an actual placebo lamp as used in the current study, which could have caused effects to be slightly overestimated (Speca et al., 2000). It is therefore unknown whether effects in the study by Meester and Waslander (2010) as well could have been slightly due to placebo effects of the lamp or something BLT and DRL might have in common. Moreover, in the study by Meester and Waslander (2010), people were already treated for burnout, meaning they had more severe complaints to recover from and they already could receive other treatments effective in lowering burnout complaints.

5.1.2. BLT EFFECTS ON EXHAUSTION

We hypothesised that BLT could lower exhaustion (hypothesis 2). No effects were found of BLT on exhaustion. A trend was found of the DRL on lowering exhaustion scores on the weekly questionnaire (FAS), while no effect was found of DRL on the daily questionnaire (VVV). Hypothesis 2 was therefore not supported. Findings were not only against expectation but also inconsistent with literature, which shows bright light has a positive effect on exhaustion (Ancoli-Israel et al., 2012; Meesters & van Velzen, 2010; Meesters & Waslander, 2010; Rüger et al., 2006) or vitality (Leppämäki et al., 2002; Partonen & Lönnqvist, 2000; Smolders et al., 2013). Only results from one study were found consistent with our finding, since light exposure did not influenced vitality (De Kort & Smolders, 2010). Effects in previous research were found in
healthy individuals (Leppämäki et al., 2002; Rüger et al., 2006; Smolders et al., 2013), patients undergoing chemotherapy (Ancoli-Israel et al., 2012) and people with an actual burnout (Meesters & van Velzen, 2010; Meesters & Waslander, 2010). This indicates healthy individuals could also benefit from BLT as well. Levels of exhaustion in the studies with healthy people cannot be compared with exhaustion level in our study, since a different measurement scale was used. Levels of exhaustion in people with an actual burnout were however more than double as high as compared to our study on VVV. Exhaustion levels in the current study were thus less severe, meaning there was less to improve from (Meesters & van Velzen, 2010; Meesters & Waslander, 2010). However as mentioned before, effects of the latter two studies could also have been overestimated by the use of a waiting list control condition (Speca et al., 2000). Moreover, other studies also did not use a placebo lamp (Leppämäki et al., 2002; Partonen & Lönnqvist, 2000), while some of these studies did use placebo lamp (Ancoli-Israel et al., 2012; Rüger et al., 2006). Note that using a placebo lamp or no placebo lamp did not influenced whether BLT was found effective or not, moreover BLT in these studies was still more effective than the placebo lamp.

Compared to our study, previous literature differed in duration of light exposure, duration of the BLT period, and the intensity of BLT. In general, the duration of the bright light exposure in other research was longer, since this varied between from 45-60 minutes, till an entire working day. The duration of the BLT was in some cases similar (Leppämäki et al., 2002), but in other cases longer, since this was two weeks (Meesters & van Velzen, 2010; Meesters & Waslander, 2010; Partonen & Lönnqvist, 2000) or tree weeks (Smolders et al., 2013). Research that did use lower light levels (500-700 lux eye level, Smolders et al., 2013), also used a longer intervention period (3 weeks) or a longer duration in light exposure (entire working day), but however did not found an effect. Research that did use higher light levels compared to our study (2500 lux at eye level, Leppämäki et al., 2002; Partonen & Lönnqvist, 2000) (5000 lux, Rüger et al., 2006) (10.000 lux, Meesters & van Velzen, 2010; Meesters & Waslander, 2010), used a more similar, but still higher, duration in light exposure that varied between 45-60 minutes, with one exception of 4 hours (Rüger et al., 2006), for one or two weeks. Moreover, all these studies did found an effect. It could therefore be suggested that results could have been consistent with another study using lower light intensity levels, while other studies with higher light levels were inconsistent with our findings due to a higher light intensity and perhaps a slightly longer duration of light exposure.

5.1.3. BLT effects on (depressive) mood
It was expected that BLT could lower (depressive) mood (hypothesis 3). Both BLT as well as DRL had significantly lowered depressive mood (BDI) and stress experience. On positive affect (hedonic tone), DRL had a significant negative effect as well, while BLT only showed a trend in lowered hedonic tone. The effectiveness of BTL was not different from DRL, suggesting a placebo effect might have occurred or that BLT and DRL have a shared component causing improvement. Both BLT and DRL had no effect on tension, concentration and the amount of stimulation. Therefore hypothesis 3 was not supported. Findings were slightly inconsistent with previous research, which shows that depression lowers by the use of BLT (e.g. Avery et al., 2001; Lingjaerde et al., 1998; Meesters & van Velzen, 2010; Meesters & Waslander, 2010; Yamada et al., 1995) and that BLT increases positive affect (Leppämäki et al., 2002). Note however, that again not all studies used a placebo lamp (Leppämäki et al., 2002; Meesters & van Velzen, 2010; Meesters & Waslander, 2010; Partonen & Lönnqvist, 2000).

Only one study, employed in a hospital, which found that BLT was more effective than a dim control condition used a placebo condition (Yamada et al., 1995). This latter study showed that the effect of BLT could be higher compared to a dim condition. Several procedural differences are however present between the study by Yamada and colleagues (1995) and the current study. Light intensity (2500 lux) was higher compared to our study (= 1000 lux), duration of light exposure was longer (2 hours), the experiment took place in all season, and participants were not allowed to go outside to prevent influence from daylight. Compared to our study, participant had no restrictions to daylight, participated during spring and therefore could have been exposed to bright light levels in all experimental periods (baseline, BLT, or DRL), this factor therefor could not have been controlled for. Daily bright light levels could had influenced mood (Smolders...
et al., 2013). Moreover, the placebo condition in the study by Yamada and colleagues (1995) was only a reduction in light intensity (500 lux), instead of also a change in colour. A dim red control condition is more common to be used as a control condition in light research. Other studies that used a different control condition, are studies on actual burnout patient with a waiting list control condition (Meesters & van Velzen, 2010; Meesters & Waslander, 2010). In these studies depression scores were twice as high compared to our participants, but our results were consistent with their findings. However, in our study a dim red control was used, and was shown to be as effective as BLT. It is unsure whether effect in their studies were also subject to a placebo effect. Light levels were similar, although it is unknown whether the eye received the same amount of light, plus the duration was longer (45 minutes for two weeks) compared to our study (20-30 minutes for one week).

5.1.4. BLT effects on sleep complaints

It was hypothesised that BLT improves the following sleep disturbances: wakefulness, sleep onset, and no refreshing sleep (hypothesis 5). BLT as well as DRL significantly improved wakefulness, sleep onset, and easiness of falling asleep, but significantly decreased the easiness of waking up. This while only DRL significantly improved refreshedness after awakenings or only decreasing the quality of sleep based on a trend. The effectiveness of BLT was not greater for wakefulness, sleep onset and easiness of falling asleep, but for sleep quality effectiveness of BLT was greater compared to DRL. DRL was however significantly greater in improving refreshedness after awakening and showed a trend in decreasing easiness of waking up, when compared to BLT. Therefore, hypothesis 5 was not supported.

Findings for alertness were inconsistent with previous findings where BLT improved alertness (Avery et al., 2001; Rüger et al., 2006; Vandewalle et al., 2006), but consistent with previous findings where bright light exposure was not related to alertness (De Kort & Smolders, 2010). The difference in previous results may be caused by differences in light intensity used. Present results are in line with results from the study using the lowest light intensity (500-700 lux at eye level) (De Kort & Smolders, 2010). Inconsistencies are found in studies using higher light intensities, which were 2,500 at eye level (Avery et al., 2001) and 5,000 lux (Rüger et al., 2006) in which in the latter case light level at eye level was not reported. Although participants in our study should had received around 1000 lux at eye level, light intensity received at eye level could strongly had varied based on the placed distance and position of the lamp. Duration of the light exposure between previous research varied as well, namely between 2 hours for 1 weeks (Avery et al., 2001) and 4 hours for 2-3 days (Rüger et al., 2006), compared to our 20-30 minutes for 1 week. Therefore it could be suggested that results could have been consistent with another study using lower light intensity levels, while other studies with higher light levels were inconsistent with our findings due to a higher light intensity and perhaps a longer duration of light exposure. It is unlikely that consistency with previous results depended on whether previous research was a lab or a field experiment, since two different field studies showed inconsistency (Avery et al., 2001) and consistency (De Kort & Smolders, 2010) with our study. The only difference is that the latter study did not use and intervention such as BLT, but instead investigated daily bright light levels. It is unsure whether seasonality was of influence. Avery and colleagues (2001), with inconsistent findings, did not report the season when their experiment was conducted. De Kort and Smolders (2010) with consistent findings, conducted their experiment from January till March. Although our experiment was only conducted during spring (March till May), experimental periods overlapped.

Findings for sleep quality are slightly inconsistent with previous findings, which show that sleep quality improved by bright light exposure (Hubalek et al., 2010; Riemersma-van der Lek et al., 2008). Our results indicated that sleep quality decreased with DRL, but that BLT was better compared to DRL. It might have been that overall sleep quality decreased after baseline, but that sleep quality decreased less with BLT. Note that findings as far as now cannot be compared on results for, and refreshment of sleep by BLT, since to our knowledge no studies have investigated this relationship.

5.1.5. BLT effects on psychosomatic complaints

We suggested that BLT might lower psychosomatic complaints (hypothesis 5), which are headaches, muscular pain in the neck, arms and shoulders, and dizziness. No effects were found of BLT on
psychosomatic complaints, while a trend was found for DRL. Hypothesis 5 was therefore not supported. As far as known, no direct studies of BLT on psychosomatic effect have been conducted. However, research by Meest and Waslander (2010) indicated BLT might improve psychosomatic complaints in burnout patients, due to the overall improvement on a severity scale of burnout, which includes a dimension of bodily manifestations. The relatively low reliability of the single dimension of psychosomatic complaints might be one reason why we did not find an effect.

5.1.6. User experience
Before the start of the experiment we were aware that the population of interest could already experienced their daily life slightly as a burden, since work demands could already predominated resources available for an extended period in time. The experimental design could had been an extra burden on the participants’ daily life. Findings indicate that sitting in front of the artificial light source was indeed experienced as a burden. Either sparing 20-30 minutes in the morning or waking up earlier to start at 9.00 latest might had caused a burden. This might explain why in some cases no effect was found of BLT on burnout complaints. It can however not explain the cases in which BLT was effective, but no difference in effectiveness was present when compared with DRL. Based on the Net Promoter Score (NPS), the use of light therapy was not rated as positive in general. However, opinions about the effectiveness of BLT as used in the current setting were divided, leading to a split in people who believed that BLT was more effective than DRL and people who did not experienced change on any of the factors measured when using either BLT or DRL. In general, participants significantly experienced BLT made them more active compared to the DRL. Although only speculation, it could had been that people who had experienced more severe complaints experienced more effects.

The burden of the BLT in the current study may have been higher than the burden of BLT experienced by participants in other studies. Reasons for this include that participants in other studies were merely at home due to problems they were treated for (e.g. chemotherapy, burnout, and exhaustion) or the bright light exposure did not obstructed their daily routine at all. In the current research some participants mentioned personally to the researcher that they had to waken up earlier to sit behind the lamp. This could explain why BLT in this scenario might have been a burden to some participants. To our knowledge, no qualitative data on the user experience of BLT has however ever been acquired. This makes it impossible to compare the user experience of BLT in the current study to the user experience in other studies. It is thus only speculation whether BLT was experienced as a larger burden in the current study compared to other studies.

5.1.7. Theoretical clarifications of effects found
The controversial findings found can be explained by theoretical clarifications which were not necessarily based on limitations of the design. These theoretical clarifications will be discussed below.

PLACEBO EFFECT OR SHARED COMPONENTS BLT AND DRL
As mentioned, in most cases where BLT as well as DRL were effective in lowered burnout complaints, the effectiveness of BLT was not significantly different from that of DRL. This indicates that either a placebo effect occurred or that BLT and DRL shared components which could explain effects found. It is less likely that a placebo effect occurred, since results from the user experience indicated that only a few people noticed a change in themselves by the use of DRL. Results might be explained by people taking a moment for themselves in the morning, before the start of their workday, when using either BLT or DRL. A main cause of burnout is that demands exceed resources. Research has shown that interventions based on relaxation or mindfulness were effective in lowering stress, relaxation might thus have improved resources in these studies (overviews see: Awa et al., 2010; Bährer-Kohler, 2013, pp. 230–237). Participants who normally do not take a moment for themselves before a demanding working day, could already had benefitted from taking a brief moment for themselves in the morning, which is a certain form of relaxation. Unfortunately, it is unknown whether this has actually happened in the current study.

LONG TERM EFFECT VS DIRECT EFFECTS
The Non-Image Forming (NIF) effects of light can be divided into long term effects and direct effects of light. Each intervention period lasted one week. This period might have been too be short to find long term effects,
including changes in sleep wake regulation, such as sleep complaints. Although direct effects of mood and alertness are not unfamiliar, enduring exhaustion might not be something one can easily recover from. While participants in our study might not have been severely exhausted, it could also take more time to break the vicious circle of exhaustion, sleep complaints, and burnout when complaints are not that severe. The recovery from burnout can be just as long a process as the development of an actual burnout, which could easily take half a year or even longer (Bährer-Kohler, 2013). Moreover, since burnout is due to an experience of stress, only providing more resources is not always sufficient. The severity of a burnout could also strongly depend on a certain state of mind. It is therefore that Cognitive Behaviour Therapy (CBT), which learn how to deal with certain situations, is very effective in lowering stress experience and help people coping with stress (Awa et al., 2010).

5.2. LIMITATIONS AND FUTURE RESEARCH

5.2.1. Effectiveness BLT
BLT was used in a field experiment, meaning that daylight light levels could have influenced results. During the experimental period there were both sunny as well as cloudy days. Participants who were outside might have received bright light, which could have influenced results. It cannot be assumed that exposure to this bright light was equal among participants, since the light intensity received at the eye depended partly on the amount of time spend outdoors. Moreover, exposure to bright light from the energy up also might had fluctuated between participants, since the amount of light received at the eye may have differed based on different placements of the lamp. Compared to a lab study, a field study might be less precise despite the instructions given on placing the lamps. The effectiveness of the light therapy may have depended on the actual exposure to bright light, and thus depended on exposure to daylight and the placement of the energy up lamp. Therefore, it is suggested that participants wear a light sensor near eye level in future research, in order to measure actual bright light exposure. This could not only test how much light people received when using BLT, but could also measure bright light exposure besides BLT. Besides the actual light exposure, the light intensity of BLT might had been too low, or the duration of BLT might have been too short to find effects. Other studies that did found an effect and report light intensity at eye level, report and exposure >2000 lux at eye level, or a longer duration (45 minutes till an hour or more, for 2-3 weeks). Our period might had been too short to found effects on all complaints.

It is also worthy of further investigating why BLT and DRL did not differed in effectiveness. In order to test whether taking a brief moment for oneself might have increased resources, an extra intervention period could be added. This intervention period for example could be to listen to music for 20-30 minutes in the morning or to do a mindfulness exercise (Awa et al., 2010), since this could be found relaxing and is expected to be similar in level of burden. Adding this intervention period will moreover establish whether waking up earlier might have influenced results. Note however that a pilot study might be needed to test the effect of music on relaxation.

5.2.2. Recruitment participant sample and burden nature of BLT and experiment
The recruitment of participants was found to be difficult. At first the experiment was supposed to be conducted with teachers only. However, not enough teachers could be recruited, despite addressing over 75 schools, personal contact with teachers, flyers and social media. Since it was impossible to recruit the required number of teachers needed for the current research, students were recruited to supplement the participant group of teachers. Finding enough students to supplement the participant sample was found very effortful but feasible. The amount of questions a day or the requirement of 20-30 minutes of light therapy in the morning might have been reason for not participating in the experiment.

The burden of sitting in front of the lamp was found to be high. Reducing the burdensome nature of a task or intervention is likely to increase the possibility of finding members of the target group willing to participate in the study (Scollon et al., 2003). Decreasing the burden of the intervention would also make it less demanding and therefore also less depleting. There are several ways to possibly lower the burden of research involving bright light therapy. The first option is to change the moment of using BLT. Altering the time of using BLT is likely more important when students are the target group. Their time of waking up is
often later compared to the time employees get up, since the latter probably have to start working at 9.00 o’clock. The burden of BLT might also be lowered by presenting bright light in a more automatic manner, such as by the use of increased brightness in ceiling illumination, which has been successful in previous research (Leppämäki et al., 2002; Riemersma-van der Lek et al., 2008). Using ceiling or other build-in illumination to increase exposure to bright light levels does not require one to wake up earlier, and would therefore less obstruct people in their daily life.

5.2.3. Consciousness by Experienced Sampling Method (ESM)

The use of an Experienced Sampling Method (ESM) – frequent assessment of a questionnaire – provided more insight in the variable of interest. Moreover, in our case it could assessed whether people could benefit more from BLT at different moments of the day. However, ESM could cause reactivity. Some participants mentioned that the daily questionnaires made them conscious about their current wellbeing; some mentioned even being slightly shocked by their answers. The questionnaires could thus had made people more aware of their mental state, and perhaps already acted thereon. Although this is not negative per se, since this reactivity can already improve their wellbeing regardless the intervention.

5.2.4. Level of exhaustion on burnout subscale

Compared to another study on burnout and BLT, levels of exhaustion were less than half as high (Meesters & van Velzen, 2010; Meesters & Waslander, 2010). Although it is not unexpected that levels of exhaustion were higher in an actual population with burnout, the levels of exhaustion in the screening questionnaire of burnout might not had been representative. The threshold for the exhaustion dimension for teachers is validated, however the threshold for student is not validated yet. The threshold selected was based on results found in previous research (Bolwerk, 2011; Frese, 2009; Hackelberg, 2012; Kaebisch, 2011). Perhaps the threshold was not high enough to experience exhaustion. Especially since exhaustion is seen as a key element in burnout, this limitation must be taken into account for future research. The students selected for participation might not have been exhausted enough to experience improvements when using BLT. Furthermore, participants’ answers to the screening questions used for the exhaustion threshold might have been dependent on the moment people filled in the questionnaire. During a moment of 8 weeks people could filled in the screening questionnaire, a stressful week with high work demands could had influenced result of the screening questionnaire. People who filled in the questionnaire during an occasional week or a week of exhaustion, due to high work demands, might have been subject to this same phenomenon as well. Therefore, it is important to note that the participants selected might not have been exhausted enough as their answers might have been subject to a coincidence of time. It is recommended if students will be used in further research, that the threshold for the subscale of exhaustion will be increased. Since no validated sub threshold for students exist, increasing the threshold will exclude students with lower scores, and perhaps also with less severe burnout complaints.

5.2.5. Software shortcomings

During the experimental period there were several problems with the software, leading to missing data points. Both daily measures, assessed with the app Metricwire, and weekly measures, assessed with a website were subject to technical problems.

5.2.6. Contextual factors

Contextual factors, such as exam weeks and public holidays, might had influenced exhaustion, mental wellbeing and sleep habits, as these were present in the intervention weeks and not during the baseline period. The contextual factor of exam weeks could explain why there were 58 outliers on stress experience alone.

5.3. Practical implications of Bright Light Therapy

The most important question is not only whether BLT could influence burnout related complaints, but also whether BLT will be used in daily life. In order for BLT to be used, the benefits must outweigh the costs (e.g. effort) involved. The use of BLT was experienced more as a burden then not as a burden, and is therefore less likely to be used in daily life. Moreover, the negative Net Promoter Score for BLT and light therapy
indicated a negative attitude against the product and usage of light therapy and BLT. It would therefore require effort by people to engage in BLT. People who experience burnout related complaints over a prolonged period of time exceed their resources by high work demands, which indicates these people might not have enough time to increase resources or it might be impossible for them to increase their resources by relaxation. Those suffering from burnout related complaints, including high fatigue, could therefore perceive they had no time available to use the lamp. A more automatic bright light exposure might form a more practical solution for them. This automatic bright light exposure can be labelled as ambient lighting – lighting that is part of the environment. Many implications for this ambient lighting could be given. First, an application for ambient lighting could be ceiling illumination, with a slightly higher light intensity. Increased ceiling illumination will probably be most feasible in office buildings, or others buildings were people will spend their working hours. This application will not obstruct daily life. Second, another application could be a lamp which appears less dominant, since a single participant mentioned to hide the lamp after usage. The lamp going to be used in BLT could therefore be more in line with the interior, compared to the energy up used for BLT in this study. Thus, it becomes part of the interior, examples for this could be usage of a hue lamp. Another application could be a more playful type of lamp, which could integrate for example mindfulness or other relaxation technique with a lamp (For examples see: Siepel, 2014). If future research will establish even more positive results of BLT on the severity of burnout related complaints, application options can be tremendous.

5.4. CONCLUSION

The findings of the current research show only partial support for an effect of Bright Light Therapy (BLT) on burnout related complaints. In some cases both BLT and DRL had an effect, which shows a promising role of light in lowering the severity of some burnout related complaints. However, the effectiveness of BLT was in the majority of the cases not greater than the effect of DRL. A moment for oneself in this case might already have been effective in lowering some burnout complaints. The key component of burnout, exhaustion, however did not improve with either BLT or DRL. This could mean that a vicious circle of exhaustion, sleep complaint and burnout has not been broken or that exhaustion levels were not that severe as intended, meaning no vicious circle was present to be broken. That exhaustion did not improved could also had depended on the actual amount of light entering the participants’ eye, which might had been too low. We therefore cannot conclude whether a moment of brightness by the use of BLT is suggested when burnout complaints are present. Limitations of the current research should first be overcome in order to draw more reliable conclusions for the use of BLT. If controlling for these limitation shows to lower the severity of burnout related complaints, implication of BLT could be tremendous. For example, ambient lighting embedded in housing and increased ceiling illumination at work or school or a more playful type of lamp integrated with mindfulness. Moreover, to lower the burden nature of sitting in front of an artificial light source, ambient lighting might be a more practical solution for not only future research, but also when it should be implemented in daily life. Relaxation and a reduction in fatigue and exhaustion however may already be achieved by reflection on personal wellbeing due to the frequent questionnaires or by taking a moment for oneself in the morning. Burnout related complaints may therefore be improved by a moment of brightness; whether it be by light, consciousness of wellbeing or taking a moment for oneself.
6. REFERENCES


7. APPENDIX

APPENDIX A: FAS QUESTIONNAIRE

De volgende tien uitspraken gaan over hoe u zich de afgelopen week heeft gevoelt. U kunt per uitspraak kiezen uit 5 antwoordmogelijkheden variërend van Nooit tot Altijd.

<table>
<thead>
<tr>
<th></th>
<th>Nooit</th>
<th>Soms</th>
<th>Regelmatig</th>
<th>Vaak</th>
<th>Altijd</th>
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<tr>
<td>Ik heb last van vermoeidheid</td>
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<td>Ik ben gauw moe</td>
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<td>Ik vind dat ik weinig doe op een dag</td>
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<tr>
<td>Ik heb genoeg energie voor het leven van alledag</td>
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<tr>
<td>Lichamelijk voel ik uitgeput</td>
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<tr>
<td>Ik heb problemen om met dingen te beginnen</td>
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<tr>
<td>Ik heb problemen om helder na te denken</td>
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<tr>
<td>Ik heb geen zin om iets te ondernemen</td>
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<tr>
<td>Geestelijk voel ik uitgeput</td>
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<tr>
<td>Als ik ergens mee bezig ben, kan ik mijn gedachten er goed bijhouden</td>
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**APPENDIX B: BDI-II-NL QUESTIONNAIRE**

Deze vragenlijst bestaat uit 21 rijtjes uitspraken. Lees a.u.b. ieder rijtje aandachtig, en kies *één uitspraak*, die het beste beschrijft hoe u zich de *afgelopen week met vandaag erbij* gevoeld heeft. Als meerdere uitspraken in een rijtje goed van toepassing zijn, kies dan het hoogste cijfer van dat rijtje. U kunt steeds maar één antwoord per rijtje kiezen.

### 1. Somberheid, verdriet
- 0 Ik voel me niet somber.
- 1 Ik voel me een groot deel van de tijd somber.
- 2 Ik ben de hele tijd somber.
- 3 Ik ben zo somber of ongelukkig dat ik het niet meer verdragen kan.

### 2. Pessimisme
- 0 Ik ben niet ontmoedigd over mijn toekomst.
- 1 Ik ben meer ontmoedigd over mijn toekomst dan vroeger.
- 2 Ik verwacht niet dat de dingen goed voor mij zullen uitpakken.
- 3 Ik heb het gevoel dat mijn toekomst hopeloos is en dat het alleen maar erger zal worden.

### 3. Mislukkingen
- 0 Ik voel me geen mislukking.
- 1 Ik heb te veel dingen laten mislukken.
- 2 Als ik terugkijk, zie ik een hoop mislukkingen.
- 3 Ik vind dat ik als persoon een totale mislukking ben.

### 4. Verlies van plezier
- 0 Ik beleef net zo veel plezier als altijd aan de dingen die ik leuk vind.
- 1 Ik geniet niet meer zoveel van dingen als vroeger.
- 2 Ik beleef heel weinig plezier aan de dingen die ik vroeger leuk vond.
- 3 Ik beleef geen enkel plezier aan de dingen die ik vroeger leuk vond.

### 5. Schuldgevoelens
- 0 Ik voel me niet bijzonder schuldig.
- 1 Ik voel me schuldig over veel dingen die ik heb gedaan of had moeten doen.
- 2 Ik voel me meestal erg schuldig.
- 3 Ik voel me de hele tijd schuldig.

### 6. Gevoel gestraft te worden
- 0 Ik heb niet het gevoel dat ik gestraft word.
- 1 Ik heb het gevoel dat ik misschien gestraft zal worden.
- 2 Ik verwacht gestraft te worden.
- 3 Ik heb het gevoel dat ik nu gestraft word.

### 7. Afkeer van zichzelf
- 0 Ik voel me over mezelf net als altijd.
- 1 Ik heb minder zelfvertrouwen.
- 2 Ik ben teleurgesteld in mezelf.
- 3 Ik heb een hekel aan mezelf.
8. Zelfkritiek
   O 0 Ik bekritiseer of verwijt mijzelf niet meer dan gewoonlijk.
   O 1 Ik ben meer kritisch op mezelf dan vroeger.
   O 2 Ik bekritiseer mezelf voor al mijn tekortkomingen.
   O 3 Ik verwijt mijzelf al het slechte wat gebeurt.

9. Suicidale gedachten of wensen
   O 0 Ik heb geen enkele gedachte aan zelfdoding.
   O 1 Ik heb gedachten aan zelfdoding, maar ik zou ze niet ten uitvoer brengen.
   O 2 Ik zou liever een eind aan mijn leven maken.
   O 3 Ik zou een eind aan mijn leven maken als ik de kans kreeg.

10. Huilen
    O 0 Ik huil niet meer dan vroeger.
    O 1 Ik huil meer dan vroeger.
    O 2 Ik huil om elk klein ding.
    O 3 Ik wil graag huilen, maar ik kan het niet.

11. Agitatie, onrust
    O 0 Ik ben niet rustelozer of meer gespannen dan anders.
    O 1 Ik ben rustelozer of meer gespannen dan anders.
    O 2 Ik ben zo rusteloos of opgewonden dat ik moeilijk stil kan zitten.
    O 3 Ik ben zo rusteloos of opgewonden dat ik moet blijven bewegen of iets doen.

12. Verlies van interesse
    O 1 Mijn belangstelling voor andere mensen of activiteiten is niet verminderd.
    O 2 Ik heb nu minder belangstelling voor andere mensen of dingen dan vroeger.
    O 3 Ik heb mijn belangstelling voor andere mensen of dingen grotendeels verloren.
    O 4 Het is moeilijk nog ergens belangstelling voor op te brengen.

13. Besluiteloosheid
    O 0 Ik neem beslissingen ongeveer even makkelijk als altijd.
    O 1 Ik vind het moeilijker om beslissingen te nemen dan gewoonlijk.
    O 2 Ik heb veel meer moeite met het nemen van beslissingen dan vroeger.
    O 3 Ik heb moeite met alle beslissingen.

14. Waardeloosheid
    O 0 Ik heb niet het gevoel dat ik waardeloos ben.
    O 1 Ik zie mezelf niet meer zo waardevol en nuttig als vroeger.
    O 2 Vergeleken met anderen voel ik me meer waardeloos.
    O 3 Ik voel me volstrekt waardeloos.

15. Energieverlies
    O 0 Ik heb nog evenveel energie als altijd.
    O 1 Ik heb minder energie dan vroeger.
    O 2 Ik heb niet voldoende energie om veel te doen.
    O 3 Ik heb niet genoeg energie om wat dan ook te doen.
16. Verandering van slaappatroon
   O 0 Mijn slaappatroon is niet veranderd
   O 1a Ik slaap wat meer dan gewoonlijk.
   O 1b ik slaap wat minder dan gewoonlijk.
   O 2a Ik slaap veel meer dan gewoonlijk.
   O 2b Ik slaap veel minder dan gewoonlijk.
   O 3a Ik slaap het grootste deel van de dag.
   O 3b Ik word 1-2 uren te vroeg wakker en kan niet meer inslapen.

17. Prikkelbaarheid
   O 0 Ik ben niet meer prikkelbaar dan anders.
   O 1 Ik ben meer prikkelbaar dan anders.
   O 2 Ik ben veel meer prikkelbaar dan anders.
   O 3 Ik ben de hele tijd prikkelbaar.

18. Verandering in eetlust
   O 0 Mijn eetlust is niet veranderd.
   O 1a Mijn eetlust is wat kleiner dan gewoonlijk.
   O 1b Mijn eetlust is wat groter dan gewoonlijk.
   O 2a Mijn eetlust is veel kleiner dan vroeger.
   O 2b Mijn eetlust is veel groter dan gewoonlijk.
   O 3a Ik heb helemaal geen eetlust.
   O 3b Ik verlang de hele tijd naar eten.

19. Concentratieproblemen
   O 0 Ik kan me net zo goed concentreren als anders.
   O 1 Ik kan me niet zo goed concentreren als anders.
   O 2 Het is lastig om mijn gedachten ergens langs bij te houden.
   O 3 Ik kan me nergens op concentreren.

20. Moeheid
   O 0 Ik ben niet meer moe of afgemat dan gewoonlijk.
   O 1 Ik word sneller moe of afgemat dan gewoonlijk.
   O 2 Ik ben te moe of afgemat voor veel dingen die ik vroeger wel deed.
   O 3 Ik ben te moe of afgemat voor de meeste dingen die ik vroeger wel deed.

21.
   O 0 Ik heb de laatste tijd geen verandering gemerkt in mijn belangstelling voor sex.
   O 1 Ik heb minder belangstelling voor sex.
   O 2 Ik heb tegenwoordig veel minder belangstelling voor sex.
   O 3 Ik heb alle belangstelling voor sex verloren.
## APPENDIX C: BO-NKS QUESTIONNAIRE

Onderstaande vragen richten zich op ervaren gevoelens van uitputting en lichamelijke klachten. Wilt u voor elk van de onderstaande vragen aangeven hoeveel last u hiervan heeft gehad gedurende de *afgelopen week*.

<table>
<thead>
<tr>
<th>Geen energie hebben om na te denken</th>
<th>Geen last</th>
<th>Enige last</th>
<th>Nogal last</th>
<th>Tamelijk veel last</th>
<th>Heel erg last</th>
</tr>
</thead>
<tbody>
<tr>
<td>Een zwaar gevoel in het hoofd</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Pijn in de schouder</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Afdwalen met uw gedachten tijdens gesprekken</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Piekeren als u wakker bent</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Hoofdpijn</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Sneller moe zijn na een lichamelijke inspanning</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Een zwaar gevoel in uw lijf</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Een gespannen gevoel</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Snel geirriteerd zijn</td>
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<td>0</td>
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<tr>
<td>Het gevoel hebben dat alles moeite kost</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Spierpijn</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Constant denken aan wat er allemaal nog gedaan moet worden</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Het gevoel hebben dat niets tot u doordringt na korte tijd</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Slechts kort kunnen concentreren</td>
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</tr>
</tbody>
</table>
## APPENDIX D: VV QUESTIONNAIRE

<table>
<thead>
<tr>
<th></th>
<th>Ja dat klopt</th>
<th>Nee dat klopt niet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ik voel me moe</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ik voel me fit</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Lichamelijk voel ik me uitgeput</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Ja dat klopt

Nee dat klopt niet
**APPENDIX E: MOOD QUESTIONNAIRE**

Geef onderstaand aan hoe je je **op dit moment** voelt.

<table>
<thead>
<tr>
<th></th>
<th>Helemaal niet</th>
<th>Heel erg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gespannen</td>
<td>0 0 0 0 0 0 0 0</td>
<td></td>
</tr>
<tr>
<td>Verdrietig</td>
<td>0 0 0 0 0 0 0 0</td>
<td></td>
</tr>
<tr>
<td>Kalm</td>
<td>0 0 0 0 0 0 0 0</td>
<td></td>
</tr>
<tr>
<td>Blij</td>
<td>0 0 0 0 0 0 0 0</td>
<td></td>
</tr>
<tr>
<td>Rustig</td>
<td>0 0 0 0 0 0 0 0</td>
<td></td>
</tr>
<tr>
<td>Vrolijk</td>
<td>0 0 0 0 0 0 0 0</td>
<td></td>
</tr>
<tr>
<td>Futloos</td>
<td>0 0 0 0 0 0 0 0</td>
<td></td>
</tr>
<tr>
<td>Neerslachtig</td>
<td>0 0 0 0 0 0 0 0</td>
<td></td>
</tr>
<tr>
<td>Prikkelbaar</td>
<td>0 0 0 0 0 0 0 0</td>
<td></td>
</tr>
</tbody>
</table>

Hoeveel stress ervaar je **op dit moment**?

<table>
<thead>
<tr>
<th></th>
<th>Helemaal niet</th>
<th>Heel erg</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>0 0 0 0 0 0 0 0</td>
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</tbody>
</table>

Hoe goed kun jij je **op dit moment** concentreren?

<table>
<thead>
<tr>
<th></th>
<th>Helemaal niet</th>
<th>Heel erg</th>
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<tbody>
<tr>
<td></td>
<td>0 0 0 0 0 0 0 0</td>
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</table>

In hoe verre vindt u dat er **op dit moment** te veel prikkels zijn?

<table>
<thead>
<tr>
<th></th>
<th>Helemaal niet</th>
<th>Heel erg</th>
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<tbody>
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</table>
**APPENDIX F: SLEEPINESS QUESTIONNAIRE (KSS)**

Hoe alert of slaperig voelt u zich **op dit moment**? (leest u a.u.b. eerst alle antwoorden alvorens te antwoorden)

- O Extreem alert
- O Erg alert
- O Alert
- O Eerder alert
- O Niet alert of slaperig
- O Enige verschijnselen van slaperigheid
- O Slaperig, maar zonder moeite om wakker te blijven
- O Slaperig, met enige moeite om wakker te blijven
- O Erg slaperig, met veel moeite om wakker te blijven, vechten tegen de slaap
APPENDIX G: DIARY MORNING (KSD)

De volgende vragen hebben betrekking over uw nachtrust van de afgelopen nacht.
1. Hoe laat bent u afgelopen nacht naar bed gegaan? (bv 21.50)
2. Hoe laat bent u wakker geworden?
3. Hoe lang heeft u naar uw gevoel afgelopen nacht geslaapt?
4. Hoe lang heeft het geduurd voordat u in slaap viel nadat u naar bed bent gegaan?

5. Hoe heeft u afgelopen nacht geslapen?
   Erg goed      Erg Slecht
   O            O

6. Hoe verfrist voelde u zich nadat u wakker werd?
   Totaal       Helemaal niet
   O            O

7. Hoe rustig heeft u vannacht geslapen?
   Zeer rustig  Zeer onrustig
   O            O

8. Heeft u volledig doorgeslapen totdat uw wekker ging?
   Ja           Ik werd veel eerder wakker n.v.t.
   O            O

9. Hoe gemakkelijk was het voor u om wakker te worden?
   Zeer makkelijk Zeer moeilijk
   O            O

10. Hoe makkelijk was het voor u om in slaap te vallen?
    Zeer makkelijk Zeer moeilijk
    O            O

11. Hoeveel heeft u vannacht gedroomd?
    Veel         Niet
    O            O

12. Hoe vaak bent u vannacht wakker geworden?
APPENDIC H: DIARY EVENING

1. Hoeveel cafeïne houdende dranken (thee, koffie, fris energiedrankjes) heeft u afgelopen dag ongeveer genuttigd?
2. Wanneer heeft u deze voor het laatst genuttigd?
3. Hoeveel alcoholische dranken heeft u afgelopen dag ongeveer genuttigd?
4. Wanneer heeft u deze voor het laatst genuttigd?
5. Onderstaand kunt u eventuele bijzonderheden invullen die tot nu toe niet in de vragenlijst voorkomen (bv u bent ziek)
**APPENDIX G: MCTQ QUESTIONNAIRE**

Het doel van deze vragenlijst is om na te gaan of je stemming en gedrag veranderd over de tijd.

Kruis u voor de volgende items alstublieft aan welke maand(en) op u van toepassing zijn. Dit kan een enkele maand zijn, een aaneengesloten groep van maanden of losse maanden.

**Op welke tijd van het jaar ervaart u dat u:**

<table>
<thead>
<tr>
<th></th>
<th>Jan</th>
<th>Feb</th>
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<th>Aug</th>
<th>Sep</th>
<th>Okt</th>
<th>Nov</th>
<th>Dec</th>
<th>Geen</th>
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</tr>
</tbody>
</table>

In welke mate verandert het volgende op basis van de verschillende seizoenen?

<table>
<thead>
<tr>
<th></th>
<th>Geen verandering</th>
<th>Geringe verandering</th>
<th>Matige verandering</th>
<th>Duidelijke verandering</th>
<th>Extreem duidelijke verandering</th>
<th>Geen antwoord mogelijk</th>
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</thead>
<tbody>
<tr>
<td>Slaap duur</td>
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<td>0</td>
<td>0</td>
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</tbody>
</table>
Als u een verandering ervaart tussen de seizoenen, voelt u dan dat dit een probleem vormt voor u?
  O  Nee
  O  Ja
  O  Ik ervaar geen verandering

Indien ja, is dit probleem voor u:
  O  Mild
  O  Matig
  O  Duidelijk
  O  Zwaar
  O  Beperkend
  O  Geen antwoord mogelijk (indien vorige vraag niet met 'ja' is beantwoord)

In hoeverre fluctueert uw gewicht gedurende de loop van het jaar?
  O  0 - 2 kg.
  O  2 - 4 kg.
  O  4 - 6 kg.
  O  6 - 8 kg.
  O  8 - 10 kg.
  O  meer dan 10 kg.

Merkt u een verschil in voedselvoorkeur gedurende verschillende seizoenen?
  O  Nee
  O  Ja
  O  Ik ervaar geen veranderingen

Hoeveel uur van de 24 uur per dag slaap u ongeveer per seizoen? (inclusief dutjes)

Winter (Dec 21 - Mar 20) :
______________________ uur geslapen per dag

Lente (Mar 21 - Juni 20):
______________________ uur geslapen per dag

Zomer (Juni 21 - Sept 20):
______________________ uur geslapen per dag

Herfst (Sept 21 - Dec 20):
______________________ uur geslapen per dag
APPENDIX H: SPAQ QUESTIONNAIRE

In onderstaande vragen wordt u gevraagd naar verschillende bedrituelen en wensen omtrent slaappatronen. Dit om erachter te komen of u een ochtend- of avondmens bent. U wordt regelmatig gevraagd om een tijd op te geven, deze kunt u invullen als volgt:

*Op werkdagen moet ik opstaan om 7.10 uur.*

**Op werkdagen...**
1. Moet ik opstaan om ________ uur.
2. Heb ik ________ minuten nodig om wakker te worden.
3. Wordt ik regelmatig wakker...
   O voor de wekker
   O door de wekker
4. Ben ik volledig wakker vanaf ________ uur
5. Heb ik rond ________ uur een energie dip.
6. Op de avond voor een werkdag ga ik naar bed om ________ uur.
7. Het kost me dan ________ minuten om in slaap te vallen.
8. Als ik de mogelijkheid zou hebben, zou ik graag een siësta of dutje willen.
   O Klopt
   O Klopt niet

**Op werk vrije dagen (beoordeel a.u.b. alleen de normale dagen, dus zonder feestjes etc.)...**
9. Zou het mijn droom zijn om te slapen tot ________ uur
10. Wordt ik normaal gesproken wakker om ________ uur.
11. Als ik wakker zou worden rond de normale (werkdag) alarm tijd, probeer ik opnieuw in slaap te vallen
   O Klopt
   O Klopt niet
12. Als probeer om opnieuw inslaap te vallen, slaap ik voor nog ________ minuten (indien vraag 11 met 'klopt niet' is beantwoord, kunt u hier 0 invullen).
13. Heb ik ________ minuten nodig om wakker te worden.
15. Heb ik rond ________ een energie dip.
16. Op avonden voorafgaand aan een werk vrije dag, ga ik naar bed om ________ uur.
17. Het kost me dan ________ minuten om in slaap te vallen.
18. Als ik de mogelijkheid zou hebben, zou ik graag een siësta of dutje willen.
   O Klopt
   O Klopt niet

**In het algemeen...**
19. Als ik in bed lig lees ik graag nog ________ minuten
20. Als ik in bed lig val ik in slaap na niet meer dan ________ minuten.
21. Ik slaap liever in een kamer die compleet donker is
   O Klopt
   O Klopt niet
22. Ik wordt makkelijker wakker wanneer ochtendlicht in mijn kamer schijnt
   O Klopt
   O Klopt niet
23. Hoe lang per dag besteedt u uw tijd gemiddeld buiten (echt buiten, niet buiten uw huis)?
   Op werkdagen: ________ uur en ________ minuten
   Op werk vrije dagen: ________ uur en ________ minuten
APPENDIX I: LIGHT EXPERIENCE QUESTIONNAIRE

NSP
Op een schaal van 0 tot 10, in welke mate zou u deze lamp aanraden aan vrienden/familie?

Zeer onwaarschijnlijk
0 0 0 0 0 0 0 0 0

Zeer waarschijnlijk
0 0 0 0 0 0 0 0 0

Op een schaal van 0 tot 10, in welke mate zou u lichttherapie aanraden aan vrienden/familie?

Zeer onwaarschijnlijk
0 0 0 0 0 0 0 0 0

Zeer waarschijnlijk
0 0 0 0 0 0 0 0 0

WLEQ
Afgelopen week heeft u gebruik gemaakt van een lamp. De volgende vragen hebben betrekking over het gebruik en de ervaring van deze lamp.

Hoe vond u het product eruit zien?

Mooi
0 0 0 0 0 0 0 0

Niet mooi
0 0 0 0 0 0 0 0

Hoe heeft u de lamp ervaren?

Onplezierig
0 0 0 0 0 0 0 0

Plezierig
0 0 0 0 0 0 0 0

Hoe was het moment van gebruik voor u?

Niet rustgevend
0 0 0 0 0 0 0 0

Rustgevend
0 0 0 0 0 0 0 0

Hoe was het effect van de lamp op u?

Eerder rustgevend
0 0 0 0 0 0 0 0

Eerder activerend
0 0 0 0 0 0 0 0
Kunt u in uw eigen woorden omschrijven wat u van de lichteigenschappen (lichtkleur en lichtintensiteit) vond?

Heeft u nog iets toe te voegen wat u graag kwijt wilt? (Indien dit niet het geval is, kunt u hier n.v.t. invullen.)

**FLEQ**

De volgende vragen hebben betrekking over het gebruik van beide lampen over de afgelopen twee weken in het algemeen.

In welke mate heeft u het als belastend ervaren om 30 minuten achter de lichtbron te zitten?

Zeer belastend  O  O  O  O  O  O  O  O  Totaal niet belastend

Zijn er momenten geweest dat u geen gebruik heeft kunnen maken van de lamp? (indien ja, hoe vaak en waarom)

Zijn er momenten geweest dat u korter achter de lichtbron heeft gezeten? (indien ja, hoe vaak, hoeveel korter en waarom)
Als u mocht kiezen om een van de twee lampen te blijven gebruiken, welke zou dit dan zijn?

Kunt u uitleggen waarop uw keuze is gebaseerd?

De volgende vragen hebben betrekking op de bovenstaande lamp.

Welk effect heeft de lamp die u hierboven heeft geselecteerd naar uw idee gehad?

Zijn er aspecten die u mist aan deze lamp?
Welke aspecten van deze lamp vindt u belangrijk en waarom?

Zijn er toevoegingen die u aan deze lamp zou willen doen?

Zou u deze lamp willen blijven gebruiken indien u de mogelijkheid had?
  - Ja
  - Nee

Wat zou u ervan overtuigen, of meer overtuigen, om wel elke ochtend deze lamp te gebruiken?

Kunt u hier uitleggen waarom wel of niet? (anders kunt u n.v.t invullen)

Heeft u nog algemene opmerkingen / suggesties op de lamp te verbeteren? (anders kunt u n.v.t invullen)
De volgende vragen hebben betrekking op de bovenstaande lamp.

Welk effect heeft de lamp die u hierboven heeft geselecteerd naar uw idee gehad?

Zijn er aspecten die u mist aan de lamp?

Welke aspecten van de lamp vind u belangrijk en waarom?

Zijn er toevoegingen die u aan het product zou willen doen?

Zou u deze lamp willen blijven gebruiken indien u de mogelijkheid had?

- Ja
- Nee
Wat zou u ervan overtuigen, of meer overtuigen, om wel elke ochtend deze lamp te gebruiken?

Kunt u hier uitleggen waarom wel of niet? (anders kunt u n.v.t invullen)

Heeft u nog algemene opmerkingen / suggesties op de lamp te verbeteren? (anders kunt u n.v.t invullen)

Gebruikt u een wake-up light?
  - Ja
  - Nee

Lichttherapie is het gebruik van een lamp met een hoge intensiteit. Heeft u wel eens eerder gebruik gemaakt van lichttherapie?
  - Ja
  - Nee

In welke mate was u voorafgaand aan het onderzoek bekend met Lichttherapie?

<table>
<thead>
<tr>
<th>Totaal</th>
<th>Zeer bekend</th>
</tr>
</thead>
<tbody>
<tr>
<td>onbekend</td>
<td>O</td>
</tr>
</tbody>
</table>