

**MASTER**

**Exploring the effect of colored light on psychiatric patients**

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# Exploring the effect of colored light on psychiatric patients

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## Summary

Being separated during psychiatric crisis has been found to be traumatizing and counter-effective. A combined effort of the GGzE and Philips resulted in a high care department on the crisis center of psychosis from the GGzE. The high care department intends to help the most ill clients creating a healing environment that is pleasant and enhances their well-being, subsequently accelerating the recovery process. The current study aims at gaining more knowledge about what type of colored light could be applied in the high care department to help reduce the anxiety of these patients by creating an environment that is relaxing and enhances the social bond between patient and caregiver. It was investigated whether warm colored (orange) ambient lighting increases relaxation and perceived social support more than cool colored (blue) ambient lighting and neutral (white) ambient lighting. We anticipated that orange light relaxes the psychiatric patients more than blue light and neutral white light, because the literature seems to indicate this. Second, it was expected that orange light enhances the social support perceived by the psychiatric patients more than blue light and neutral white light, because literature seems to point out that warm toned color light increases social supportive behavior. Third, it is presumed that enhancing both relaxation and the perceived social support reduces the anxiety of psychiatric patients, because both concepts have been proven to impede anxiety. A within-subjects design with three lighting conditions (orange, blue, and white) was used to test the influence of light on affinity towards a (bogus) person, mood and atmosphere perception. At the end, qualitative interviews were conducted. Twenty -three ( $n=23$ ) experts of experience (former psychiatric in-patients) participated in the study. During each light condition participants played an imagination game with a (bogus) person, this person was rated afterwards by use of a questionnaire to see if affinity differed among light conditions. Results showed significant effects of light on affiliation towards the (bogus)person and atmosphere perception, but not on mood. Effects are as expected by the hypothesis showing that warm colored light (orange) can increase positive judgments of another person and positively influences the atmosphere. It may be concluded that warm colored light seem to be able to contribute positively to the mental healthcare setting by enhancing the social bond and creating a cozy and lively atmosphere that helps reduce escalating behavior and length of stay in separation. Overall, the findings are promising concerning the use of colored light to promote recovery in the mental health care setting.



## Table of contents

1.	Introduction .....	- 7 -
	The organization GGzE .....	- 9 -
	High care vision .....	- 9 -
	High care unit .....	- 9 -
	Experts of Experience .....	- 9 -
2.	Theoretical Background .....	- 11 -
	Psychosis .....	- 11 -
	Anxiety .....	- 11 -
	Relaxation .....	- 12 -
	Social support .....	- 13 -
2.1	The effects of color and light .....	- 14 -
	Color .....	- 14 -
	Light .....	- 16 -
2.2	The effects of colored light on relaxation and social support .....	- 19 -
	Colored light and relaxation .....	- 19 -
	Colored light and social support .....	- 20 -
3.	Research question .....	- 21 -
4.	Method .....	- 22 -
	Design .....	- 22 -
	Participants .....	- 22 -
	Setting .....	- 22 -
	Stimuli & Equipment .....	- 23 -
	Task .....	- 24 -
	Measures .....	- 24 -
	Procedure .....	- 26 -
5.	Results .....	- 27 -
	Likeability .....	- 27 -
	Mood .....	- 28 -
	Atmosphere perception .....	- 30 -

Need for affiliation .....	- 33 -
5.1 Post-experiment Interview .....	- 33 -
Overall impression of three light conditions .....	- 33 -
Personal light color preference .....	- 34 -
Likeability towards the (bogus) person.....	- 35 -
Preference and likeability .....	- 36 -
Mood.....	- 37 -
Preference and mood.....	- 38 -
Atmosphere perception .....	- 40 -
Separation experience.....	- 41 -
Dynamic light .....	- 42 -
Recommendations .....	- 42 -
6. Discussion .....	- 44 -
Effects of colored light on likeability.....	- 44 -
Effects of colored light on mood .....	- 45 -
Effects of colored light on atmosphere perception .....	- 46 -
The influence of personal preference .....	- 47 -
Limitations and future research.....	- 47 -
Implications.....	- 49 -
7. Conclusion .....	- 51 -
8. Literature .....	- 52 -
Appendix 1 – Need for affiliation questionnaire (in Dutch).....	- 62 -
Appendix 2 – Mood questionnaire (in Dutch).....	- 63 -
Appendix 3 – Affiliation towards the (bogus) person (in Dutch) .....	- 64 -
Appendix 4 – Atmosphere perception questionnaire (in Dutch).....	- 65 -
Appendix 5 – Interview questions .....	- 66 -
Appendix 6 – Flow chart experiment .....	- 67 -

## 1. Introduction

In recent years separation rooms in psychiatric care occasionally made headlines as a result of negative practice. We have seen terrible circumstances in which patients were tied to the wall, laid in their own excreta or even died due to defects. Whenever these dreadful situations attract our attention, nationwide we seem to be appalled by it and want to alter these situations. We think that once it made headlines, things will change for the better. Unfortunately, today, there are still many psychiatric patients that are exposed to circumstances, often less dramatic as seen in the news, that are causing the patients harm. When separated, patients are put in isolation behind thick doors, with nothing more than a toilet and a bed that is part of the clinical environment. For safety reasons they can be disposed of their clothes and all personal belongings and left with nothing to do and dependent on others for their basic needs. This desolate and frightening circumstance can be counter-effective and harms the patient, both physically and mentally.

As a treatment intended to reduce escalating behavior, patients can be separated. Separation is the seclusion of a patient in a low-stimulus environment. Only when escalating behavior develops into an emergency situation, separation occurs (BOPZ, 2000). An emergency situation transpires when the patient's own safety or safety for those in the environment is at risk. Patients are separated until they have calmed down. This can last a few hours up to a few days. Incidentally, there are cases in which patients were secluded for weeks or even months (Hendryx, Trusevich, Coyle, Short, & Roll, 2010). Escalating behavior occurs when the patients are unable to control the situation or their impulses and act out in uncontrollable, verbal or physically aggressive and unpredictable ways. In 2011 between 6600 and 7000 psychiatric patients were separated in Dutch mental health care facilities, varying in duration from one hour up to 1092 hours (IGZ, 2011b).

Psychosis is known as one of the most expensive syndromes in society (Seijlhouwer, 2013). According to calculations by the Geestelijke Gezondheidszorg Eindhoven en de Kempen, (abbreviate: GGzE and translated as: Dutch mental health care organization Eindhoven and the Kempen) a first day of separation at a GGzE institution costs 914 euro and each additional day costs 583 euro (GGzE, 2012b). Compared to other European countries the Netherlands is one of the front runners in applying separation in mental health care facilities. For instance, the average time a person is separated in Germany is 6,6 hours and in Norway 3 hours, whereas the Netherlands reported an average of 63 hours (Erasmus MC, 2012). Additionally, research has indicated that clients that are being separated spend, on average, twice as long in an institution (Philips, 2012). This also increases expenses.

Besides these costly effects of separation there are also emotional effects on both the staff and patients. Separation is a serious violation of a patient's freedom. For the patient, separation is a terribly frightening situation, which often makes patients even more scared than they were before (Reedijk, 1996). The experience of being in a separation cell increases immediate anxiety and can often lead to post-traumatic stress (Lezy, 2007). It can also impair self-confidence of the patients or trust patients have in others, like family or co-patients (Hommes & Abma, 2009). Many patients report that separation is a very negative experience that is similar to a trauma caused by being taking hostage (Van der Werf, 2003).



Another consequence of separation is the disruption of contact, which harms the trust of clients in the caretaker (Voskes, Theunissen & Widdershoven, 2011; Wynn, 2004). Recovering the contact takes time and occasionally the contact is never fully recovered. Furthermore, Frueh et. al. (2005) reported that patients' negative perceptions of separation and restraint were stable across time. Due to the negative effects of separation on both the staff and patients the GGZ (Geestelijke Gezondheidszorg translated: Mental Healthcare), in accordance with current policy, is trying to reduce the number of psychiatric patients that are being separated. Despite the intentions to reduce the amount of separations each year with 10%, this decrease was only achieved in 2009 (IGZ, 2011a). During 2010 and 2011 the decline stagnated.

While research is widely spread in the area of psychosis, in recent decades the treatment has not substantially improved (Seijlhouwer, 2013). A combined effort of the GGzE and Philips is trying to improve this treatment. This resulted in a high care department on the crisis center of psychosis from the GGzE. The high care department of this unit uses a unique combination of dynamic light, sound, projections and an interactive wall that assists in empowering the patients by obtaining control over their environment. This concept is based on the Philips Ambient Experience concept, an audiovisual intervention that projects calming content, that is already implemented in four hundred hospitals worldwide (Philips, 2012). This concept (see Figure 1 as a model) has been proven to successfully reduce anxiety and create a sense of control in patients who are waiting for diagnostic testing in a PET uptake room or MRI room (Vogel et al., 2012; Philips, 2013). The high care department intends to help clients to create a healing environment that is pleasant and enhances their well-being, subsequently accelerating the recovery process. An important aspect of the department is the support room, a room for people with a high chance of losing control and ending up in a crisis situation (GGzE, 2012a). The room should aid in preventing escalation. By means of the high care department traditional separations should become redundant.

The current study aims at gaining more knowledge about what type of light could be applied in the high care department to help reduce the amount of separations that take place. First, the context and background will be described. Second, an introduction will be given into the psychiatric disorder psychosis and the influence of anxiety on psychosis. This is followed by the relation between anxiety, relaxation, social behavior, color and light. Third, the study will be described, followed by the results. Then, the results are discussed and lastly, conclusions are drawn.



Figure 1. An indication of the ambient concept applied in a MRI room

## **The organization GGzE**

The Geestelijke Gezondheidszorg Eindhoven en de Kempen (GGzE) offers help and support for people with severe, multiple and often chronic psychiatric problems. The GGzE provides both ambulant and clinical care for their patients. They work in the region of Eindhoven and the Kempen and have several institutions in this area. On a yearly basis they support over 20.000 people with psychiatric problems, ranging from psychotic disorders, autism, mood and anxiety disorders, and personality disorders (GGzE, 2010). This project will run at the crisis center of psychosis at the GGzE psychiatric location 'de Grote Beek'.

## **High care vision**

As mentioned before, the GGzE is trying to reduce the number of separations in their facilities. Recent policy of the government also aims at reducing the number of separation rooms and the need for separation (Voskes, Theunissen, Widdershoven, 2011). The negative effects of separation are numerous and affect all parties involved. Recently, a new high care vision is created in which they focus on establishing and preserving the contact between patient and caretaker in order to reduce coercion and separation (Voskes, Theunissen, Widdershoven, 2011). New norms regarding physical restraint focus on safety, humane and respectful treatment, as well as stimulating both the patient and caretaker to improve the situation as soon as possible (ten Voorde, 2013). The aim at the GGzE is to create a context in which separation is reduced to the bare minimum to ensure minimal load and damage for the patient (IGZ, 2013). The new high care unit at the crisis center of psychosis is realized to assist in reaching this goal.

## **High care unit**

The high care unit at the crisis center of psychosis is a secluded section at the institute. The section is available for those patients that are at risk of ending up in a crisis. Typical of the department is the focus on the patients control and maintaining contact between the patient and caretaker (ten Voorde, 2013). The department consists of two support rooms, two separation rooms, an intake room and the corridor. The full ambient experience concept is implemented in the intake room, the corridor, two support rooms and one separation room. The concept helps the patients create an environment in which they have more control. Empowering the patients in their healing process by giving them control over their environment is an important feature of the high care unit (van der Zwaag, 2013). Patients become in control of their environment by use of an interactive screen (for an indicative picture see Figure 2). The interactive wall gives patients the opportunity to view their guidance plan, to play games or draw sketches. Furthermore it gives them the opportunity to personalize the room by choosing a theme. Changing the theme would personalize the light color and content on the interactive wall. Furthermore, the room is divided in two zones by use of two colors (ten Voorde, 2013). This assists in creating a contact zone and a private zone for the patient, this private zone can only be entered by the caretaker after permission from the patient. All of these features are implemented to support the patient in regaining control and creating a healing environment. Nonetheless, the concept has only been recently applied in the treatment of psychotic patients. As a result, it is as yet unclear what the effects of the ambient concept are on the patients. Due to this, both Philips and the GGzE are

interested in gaining more understanding about the impact of the ambient concept. For that reason, this study focusses on acquiring knowledge about the influence of colored light on psychotic patients.



Figure 2. Picture of a separation room, with integrated interactive screen

### Experts of Experience

The participants of the study will be experts of experience. These are former psychiatric inpatients who use their past experience to help others. Experts of experience have had professional help to cope with their previous problems and are now capable of reflecting on their past problems and learned ways to deal with these problems. After they were successively treated they have chosen to be educated in becoming an expert of experience, in order to help new patients deal with comparable problems.

## 2. Theoretical Background

### Psychosis

Psychosis is a broad and general term often used to describe many psychiatric symptoms and signs that affect the mind. Persons who suffer from psychosis are in a state of being in which they lose themselves in illusions, hallucinations and incoherent thoughts (Lezy, 2007). This means that they have lost touch with the real world and are unable to distinguish reality from their own imagination. A psychotic episode can differ in strength, experience and duration and can originate from different causes. There are functional psychoses and organic psychoses (van Praag, 2000). Functional psychoses can be instigated by schizophrenia, bipolar disorder, psychotic depression and being bullied (Royal College of Psychiatrists, 2009). Organic psychoses originate from Alzheimer's disease, brain tumors, epilepsy, low birthweight, and more (Nordqvist, 2012; Thomas et al., 2009). Substances like alcohol, drugs and prescription medication can also trigger functional psychoses. Symptoms like delusions, hallucinations and incoherent thoughts are often the root of patient's dissociation and anxiety (Glas, 2001). Anxiety is a symptom that is often present in individuals suffering from psychosis. During all phases of the illness anxiety is a prevalent symptom (Waller et al., 2013). Anxiety plays a fundamental role in the onset and preservation of psychosis (Birchwood, 2007, and Waller et al, 2013). As a reaction on a psychotic episode anxiety can also occur. A large portion of clients admitted to the crisisunit of psychosis of the GGzE suffers from schizophrenia and a co-morbid condition of schizophrenia is anxiety (Oud, Schuling, Slooff, & Jong, 2007). Moreover, according to Waller et al. (2013) a main goal of psychological interference is to reduce anxiety for people with psychosis.

Summarized, a psychosis is a disturbing period for the patient, in which anxiety is a prevalent symptom that often reinforces the psychotic episode. Creating a healing environment that reduces this anxiety enhances the patient's wellbeing and prevents escalation, consequently reducing the need for separation.

### Anxiety

As a product of deep evolutionary origin, anxiety has been crucial to our evolution. Staying alive by avoiding dangerous situations has been essential for the survival of mankind. Anxiety is therefore a product of natural selection and subsequently imbedded in our genes (Lewis, Haviland-Jones, Barret, 2010). Consequently it is not strange that the majority of the people have experienced anxiety at one point in their life (Macintyre, 1995). Anxiety is an uncomfortable feeling of fear and concern due to a real or perceived threat to physical or mental well-being (Patel, 2013; Badger, 1994). "Anxiety can create feelings of fear, worry, uneasiness and dread and is associated with feelings of restlessness, fatigue, concentration problems and muscle tension" (Patel, 2013). Anxiety is not the same as fear, despite the fact that they are both negative emotional states. Fear involves an identifiable stimulus, which appears to be an immediate danger and results in an intense urge to defend oneself (Patel, 2013; Lewis, et al., 2010). Fear, in that sense, is an immediate reaction towards a stimulus, while anxiety does not involve an eliciting stimulus but is the suspicion of something threatening that might be out there. Anxiety can occur in response to external or internal events (Badger, 1994). External events are things that happen to us, without our deliberate influence. Internal events descend from our considerations,

thoughts about what is transpiring, has transpired or is about to transpire. Anxiety is a normal reaction to a stressor and a coping mechanism (Lewis, et al., 2010). It provokes an individual to cope with a demanding situation. However, anxiety can become overwhelming. Badger (1994) states "the greater the threat, either perceived or actual, the greater the patient's anxiety response". Thus, it can be experienced in different degrees, ranging from mild to severe anxiety (panic attacks). These different degrees of anxiety involve different symptoms and not everybody experiences the same symptoms. Severe anxiety can paralyze individuals resulting in a feeling of helplessness and an inability to cope with the situation (Lewis, et al., 2010). "Anxiety can also consume attentional resources and lead to withdrawal" (Amstadter, 2008). Other symptoms of anxiety are increased rapid heartbeat, trembling, nervousness, feeling faint, nausea, shortness of breath, unusual body sensations, restlessness and inability to keep mind on a task (Sainsbury & Gibson, 1954; Reiss, Peterson, Gursky, & McNally, 1986). When anxiety increases, muscle tension, heartbeat and shortness of breath also increase.

A number of studies have indicated that anxiety and loss of control (for instance perceived during separation) are detrimental to health and overall well-being (Tayler, Repetti & Seeman, 1997; Lindheim & Syme, 1983). To illustrate, it has been reported that seclusion evokes feelings of anxiousness, anger and hostility in patients (Lezy, 2007; Wynn, 2004; Reedijk, 1996). Patients occasionally report that anxiety increases because memories of prior abuse are revived (Wynn, 2004). Anxiety for the duration of separation often increased due to fear for small and closed spaces, injections or medication (Meehan, Vermeer & Windsor, 2000). It was also reported that fear did not immediately decline once patients left the separation room. Additionally, research has indicated that patients who were separated felt fearful and vulnerable about the experience for a long period of time (Meehan, Vermeer & Windsor, 2000). Overall, it seems that the experience of separation increases a patient's anxiety.

Briefly worded, anxiety is an emotional state of high tension in which fear and concern, caused by a real or perceived threat to physical or mental well-being, is elicited in order to cope with the demanding situation.

## **Relaxation**

There are different ways in which anxiety can be reduced, one of them is applying a strategy of relaxation. In general relaxation techniques are found to reduce anxiety and pain in the general population, patients and psychotic individuals (Rasid, & Parish, 1998; Gill, Kolt, & Keating, 2004; Manzoni, Pagnini, Castelnuovo, & Molinari, 2008; Cheung, Molassiotis, & Chang, 2001; Lundgren, Carlsson, & Berggren, 2006; Roykulcharoen, & Good, 2004). According to the dictionary relaxation is "the state of being free from tension and anxiety". Meaning that relaxation is a condition of low tension. The process of relaxation promotes the release of hormones such as endorphins, encephalins and serotonin, which are known to give you a 'feel-good' sensation (Weintraub, 2004). The process can be achieved in many ways and different techniques can be applied. Some apply behavioral therapy and others cognitive therapy by focusing on coping with stress or on relaxation itself. These therapies often focus on breathing rhythm and overall relaxation of the muscle tissue. In a review by Esch, Fricchione and Stefano (2003) on therapeutic use of relaxation in stress-related diseases like anxiety disorders, they conclude that relaxation is a highly recommendable technique. Applying relaxation techniques

counteracts anxiety, because it stimulates a lower heart rate, lower muscle tension and lower breath rate.

In short, the strategy of applying relaxation techniques is seen as inhibiting anxiety. This study hopes to enhance a relaxation strategy in order to reduce the anxiety of the patients.

### **Social support**

It has been found that social support can also reduce the feeling of anxiety. Social support refers to the functions performed for the individual by significant others (Thoits, 1995). Social support has been indicated to control the feeling of anxiety and lower the risk of psychological disturbance (Thoits, 1986; Berkman, 2001). Furthermore, it has been demonstrated that humans generally want to be close to others, especially during times of social distance and isolation (Williams, 2007). It is frequently reported that the lack of social support contributes negatively to mental illnesses as psychosis, schizophrenia, and other psychiatric symptoms (Lin, Ensel, Simeone & Kuo, 1979; Liem & Liem, 1978; De Silva, McKenzie, Harpham & Huttly, 2005). It has also been known that mental illnesses actually increase the social distance between patients and significant others (Link, Phelan, Bresnahan, Stueve & Pescolido, 1999). On one hand, this is due to the fact that those suffering from mental illnesses often have symptoms that are socially undesirable and hurt the social relation. But also because those suffering from mental illnesses are associated with displaying aggressive behavior and this increases the fear of interaction. These two reasons are often root to the low social support experienced by people suffering from psychosis. This influences the psychotic patient in a negative way because during the acute phase of a psychosis there is a high need for social support (Reed, 2008). Normal social connections have been proven to reduce stress and the risk of creating a psychosis (Broome et al., 2005). Moreover, it has been reported that social support reduces psychotic relapses and improves the well-being of people suffering from psychosis (Castelein et al., 2008; Link et al., 1999; Ulrich, 1991). Social support seems to improve mental and physical health in general (Seeman, 1996). Additionally, social support is considered a coping resource, because of the supportive function. The perception of social support available (and not the actual support) appears to have a strong influence on mental health and general well-being of an individual (Thoits, 1995). Besides, it has been recorded that effective therapeutic relationships help to alleviate anxiety and confusion, and enable the patient to feel more in control, consequently improving the patient's well-being (Reed, 2008).

The reported research mainly includes long-term effects of perceived social support on health and well-being. However, there is some evidence that shows that short term effects are also conceivable. Williams and Bargh (2008) found that participants who held a warm cup of coffee for a short period of time acted more social towards other compared to participants who held a cold cup of coffee. They also showed that participants who held the warm cup of coffee were more likely to choose a gift for their friends while those exposed to the cold cup of coffee more often choose a gift for themselves. This research shows that it is possible to increase social behavior during a short-time period.

In short, social support has been frequently reported to help alleviate anxiety and is seen as a coping mechanism to deal with psychological turbulence. This study wants to try to improve the perceived social support by improving the immediate perception the patient has of the caretaker. By

creating a more positive apperception of the caretaker, the social bond between the patient and caregiver might be improved.

## 2.1 The effects of color and light

Studies on the effects of color and light have been widely spread among the literature. Both color and light have been found to influence many aspects of our daily lives. The use of color and light has been researched in many areas like fashion, aesthetics, environmental design, healing environments, medical treatments, and physical and cognitive performance. A short overview of some of the findings and relations will be given, starting with an overview of color research, followed by light research and then the effect of them on social support and relaxation.

### Color

Color is often described in characteristics as warm-cool, bright-dim, soft-hard, light-dark (Gao et al., 2007) in everyday life. Officially, colors can be described by three attributes: brightness, hue and chroma (Perz, 2010). As Perz (2010) describes it: "Brightness refers to the total amount of light reflected from a surface". Hue is defined by Fairchild (2013) based on CIE as "an attribute of a visual perception according to which an area appears to be similar to one of the colours (red, yellow, green and blue) or to a combination of two colors." Chroma "is the colorfulness of an area judged as a proportion of the brightness of a similarly illuminated white or highly transmitting area" (Fedorovskaya, Ridder & Blommaert, 1997). White and yellow are for instance bright colors, because they reflect a large amount of light while black and brown are dark colors. Black and white on the other hand are achromatic colors and devoid of hue while yellow and brown do possess hue (Perz, 2010). Achromatic colors do not exhibit chroma, while for chromatic colors chroma increases when the amount of color content increases (Perz, 2010). Hence, officially colors are described by three attributes, however in psychological research colors are often described as warm-cool, bright-dim, soft-hard and light-dark.

There is an extensive framework that indicates that there is a relation between color and perception, physiology and emotions. We, for instance, often communicate our state of mind by use of colors. Some examples are feeling blue, to be purple with rage, to be browned off and green with envy. These expressions already indicate that there is a relationship between color and feelings (Terwogt & Hoeksma, 1995). Some more of the presumed relations will be highlighted here.

Color seems to be able to elicit different emotional reactions. It is, for instance, declared that some colors make you happy and others make you sad (Terwogt & Hoeksma, 1995). The color yellow often elicits a feeling of enjoyment, happiness and cheerfulness, and orange is associated with lively, energetic and extroverted (Manav, 2007). The color blue and red seems to stimulate different emotional reactions. Calming effects are often ascribed to blue, but on the other hand it is described as cold, dull, activating and sometimes even depressing (Plitnick, Figueiro, Wood & Rea, 2010; Manav, 2007; Dalke, et al., 2006; Singh, 2006; Bellizzi, Crowley & Hasty, 1983). Dalke et al. (2006) reviewed color application in the design of hospitals and recognized that overuse of blue was often found to increase depression. The study by Manav (2007) examines existing beliefs about color and found that

blue was associated with calmness, being peaceful and cold. Singh (2006) showed in a literature review that blue was seen as calming in restaurants and shops, had an calming effect on overall mood but that it was also described as being cold and dull. Plitnick et al. (2010) found in a study about the effect lights have on momentary mood and alertness at night, that blue and red had an activating effect (it reduced sleepiness). The color red, as mentioned, also provokes both positive and negative emotions. On one hand we often associate it with love and caring, but rage and aggressive behavior are also linked with the color red (Manav, 2007). Additionally, Valdez and Mehrabian (1994) examined what feelings were elicited by a color sample. They found a relationship between color brightness and the feelings of pleasure, arousal and dominance, indicating that the brightness of a color can also influence the perception and emotional response to colors. In general it has been suggested that light colors (yellow, red, blue) are associated with positive emotions, while dark (black, grey) colors are associated with negative emotions (Manav, 2007; Naz & Epps, 2004; Naz & Helen, 2004).

Moreover, colors has been found to be associated with different things. From an evolutionary viewpoint bright colors have warned us for danger, like poisonous food or vicious animals. Still today, red is often used as a warning signal. But red is also seen as an aphrodisiac regarding sex and romance (Elliot & Niesta, 2008). A well-known Dutch example of this association is the red light district. Other examples of associations with color are that the color green is often associated with nature and trees, blue with the ocean and the sky and yellow is related to the sun and summer time (Naz & Helen, 2004). These examples seem quite basic. But it has been found that past memories also influence associations we have with colors. Naz & Helen (2004) have studied associations and the role of experiences. They found that people were reminded of past experience upon seeing a color. Participants mentioned, for instance, that yellow-red reminded them of school buses and their childhood. Or that blue-green reminded them of mints and toothpaste, while black reminded some participants of nice sport cars and others of funerals. But there are also studies indicating that the natural, remembered, color of objects is often most important when indicating what color an object has. In a study by Branca (1964) participants looked at a lemon and tomato who had the exact same color. After seeing the objects they had to choose a color from a color wheel that corresponded to these objects. It was found that lemons were matched with more yellow colors and tomatoes with more red colors, despite the fact that they had the exact same color. This shows that past experiences with these items influence the association and consequently the perception of the color. Generally speaking, color associations seem to be highly dependent on both personal preference and past experience with a specific color (Naz & Helen, 2004; Branca, 1964; Loftus, 1977).

Color has also been reported to influence the perception we have of other people and objects. One example of this is the fact that men view women as more attractive when wearing red clothes (Elliot & Niesta, 2008). Likewise, it was found that males and females wearing either black or red were rated as more attractive compared to wearing blue, green, yellow and white clothing (Roberts, Owen & Havlicek 2010). Another study about clothing showed that teams in black uniforms were rated as more aggressive compared to teams with nonblack uniforms (Frank & Gilovich, 1988). Furthermore, Takahashi (2009) found that people in a red lighting condition judged others to be more emotional compared to a white lighting condition. Not only the apperception of other people is influenced by color but also the apperception of food has been found to be influenced by color. Zellner & Kautz (1990)



found that strawberries were rated as smelling stronger when colored red than when colorless. Findings summarized by Grossman & Wisenblit (1999) indicate that certain colors are preferred dependent on the context. The colors blue, gray, red, white and black are preferred for automobiles, whole carpeting and furniture whereas paint is preferred in beige. Moreover, it was found that the surface color of an object was important in deciding if two stimuli were the same. When the surface color of a picture corresponded with the prototypical color of an object it increased the capacity to give the object the correct name (Joseph & Proffitt, 1996). Overall, it seems that color can influence perceptual judgments of both objects and other persons.

In addition, the context of an environment has also found to be influenced by colors. Hidayetogly, Yildirim and Akalin (2012) found that cool-colored (blue and green) walls in spaces increased the navigability compared to warm-colored (red and yellow) walls. Similarly, it was found that black and white pictures took longer to name than color pictures (Ostergaard & Davidoff, 1985; Albright & Stoner, 2002). Another study found that a blue environment in retail settings made consumers react more favorably. And eliciting people's attention and attraction was easier with warm-colored (red) backgrounds (Bellizzi & Hite, 1992). Their study seems to indicate that simulated purchase rates were higher in blue stores compared to red stores. Generally speaking, it seems that color influences the context and as a result influences our preferences.

As illustrated, effects of color on emotion and associations are examined considerably, nevertheless consistent effects have hardly been documented. As mentioned, colors are often associated with contradictory emotions and various associations. When it comes to the influence of color on person, object and context perception findings seem more coherent. Nevertheless, there are still some ambiguities. First, studies have often failed to use standardized color samples or the official system to rate colors (Dalke, et al., 2006; Roberts, Owen & Havlicek 2010; Frank & Gilovich, 1988). Second, studies have used matching tasks, in which a color is matched to prescribed emotional terms (happiness, sadness etc.), which limits the quantity of reactions to colors (Terwogt & Hoeksma, 1995; Manav 2007). Furthermore, there are indications that the effect of color on emotion, perception, context and associations is complex. As many factors seem to influence the relation, like age, gender, geographic location, experiences, background, and individual difference in environmental sensitivity (Kwallek, Woodson, Lewis & Sales, 1997; Naz & Helen, 2004; Elliot & Maier, 2007; Manav, 2007). All of this notwithstanding, it seems plausible that color stimulates different emotional reactions, associations and influences the context, objects and persons.

## **Light**

Light is an important aspect of our daily life. We seem to thrive in environments where light is integrated in supportive and enhancing ways (Veitch, 2006). Our active life has expanded beyond the hours on which only sunlight was available until the late night and early morning, as a consequence of the evolution of electronic light (Dumont & Beaulieu, 2007). But even beyond this practical transformation, light has influenced and changed our perceptions, physiology and emotions and is still influencing it every day. The effects of light seem to be far reaching and widely adopted, ranging from medical treatment to retail environment and performance contexts (Veitch, 2006; McCloughan, Aspinall, Webb, 1999). For instance, light has been found to reduce recovery time of patients in

psychiatric units (Beauchemin & Hays, 1996). In this study it was found that brighter lights reduced the depressed mood and therefore enhanced the recovery process. A short overview on the evidence of the influence of light on perception, physiology and emotion will be provided next.

Light can influence emotions directly by both image-forming and non-image forming vision (Smolders, 2013). First, non-image-forming vision is discussed briefly, followed by image-forming vision. Non-image-forming vision influences our circadian rhythm, hormone releases, metabolism and blood circulation (Fu, Liao, Do, & Yau, 2005). Our biological clock, for instance, resets after exposure to bright light, enhancing our sleep-wake cycle (Rea, Figueiro, Bullough, 2002). Additionally, light has been found to stimulate the release of serotonin and vitamin D, which are known to heighten and improve overall mood (Stumpf, & Privette, 1989). It has also been found that sunlight decreases people's negative affect and tiredness (Denissen, Butalid, Penke & van Aken, 2008). Studies have also found that light can relieve the symptoms of Seasonal Affective Disorders (Wirz-Justice, 2006; Cajochen, 2007). These symptoms often include low mood, reduced interest, decreased concentration, low energy and fatigue. A study by Knez and Kers (2000) tested the effects of lighting on mood. As hypothesized, the room light changed the participants mood. However, only the negative mood was altered. The younger participants were shown to preserve the negative mood best in the warm (more reddish) and least well in the cool (more bluish) white lighting. For the older participants, however, the reverse effect was observed. Furthermore, there are studies that looked at the time dependent effect of bright light. R ger, Gordijn, Beersma, de Vries, & Daan, (2006) found that bright light reduced sleepiness and fatigue similarly during daytime and nighttime exposure, showing no time dependent effect. Although it seems that light enhances our mood and emotions in certain ways, the findings are often circumstantial and the underlying mechanisms indistinct. Many of the illustrated effects are found under very different ranges of illuminance, spectrum, and exposure time and different mechanisms seem to be at play. It has also been found that maximum alerting effects arise when exposed to 1000 lx (Lewy, et al., 1980) consequently, the alerting effects may not be caused by the time of day or exposure time. Furthermore, light effects seem to differ among age (Knez & Kers, 2000) and do not always differ among time of day (R ger et al., 2006).

The image-forming system encapsulates our vision (Fu, Liao, Do, & Yau, 2005), impacting many aspects of our life like our performance, mood and overall perception of the environment (Smolders, 2013). As illustration, bright light conditions have been found to increase both focus and performance of a task (Veitch, Newsham, Boyce & Jones, 2007 & 2008). The following section discusses the effects of the image-forming system on our perception of others, the environment, and our associations.

First, our perception of others seems influenced by light. Belcher and Kluczny (1987) for instance state that "light can affect subjective judgment in situation, such as a courtroom setting, where one would not usually think of lighting as a contributing factor". Also, a red flame has been shown to enhance judgments of people's appearances (Quinn, 1981). This is not only the case with people: foods appear more appetizing under a red flame as well (Quinn, 1981). In a study by Baron and Rea (1991), replicated by Baron, Rea and Daniels (1992), people rated an imaginary employee significant higher on job-related skills and job performance under low illuminance (150lx), than under high illuminance (1500lx). Another task during this study was about the preferred strategy for resolving a conflict with another person. They found that participants reported significantly stronger preferences

for collaboration and weaker preferences for avoidance strategies in a warm-white light condition; those exposed to a cool-white light condition showed the reverse pattern. Furthermore, it has been found that exposure to warm-white light significantly increases the amount of time people were willing to donate as volunteer (Baron & Rea, 1991; Baron, Rea & Daniels, 1992). It was also found that under low illuminance (150lx) compared to high illuminance (1500lx) people donated more time as volunteer (Baron, Rea & Daniels, 1992). In short, it seems that the perception of others and social behavior towards others is influenced by light, although underlying processes as yet are ill understood. It seems as if low illuminance and warm light positively increase the perception of other people.

Associative processes have also been linked to light. We seem to associate brighter lighting (associated with sunlight) with warmer rooms (Quinn, 1981). It has also been found that rooms were perceived as more similar to homes and restaurants under low, warm illumination (Baron & Rea, 1991), while rooms exposed to high, cool illumination were associated with offices and hospitals. Past experience seem to play a role in this association, in the sense that warm-white lighting can elicit memories of pleasant and relaxed experiences. On the other hand, high, cool illuminance provokes memories of less pleasant and less relaxed experiences. Additionally, it has been found that people who think about suitable lighting for the solitary state, prefer low illuminance (200lx). Contrary, for the communal state, high illuminance (800 lx) was desired (Nakamura & Karasawa, 1999). The studied also showed that generally, a low color temperature (3000K) were preferred over a high color temperature (6000K) during both states (Nakamura & Karasawa, 1999). Overall, associative processes and past experiences seem to influence preferred light settings, even though the underlying mechanisms are often suggestive. It seems that warm light and low illuminance tend to be associated with positive experiences while cool light and high illuminance is more often associated with negative experiences. And that low illuminance is preferred while being alone and that higher illuminance is preferred in group settings.

Also, light has been known to affect the environment. Light, as we have all experienced in our life, is important for properly viewing an environment and can enhance the feeling of safety. Dark environments (low illuminance) have been found to be more frightening than the same environment under high illuminance (Koskela & Pain, 2000). It has been also reported that dimly lit dining areas give a feeling of warmth and intimacy, but that it also conceals architectural defects (Quinn, 1981). Moreover, it has been found that higher brightness levels in a simulated environment made participants evaluate the room more positively compared to lower brightness levels (Hidayetogly, Yildirim & Akalin (2012). In this study they also found that spaces with high brightness levels provide better spatial orientation than spaces with low brightness levels. Overall, it seems that high illuminance influences the context more positively than low illuminance as it improves the visibility of the environment.

To sum up, there is an extensive framework reporting on the effect of light on emotion, physiology and perception, nonetheless, the studies seem inconclusive. The illustrated effects are found under very different ranges of illuminance, spectrum, and exposure time and different mechanisms seem to be at play. Also, many studies failed to obtain direct mood reactions to various lighting conditions (Belcher & Kluczny, 1987; Baron & Rea, 1991; Baron, Rea & Daniels, 1992). And it has been documented that there might be gender differences concerning effects of light. Knez (1995) found that men's negative mood was induced under cool light while women's negative mood was

induced under warm white light. Despite these ambiguities, the circadian rhythm, mood, associations, perception of others, objects and the context, all seem influenced by light, despite the fact that the underlying mechanisms are ill understood.

## **2.2 The effects of colored light on relaxation and social support**

So far we have seen that both color and light affect our emotions, physiology, perceptions and associations. Due to the fact that color and light have such profound impacts on many important aspects it seems a promising combination to use during this research. Hence, the scope of this research focuses on relaxing the patient and recovering or strengthening the social bond between the patient and the caretaker by use of colored light. It seems credible that colored light can enhance the restorative effect of the environment.

Colored light has generally been accepted to influence the ambience of the environment, in which there seems a distinction between colored lights that are perceived as warm and those perceived as cold. Commonly held, cool colored lights are blue, green and violet while, red, orange and yellow are warm colored lights. Recently, research on colored light has switched focus from industrial and residential environments to healing environments, in order to reduce both stress and anxiety and increase patients' satisfaction, health, wellbeing, and accelerate the healing process (Schweitzer, Gilpin & Frampton, 2004; Stichler, 2001). The behaviors, actions, and interactions of patients and caretakers are also influenced by the environment (Schweitzer, Gilpin & Frampton, 2004). As been explained before, anxiety and loss of control are detrimental to health and overall well-being of patients. These aspects can be reduced by enhancing relaxation and improving the perceived social support.

### **Colored light and relaxation**

Some studies on the effects of colored light on relaxation will be emphasized. For instance, Laufer, Lang, Izso, & Nemeth (2009) found that red light was described as more relaxing compared to blue light, which was described as activating. During this study participants were exposed to both a red and a blue light condition and reported on the relaxation and pleasantness of the light. Pleasantness was indicated to be lower for the blue light compared to the red light. They also found that pleasantness ratings correlated positively with relaxation ratings for both light colors, indicating that a pleasant atmosphere can induce relaxation. In a study in which participants had to indicate their subjective experiences of light, it was found that warm, yellowish light (2700k) was experienced as relaxing (Izso, Lang, Laufer, Suplicz & Horvath, 2009). Furthermore, Wan (2011) performed a study about the effects of dynamic versus static colored light on relaxation. In a pretest it was found that orange light had a stronger positive effect than white light on relaxation, yet this was not confirmed in the actual experiment. There he found that pulsating orange light was perceived as more pleasant than static orange light or pulsating and static white light. In addition, Vogels (2008) found that summer and autumn light settings were rated as more cozy than winter and spring light settings. Cozy is described as pleasant and relaxing. The study seems to indicate that warmer toned light, yellowish and orange

light, increases the pleasantness and relaxation experienced in an environment compared to blue and white light.

Although there seem to be some conflicting findings, in general soft warmer colored light (orange, red and yellow) seems to enhance relaxation. Despite these interesting findings, there is scarce research available on the effects of colored light on relaxation in psychiatric patients.

### **Colored light and social support**

As explained before, social support has been found to be important for psychiatric patients. It has been proven that social support during psychological turbulence assists the recovery process (Schweitzer, Gilpin & Frampton, 2004). Research on the effects of colored light on social support are scarce. However, as highlighted before, Baron & Rea (1991) found that warm-white light enhances collaboration. They also found that memories of past events and experience might influence the perception of a room. For example, low, warm illumination in the room was experienced as more similar to lighting in homes and restaurants, indicating that these conditions generate memories of pleasant, relaxed experiences and activities. On the other hand, high, cool illumination in a room was rated more similar to that in offices and hospitals, eliciting less pleasant memories. Also, it has been found that both physical warmth and warm light increase donation behavior, an indication that social behavior can be supported by the use of light (Williams & Bargh, 2008; Baron, Rea & Daniels, 1992). Moreover, red light seems to be associated with social situation. It is for instance demonstrated that the interior and social relation of the attendees influences the light preference of participants, in which red light is preferred in more social situations (Biner, Butler, Fischer & Westergrend, 1989). It has also been found that the room temperature is assessed to be warmer when people think of a social situation compared to a situation in which they are socially excluded (IJzerman & Semin, 2010; Zhong & Leonardelli, 2008). This could indicate that warmer light colors (red and orange), compared to colder light colors, could enhance the perceived feeling of social support. Furthermore, there are studies indicating that lighting can influence the perception of others. Takahashi (2009) had individuals rated the degree of emotional expression of talkers for conversations between a man and a woman under different color lighting. It was found that people judged a person to be more emotional under red lighting compared to white lighting (Takahashi, 2009). Last, it was found that exposure to warm-white light significantly increased the amount of time people were willing to donate as volunteer compared to cool-white light (Baron & Rea, 1991; Baron, Rea & Daniels, 1992).

Overall, it seems that warmer colored light can enhance social supportive behavior like donation, collaboration and apperception. Therefore, it is assumed that warm toned colored light can enhance the feeling of perceived social support by improving patient's apperception of the caretaker.

### 3. Research question

Light and color are important aspects that can contribute to the healing process (Stichler, 2001). We have seen that there is an extensive framework on the effects of color and light on human beings in general. Even more so, there are indications that warmer colored light, like red, orange and yellow light, enhances relaxation and perceived social support. Both relaxation and perceived social support have been found to inhibit the feeling of anxiety. And anxiety has been recognized to be a prevalent symptom during all phases of a psychosis. Reducing the psychotic episodes of psychiatric patients will reduce the amount of escalating behavior they ventilate and this eventually should lead to the reduction of the number of separations.

At present, evidence on the relation between colored light and relaxation and perceived social support are ambivalent. Moreover, there is not yet reported on this proposed relation in the mental health care setting or on the support of psychiatric patients. The current research aims at gaining more knowledge about what type of colored light could be applied in the support or separation rooms of the high care department, to help prevent escalation of psychiatric patients in support rooms and help the patient recover in the separation room, leading to the reduction of separation. More specifically we explore if the patient's judgment of a person and their state of mind is influenced by the color of ambient light.

*The research question that will be investigated is whether warm colored (orange) ambient lighting increases relaxation and perceived social support more than cool colored (blue) ambient lighting and neutral (white) ambient lighting.*

Based on the theoretical framework presented previously, the following hypotheses are formulated. First, it is anticipated that orange light relaxes the psychiatric patients more than blue light and neutral white light, because the literature seems to indicate that warm toned color lights relaxes people more. Second, it is expected that orange light enhances the social support perceived by the psychiatric patients more than blue light and neutral white light, because the framework presented seems to point out that warm toned color light increases social supportive behavior. Finally, it is presumed that enhancing both relaxation and the perceived social support reduces the anxiety of psychiatric patients, because both concepts have been proven to impede anxiety.

## 4. Method

The aim of this study was to explore if warm colored (orange) ambient lighting increases relaxation and perceived social support more than cool colored (blue) ambient lighting and neutral (white) ambient lighting. Ecological validity would be best if the study was performed with real clients. However, this is a vulnerable population and any study performed with them could affect their treatment and recovery process. This first explorative study was therefore performed with experts of experience. As explained before, experts of experience are former psychiatric inpatients who have been treated successfully for their condition. The advantage of using experts of experience is that they can use their past experience to assess the impact of the different light conditions during a crisis period and it does not affect any current treatment.

### Design

A within-subjects design consisting of three counterbalanced conditions completed consecutively, tested the effect of three lighting conditions (orange, blue, and white) on affinity towards a (bogus) person, mood and atmosphere perception. At the end, qualitative interviews were conducted.

### Participants

Twenty-three experts of experience ( $n=23$ ) participated in the study. There were thirteen men and ten females with an average age of 41.4 years ( $SD_{age} = 12.8$ ; 23-64). Participants were recruited at the client interest agency at the GGzE location 'de Grote Beek', by use of flyers and e-mail. They were also recruited through contact persons at the GGZ Oost-Brabant, the foundation 'Door en Voor' (By and For) as well as through contact persons of the HBO interns and MBO interns who are ex-clients and study to become an expert of experience. Participants had had different psychiatric conditions like psychosis, depression, schizophrenia and bipolar disorder. All participants were treated successfully for their condition. Participants received €15,- cash for their contribution.

### Setting

The experiment was performed in the game lab at the GGzE Location 'de Grote Beek'. There was a sitting area (Figure 3) and the experiment room (Figure 4). The sitting area was used to welcome the participants and to conduct a post-interview. The experiment room was furnished with a table and four chairs and darkened to obscure all natural and artificial light from outside to enter the room.



Figure 3. The sitting area where the interview took place

## Stimuli & Equipment

In the experiment room, a laptop was used to collect the data of the questionnaires and a Philips LivingColors Conic Black(69166/65/PH) lamp was installed for the three lighting conditions. The backlight of the laptop was kept constant during the experiment. There were no other light sources in the room. A remote control that saved the three light conditions (orange, blue and white) was used in order to ensure that colored light conditions were equal for each participant. Figure 5 gives an impression of the room under the white light condition, while Figure 6 and 7 give an impression of the room under respectively the orange and blue light condition. The characteristics<sup>1</sup> of the light can be found in Table 1. Furthermore, participants had to read three neutral writings throughout the experiment (writings were counterbalanced across the light conditions). The different writings were about the Veluwe, the Biesbosch, and the Loonse and Drunense dunes (all different natural landscapes in the Netherlands), and all contained approximately equal amount of words (respectively, 720, 715 and 698 words).



Figure 4. The experiment room with normal light (150lx; 3123K)



Figure 5. The experiment room with white light



Figure 6. The experiment room with orange light



Figure 7. The experiment room with blue light

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<sup>1</sup> The characteristics of the light were measured at the center-spot of the light on the wall.



**Table 1. Characteristics of the three light conditions**

	Orange light	Blue light	White light
<b>Illuminance</b>	130 lx	77 lx	212 lx
<b>Luminance</b>	53,98 cd/m <sup>2</sup>	34,09 cd/m <sup>2</sup>	88,51 cd/m <sup>2</sup>
<b>Chromaticity (CIE coordinates x, y)</b>	0,602 ; 0,377	0,148 ; 0,168	0,435 ; 0,406
<b>Saturation</b>	93,8%	77,9%	
<b>Correlated color temperature</b>			3046 K

### Task

During each light condition participants played an imagination game with a (bogus) person. They were explained that they would answer eight multiple-choice questions and after each answer they would see the answer of a student who had participated in the study in the past. Participants would be coupled to same sex students (the bogus persons) called Mark, Roel, and Bart or Linda, Janneke, and Suzanne. For each light condition they were coupled to another student. Additionally, they received information about the age (at random: 23, 25 and 27 years old) and residence (Eindhoven) of the students. The instruction provided was "You are going to play a creative imagination game. In this game you get to see a set of statements in a multiple-choice format. Please imagine different objects like music instruments, animals and tools as something completely different. These statements may seem odd, but try to provide a gut level response.". An example question of the game is "If a spoon was an animal, what would it be? A) Elephant, B) Lion, C) Shark or D) Monkey". After the participant answered a question, the answer of the student was shown on the screen next to their own answer. Only after the answer of the student became visible, participants would be able to proceed to the next question. The game was manipulated in such a way that 4 out of 8 answers of the participant corresponded with the answer of the students. Corresponding answers were randomized throughout the different light conditions and in total 24 different questions were used during the game. After the game ended participants were explained that they would not receive any more information about the student.

### Measures

Three dependent measurements, one control variable, demographics and a post-interview were employed for this experiment. The dependent measurements existed of: mood activation levels, affiliation towards a (bogus) person, and atmosphere perception. A covariate measurement, the need for affiliation scale, was also taken into account.

*Mood activation levels.* Twenty mood concepts (see Appendix 2) from the Activation-Deactivation Adjective Check List (Thayer, 1989) were used to measure two subscales (tense arousal and energetic arousal). Each item was rated on a four-point scale ranging from 1 (definitely do not feel) to 4 (definitely feel). This measure was employed to see if participants were more relaxed during the orange light condition compared to the blue and white light condition. Energetic arousal ranges from awake till tired

and tense arousal ranges from tense to relaxed. A low score on energetic arousal corresponds to tiredness while a low score on tense arousal reflects relaxation (Schimmack & Grob, 2000). Scores for each subscale are computed as the average value of the related items. The subscales tense arousal and energetic arousal had high internal consistency with respectively Cronbach's alphas of 0.81 and 0.88.

*Likeability towards the (bogus) person.* The Reysen likeability scale (Reysen, 2005) consists of eight statements that measured the degree of likeability of the (bogus) persons. Measurements were taken with the use of five-point Likert scales (see Appendix 3). Participants had to indicate how much they agreed with the statements, ranging from totally agree (1) to totally disagree (7). It was expected that the orange light condition would generate higher scores on this measure compared to the blue and white light conditions. The scale has a good internal consistency with Cronbach's Alpha = 0.76.

*Atmosphere perception.* By use of a reduced questionnaire containing sixteen mood concepts designed by Vogels (2008) the atmosphere perception (Appendix 4) is determined. The atmosphere perception exists of four components coziness, liveliness, tenseness, and detachment. The questionnaire is rated by use of five-point Likert scales. Participants had to indicate how much the terms were applicable to the room, ranging from totally applicable(1) to totally not applicable(7). Scores for each component are computed as the average value of the related items. The variable was employed to see if the orange light condition was rated more cozy and lively compared to the white and blue light condition. The room under blue and white light is expected to be rated more tense and detached compared to the orange light. The subscales coziness, liveliness, tenseness, and detachment had good and moderate internal consistency with Cronbach's alphas of respectively 0.84, 0.85, 0.77, and 0.75.

*Need for affiliation.* Ten statements make up the need for affiliation scale (van Tilburg, 1988). Participants had to rate to what extent the statements were applicable to them on a seven-point Likert scale (Appendix 1), ranging from totally not applicable to me (1) to totally applicable to me (7). A high score on this measurement reflects a high need to feel involved with a social group and to be part of that social group. The participants need for affiliation was measured in order to see if this could explain a part of the variation in the data regarding the evaluation of the (bogus) persons. The scale had a high internal consistency with Cronbach's Alpha = 0.89.

*Demographics.* The demographic questions included age, gender, and residence and were administered only once at the start of the first condition.

*Post interview.* A structured interview was conducted at the end of the experiment and took place outside the experiment room. The interview was used to gather qualitative and detailed information about the participants' opinion about the use of colored light and their experience during the experiment. Different topics were discussed during the interview like participants' light color preference, their opinion about the used lighting settings, the usage of light during separation, and their idea about dynamic light. The questions can be found in Appendix 5. Beforehand, participants were asked permission for recording the post-interview. Once recorded, a transcript was made of each

interview and answers were coded by category like preferred light color, former seclusion experience, dynamic light and recommendations.

## Procedure

When a participant entered the room they were first explained the basic scheme of the experiment and their rights, and asked to sign an informed consent form. After signing the form and when participants had no more questions they were asked to read the instructions carefully and start with filling in the first two questionnaires. This was the need for affiliation questionnaire and a baseline measure of the mood questionnaire. Once these questionnaires were finished participants were asked to report this to the experimenter in order for the experimenter to switch on the first light condition. After the light was turned on, the following steps were taken, which are the same for each of the three light conditions (see Figure 8 for a graphical overview of the procedure concerning the experiment). A more detailed schematic overview of the procedure can be found in Appendix 6. First, participants had to read a text for 6 minutes, in order to adapt to the new light condition. Second, they played the imagination game, as explained above. They were then asked to fill in the affiliation questionnaire about the student they just played a game with. This contained questions like “Do you think this person is kind?”. This was followed by a second measure of the mood questionnaire and ended with the atmosphere perception questionnaire. At the end of these questionnaires participants were asked to call the experimenter again to turn on the next light color (the next condition). After all three light conditions were completed participants were asked to call the experimenter again. As a final task, participants were asked to choose a light color themselves that they perceived to be most relaxing. Participants received the remote control of the LivingColors lamp in order to select the color they preferred. After the selection, participants were guided to the place where the interview took place. They were first offered something to drink and then the interview was conducted. The interview focused on their opinion, experience and ideas concerning the experiment and the usage of light in the high care unit. At the end they were debriefed, thanked for their participation and received € 15,- for their valuable contribution.

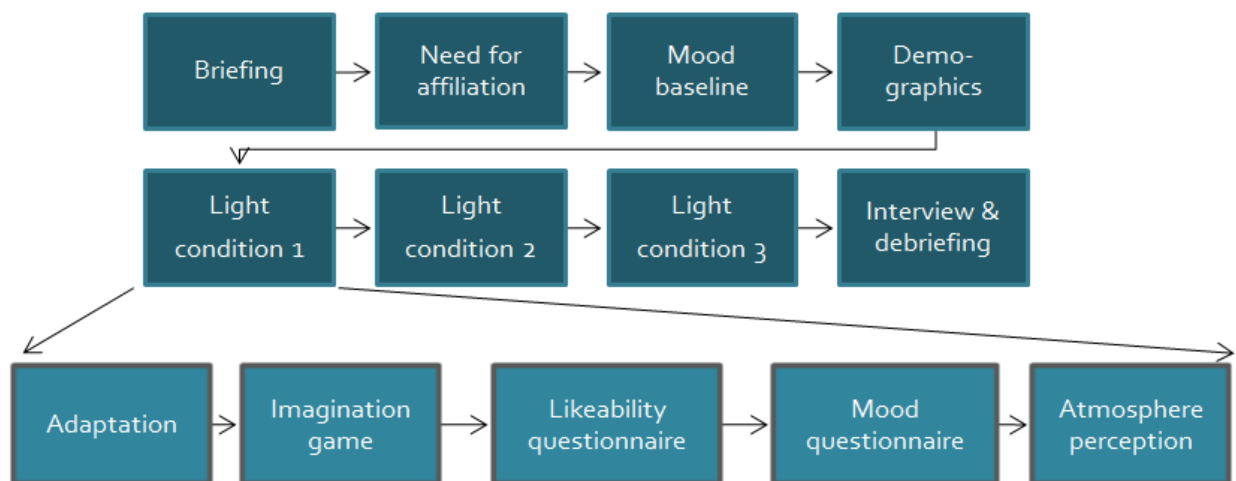


Figure 8. Graphical overview of the procedure

## 5. Results

In order to analyze the data repeated measures ANOVA were performed, using the average score of the likeability of the bogus person, the two mood concepts (tense arousal and energetic arousal), the four atmosphere perception concepts (coziness, liveliness, tenseness, and detachment) as repeated measures and the average score of the need for affiliation items as a covariate. Furthermore, a correlation analysis was performed to evaluate the relation between the covariate need for affiliation and the different light conditions. Beforehand, an outlier analysis was done where standardized z-scores below -3 or above 3 were excluded for further analysis. Nevertheless, no outliers were detected.

### Likeability

A repeated measures ANOVA was performed using the average score of the likeability of the bogus person as repeated measures and the light conditions as independent variable. After this the effect of light condition on likeability of the bogus person was examined further with a paired-sample t-test. Table 2 gives an overview of the pair-wise comparisons of the light conditions. Figure 9 shows the effect of light condition (orange, blue, and white) on the affiliation towards the (bogus) person. As hypothesized, the likeability of the bogus person was significantly higher in the orange light condition ( $M= 3.30$ ,  $SD= 0.29$ ) compared to the white light condition ( $M= 3.15$ ,  $SD= 0.34$ ), ( $t(22) = 2.22$  and  $p = 0.02$ ). Additionally, a trend was identified that failed to reach the required level of significance. This trend showed that affiliation towards the (bogus) person seems to be higher in the orange light condition compared to the blue light condition ( $M=3.16$ ,  $SD=0.42$ ), ( $t(22) = 1.53$  and  $p = 0.07$ ). No significant difference was found between the blue and white light condition.

Table 2. Overview of the pair-wise comparisons and corresponding confidence intervals, p-values and eta<sup>2</sup>. Error bars indicate standard errors.

Pair wise comparison	95% confidence interval of the difference		Significant (One-sided)	Eta <sup>2</sup>
	Lower bound	Upper bound		
Orange - Blue	-0.054	0.358	0.070 <sup>v</sup>	4.2 %
Orange - White	0.011	0.304	0.018 <sup>*</sup>	
Blue - White	-0.237	0.247	0.481	

\*\* Is significant at  $p < .01$ .

\* Is significant at  $p < .05$ .

<sup>v</sup> Is a trend at  $p < .10$ .

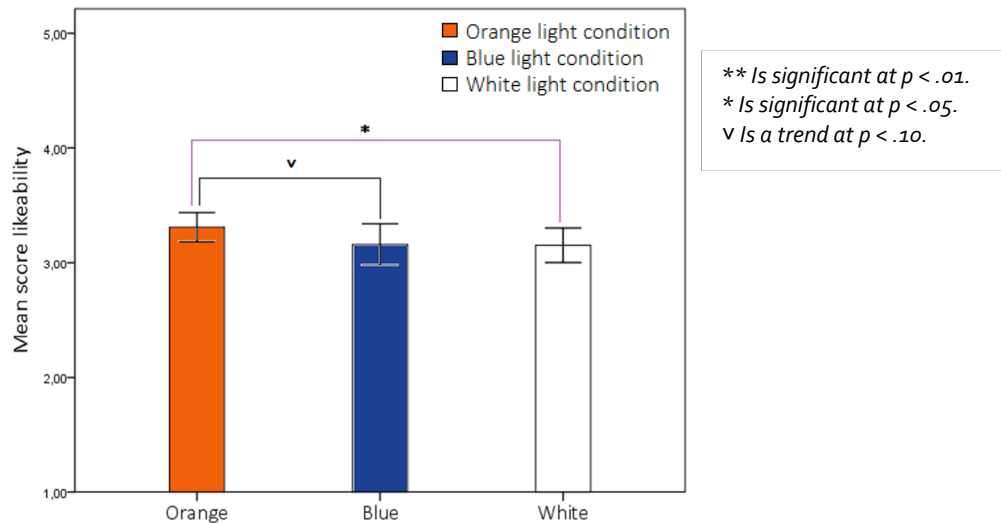


Figure 9. Average of the affiliation towards the (bogus) person for each light condition with the corresponding 95% confidence intervals.

### Mood

A repeated measures ANOVA was performed to test the effect of light condition on the two mood constructs. Energetic arousal and tense arousal were employed as repeated measures and light condition as independent variable. After this the effect of light condition on the mood constructs person was examined further with a paired-sample t-test. The mood measurements were gathered four times during the experiment, the first measurement (before the light conditions were applied) was used as baseline measure. Table 3 gives an overview of the pair-wise comparisons of the light conditions concerning the mood construct 'energetic arousal'. Figure 10 shows a graphical overview of the effect of light condition on energetic arousal. No significant effects of light condition were found on the mood construct 'energetic arousal'. However, a trend was identified that failed to reach the required level of significance. This trend showed that energetic arousal seemed higher in the blue light condition ( $M=2.76$ ,  $SD=0.69$ ) compared to the orange light condition ( $M=2.63$ ,  $SD=0.62$ ), ( $t(22) = -1.355$  and  $p = 0.095$ ).

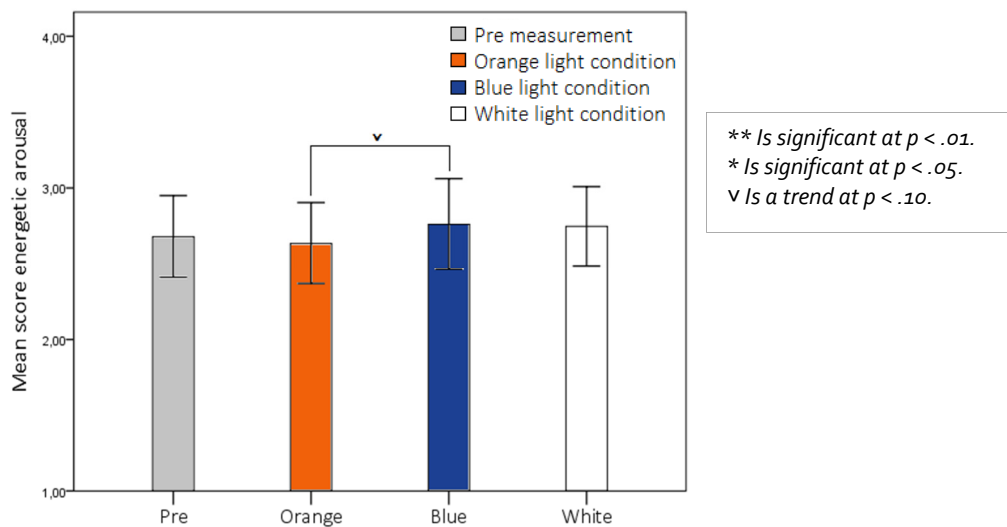


Figure 10. Average of energetic arousal for each light condition with the corresponding 95% confidence intervals.

**Table 3. Overview of the pair-wise comparisons and corresponding confidence intervals, p-values and eta<sup>2</sup> of energetic arousal**

Pair wise comparison	95% confidence interval of the difference		Significant (One-sided)	Eta <sup>2</sup>
	Lower bound	Upper bound		
Orange - Blue	-0.319	0.066	0.095 <sup>V</sup>	3.8 %
Orange – White	-0.335	0.109	0.152	
Blue - White	-0.226	0.109	0.455	
Pre - Orange	-0.224	0.311	0.370	2.6 %
Pre – Blue	-0.322	0.156	0.241	
Pre - White	-0.273	0.133	0.243	

*\*\* Is significant at  $p < .01$ .*

*\* Is significant at  $p < .05$ .*

*∨ Is a trend at  $p < .10$ .*

Table 4 gives an overview of the pair-wise comparisons of the light conditions concerning the mood construct 'tense arousal'. Figure 11 shows a graphical overview of the effect of light condition (orange, blue, and white) on tense arousal. No significant effects or trends were found of light condition on tense arousal.

**Table 4. Overview of the pair-wise comparisons and corresponding confidence intervals, p-values and eta<sup>2</sup> of tense arousal**

Pair wise comparison	95% confidence interval of the difference		Significant (One-sided)	Eta <sup>2</sup>
	Lower bound	Upper bound		
Orange - Blue	-0.355	0.121	0.159	2.8 %
Orange - White	-0.207	0.164	0.405	
Blue - White	-0.164	0.355	0.226	
Pre - Orange	-0.093	0.345	0.123	3.0%
Pre – Blue	-0.232	0.249	0.470	
Pre - White	-0.113	0.322	0.166	

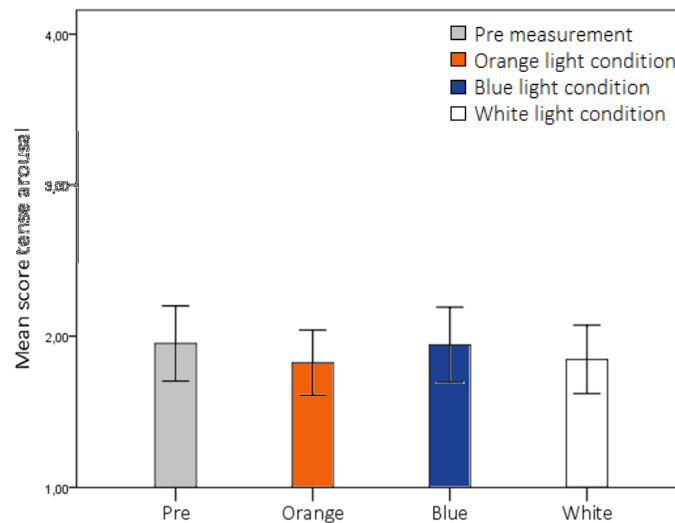


Figure 11. Average of tense arousal for each light condition with the corresponding 95% confidence intervals.

### Atmosphere perception

A repeated measures ANOVA was performed to test the effect of light condition on the four atmosphere perception constructs. Coziness, liveliness, tenseness, and detachment were employed as repeated measures and light condition as independent variable. After this the effect of light condition on atmosphere perception was examined further with a paired-sample t-test. An overview of the pairwise comparisons of the light conditions regarding the four atmosphere perception constructs (coziness, liveliness, detachment, and tenseness) can be found in Table 5. There were two significant effects of light condition on coziness. Coziness was higher in the orange light condition ( $M=3.59$ ,  $SD=0.91$ ) compared to the blue ( $M=2.42$ ,  $SD=0.91$ ) and white light condition ( $M=2.60$ ,  $SD=1.05$ ) respectively,  $t(22) = 4.62$ ,  $p < .0001$  and  $t(22) = 4.13$ ,  $p < .0001$ . A graphical overview of the effect of light condition (orange, blue, and white) on the atmosphere perception construct coziness can be found in Figure 12. Furthermore, there were no significant effects of light condition on liveliness, but a trend was identified that failed to reach the required level of significance. The orange light condition ( $M=3.08$ ,  $SD=0.77$ ) seemed to increase liveliness more than the white light condition ( $M=2.79$ ,  $SD=0.96$ ),  $t(22) = 1.39$  and  $p = 0.09$ . Figure 13 shows a graphical overview of light condition on the atmosphere perception construct liveliness. Supplementary, a significant effect of light condition was found on tenseness. Tenseness was lower in the orange light condition ( $M=2.00$ ,  $SD=0.85$ ) compared to the blue ( $M=2.60$ ,  $SD=1.07$ ) and white light condition ( $M=2.38$ ,  $SD=0.99$ ) respectively,  $t(22) = -1.96$ ,  $p = 0.03$  and  $t(22) = -2.53$ ,  $p < .01$ . Figure 14 shows a graphical overview of light condition on the atmosphere perception construct tenseness. No other significant effects or trends were found. Finally, the atmosphere perception construct detachment yielded significant effects of light condition. Specifically, detachment was lower in the orange light condition ( $M=2.05$ ,  $SD=0.92$ ) compared to the blue ( $M=3.00$ ,  $SD=0.83$ ) and white light condition ( $M=3.04$ ,  $SD=1.10$ ) respectively,  $t(22) = -3.32$ ,  $p = .001$  and  $t(22) = -4.18$ ,  $p < .0001$ . A graphical overview of the effect of light condition on the atmosphere perception construct detachment can be found in Figure 15.

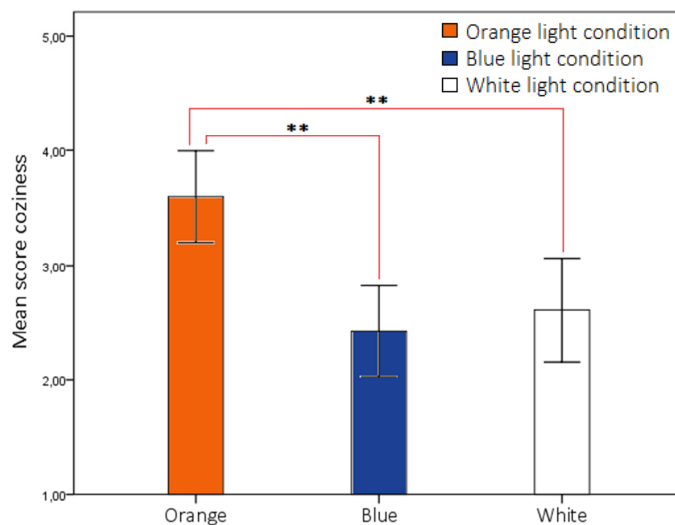
Table 5. Overview of the pair-wise comparisons and corresponding confidence intervals, p-values and eta<sup>2</sup> of the four atmosphere perception constructs

Construct	Pair wise comparison	95% confidence interval of the difference		Significant (One-sided)	Eta <sup>2</sup>
		Lower bound	Upper bound		
Coziness	Orange - Blue	0.648	1.700	0.000**	22.9 %
	Orange - White	0.493	1.485	0.000**	
	Blue - White	-0.686	0.316	0.226	
Liveliness	Orange - Blue	-0.167	0.754	0,100	2.1 %
	Orange - White	-0.143	0.730	0.089∇	
	Blue - White	-0.456	0.456	0.500	
Detachment	Orange - Blue	-1,536	-0.355	0.001**	18.9 %
	Orange - White	-1.480	-0.499	0.000**	
	Blue - White	-0.630	0.543	0.439	
Tenseness	Orange - Blue	-1.251	0.033	0.031*	6.4 %
	Orange - White	-0.691	-0.070	0.009**	
	Blue - White	-0.430	0.887	0.240	

\*\* Is significant at  $p < .01$ .

\* Is significant at  $p < .05$ .

∇ Is a trend at  $p < .10$ .



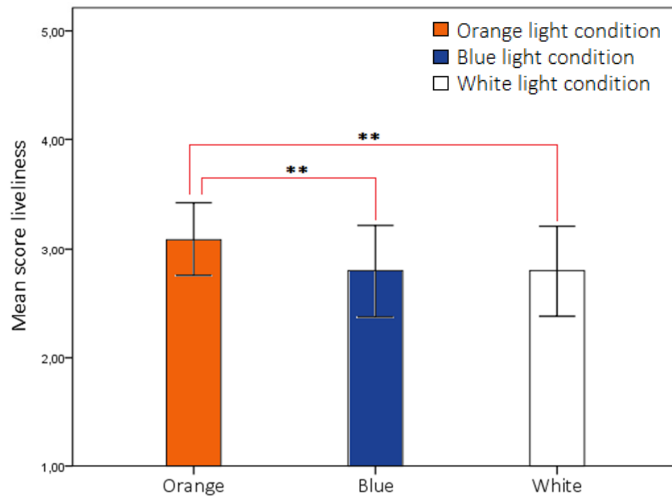
\*\* Is significant at  $p < .01$ .

\* Is significant at  $p < .05$ .

∇ Is a trend at  $p < .10$ .

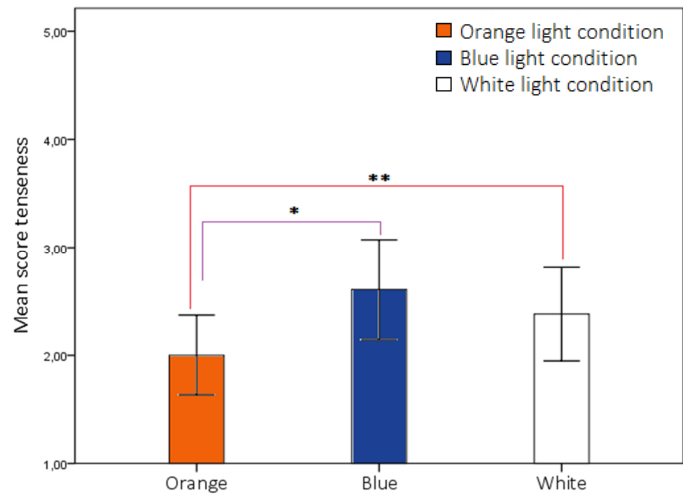
Figure 12. Average of coziness for each light condition, with the corresponding 95% confidence intervals.





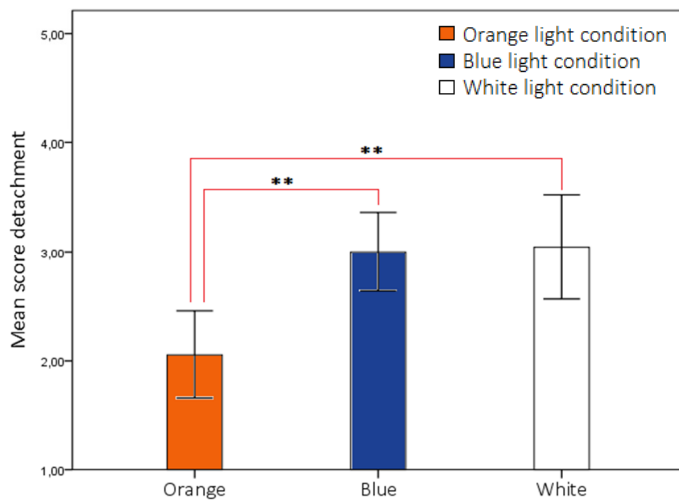
\*\* Is significant at  $p < .01$ .  
 \* Is significant at  $p < .05$ .  
 v Is a trend at  $p < .10$ .

Figure 13. Average of liveliness for each light condition, with the corresponding 95% confidence



\*\* Is significant at  $p < .01$ .  
 \* Is significant at  $p < .05$ .  
 v Is a trend at  $p < .10$ .

Figure 14. Average of tenseness for each light condition, with the corresponding 95% confidence intervals.



\*\* Is significant at  $p < .01$ .  
 \* Is significant at  $p < .05$ .  
 v Is a trend at  $p < .10$ .

Figure 15. Average of detachment for each light condition, with the corresponding 95% confidence

## Need for affiliation

A correlation analysis was performed to assess the relation between the likeability of the bogus person and the need for affiliation. There was a positive correlation between the likeability towards the (bogus) person in the orange light condition ( $M=3.30$ ,  $SD=0.29$ ) and the need for affiliation ( $M=4.60$ ,  $SD=1.14$ ),  $r(21) = 0.62$ ,  $p = 0.002$ . There was no significant correlation between the blue light condition ( $M=3.16$ ,  $SD=0.42$ ) and the need for affiliation ( $r(21) = 0.07$ ,  $p = 0.73$ ). The same goes for the white light condition ( $M=3.15$ ,  $SD=0.34$ ) and the need for affiliation,  $r(21) = 0.37$ ,  $p = 0.07$ . In order to explore the relation further a repeated measures ANOVA were performed, using the average score of the likeability of the bogus person as repeated measures and the average score of the need for affiliation items as a covariate. However, there was no significant main effect of need for affiliation on the affiliation towards the (bogus) person. Possible explanations for these findings are examined in the discussion.

## 5.1 Post-experiment Interview

The interview was conducted to collect qualitative and detailed information about participants' opinions and recommendations. Topics that were discussed concerned their opinion about the used light conditions, personal light preference, former seclusion experience, the influence of colored light on their perception of another person, their mood, the atmosphere perception and recommendations concerning light in general and dynamic light. These categories will be discussed below.

### Overall impression of three light conditions

For the overall impression of the light conditions participants were asked about their opinion of each light condition. Some participants described the blue and white light as similar. In total twelve of the twenty-three participants (52%) felt the blue light was too bright (often referred to as too bright) and eight participants (34%) thought the white light was too bright. Only one participant (4%) thought the orange light too bright, and six participants (26%) were undecided. Furthermore, fourteen participants (60%) mentioned that they found the orange light most pleasant to the eyes. The blue light was most often explained as being cold and chilly while the orange light was repeatedly explained as being warm, kind and friendly. The white was most often explained as being neutral, formal and reminded of TL-lighting. Overall, the orange light was described most positive, while the blue and white light were described more negative.

Participant 1 (male):

*"I felt the blue light was less pleasant. It came across extremely bright and I became very restless because of that. I started to read and answer questions very restless. And even though restless and calm are two loaded words, it did feel like that for me."*

Participant 15 (female):

*"The blue was too cold, too chilly and too bright. The orange light was much better, it radiated warmth and I felt better and calmer because of it. The white was a little bit calmer than the blue, a little bit more normal."*

Participant 16 (female):

*"I noticed that I stayed more alert during the blue light, the white light, on the other hand, made me dull."*

Participant 22 (male):

*"The blue and white light are colder compared to the orange light. However, they activate me more. If I want to do something active I want that bright light. But that is not cozy. The orange light is less bright and more cozy."*

### Personal light color preference

An graphical overview of the participants' preferred light color to relax in, can be found in Figure 16. The most preferred color (21%) was yellow because, many participants said that this was calming for the eyes and made them think of the sun and being outside. Four participants preferred blue because they felt the cool light was calming them down. Orange, red, and purple (all preferred by 3 participants) were found to be kind and warm colors, and therefore relaxed the participants. Some colors were also preferred because participants had positive associations with the color. For instance, one participant indicated that she had purple walls in her house and therefore she felt comfortable and relaxed when that light color was projected on the wall. Green, on the other hand, was associated with nature and for that reason preferred by some participants. Generally, it seems that people base their light color preference on diverse underlying reasons.

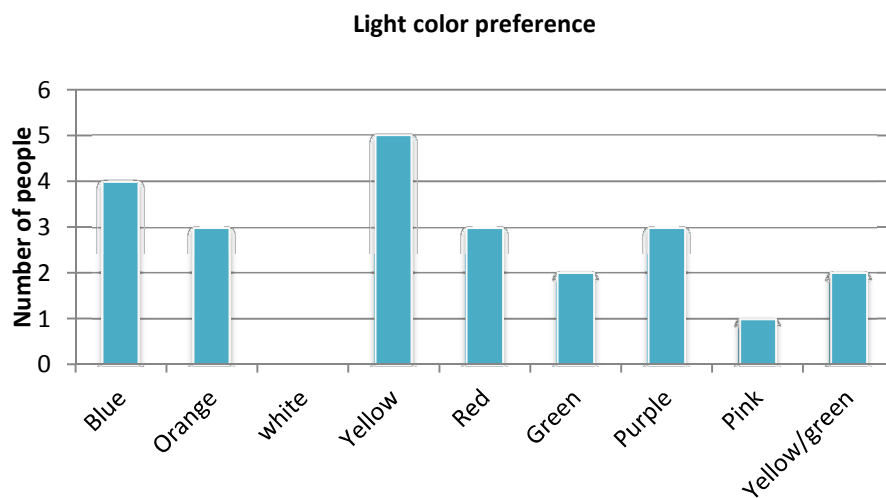


Figure 16. A graphical overview of the participants' preferred light color to relax in.

Participant 1 (male):

*"The yellow light color is calming to the eyes, and that is why I react more relaxing on that color compared to brighter colors."*

Participant 9 (male):

*"The light color yellow is radiates serenity, hence I feel most comfortable."*

Participant 12 (female):

*"Blue was a soothing color for me, it had the most friendly and warm influence on me. And I was just thinking about buying a blue colored light lamp myself now that I see that it influences me in such a positive way."*

Participant 23 (male):

*"I felt that orange was the warmest and most relaxing color, the whole environment become more friendly."*

### **Likeability towards the (bogus) person**

As indicated above, there was a significant effect of light color on the likeability towards the (bogus) person. However, there were few participants who thought the light had influenced their perception of the persons they judged. Only two participants indicated that they indeed noticed that the light color influenced their perception. Likewise, there were some people who felt that the light might have influenced their judgment. However, they were incapable of explaining in what direction the effect was going. The majority of the people, nonetheless, indicated that the different light colors did not affect their judgments of the three persons.

Participant 9 (male):

*"I find it difficult to interpret how to judge people, so it is extremely hard for me to say if I think a person is kind or friendly."*

Participant 10 (male):

*"I can imagine that I judge someone differently under a different light condition. And it could definitely be that the results fluctuate, because I surely did not only answer neutral."*

Participant 12 (female)

*"I noticed that during the white light I thought 'what does the tart want, can't she go away?'"*

Participant 21 (female):

*"With the blue light I felt the other person was cold, I thought 'Linda' was less kind than the others."*

### Preference and likeability

Previously, we saw that four participants preferred blue colored light and three participants preferred orange colored light to relax in. Here, we take a look at the effect of light color preference on likeability towards the bogus person. Figure 17 shows an graphical overview of the mean scores on likeability of the bogus person of the four persons who preferred the blue light. In the figure all three light conditions are depicted as well as the average score of all participants (n=23). We can see that, despite the fact that blue was there personal preferred color, this does not positively influence all participants concerning the likeability of the bogus person. Only two participants indeed show a pattern in which they prefer the bogus person more compared to the orange and white light condition, and this is also higher than the average participant. However, the other two participants show no a reverse pattern of personal preference on likeability towards the bogus person. The mean scores on likeability are lowest in their preferred light color compared to orange and white light.

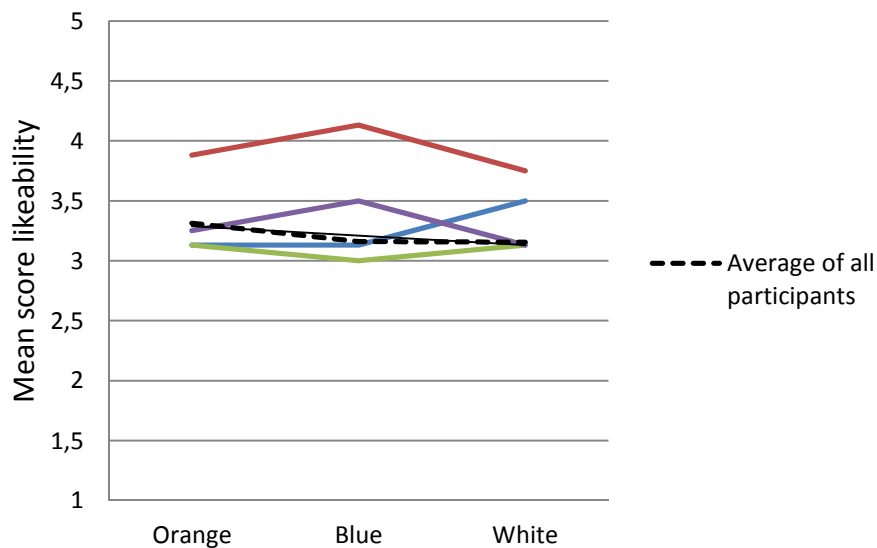


Figure 17. Graphical overview of the mean scores on likeability of the bogus person of the four participants who chosen blue as their preferred color

Figure 18 shows an graphical overview of the mean scores on likeability of the bogus person of the three persons who preferred the orange light. In the figure all three light conditions are depicted as well as the average score of all participants (n=23). We can see that two persons have higher scores on the likeability towards the bogus person, but one does not. Again, there is no clear pattern depicting a relation between the preferred light color of a participant and their scores on likeability towards a bogus person.

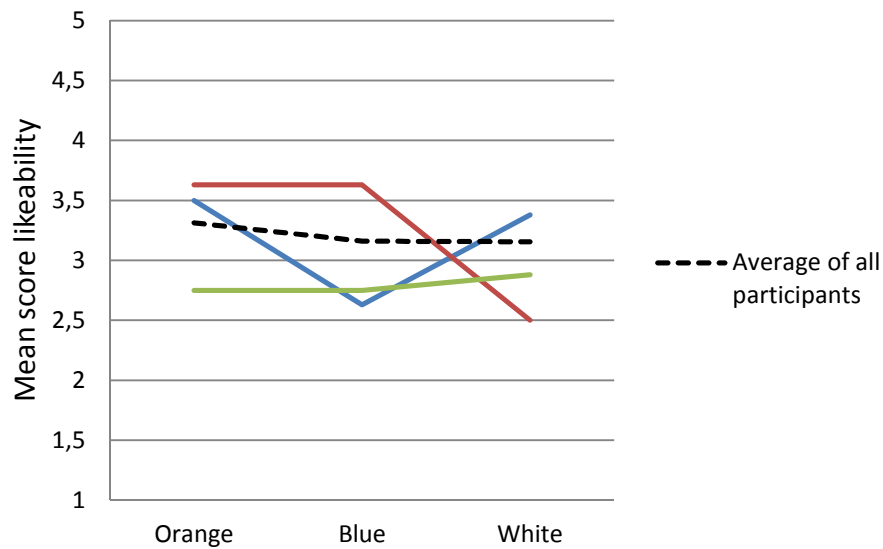


Figure 18. Graphical overview of the mean scores on likeability of the bogus person of the three participants who chosen orange as their preferred color

## Mood

The influence of the different light colors on the mood of participants frequently differed. Some participants indicated that blue and white light activated them, while others said that red was more activating. Other participants became restless due to the blue light or felt that it made them cold. Also, there were participants who felt the blue light was relaxing, while others found the orange light to be relaxing. In short, there were very mixed reactions, however almost all participants felt that the light impacted the way they felt. Despite the fact that the results show no effect of colored light on mood, participants did believe that the light influenced their mood.

Participant 6 (male):

*"The blue light was not nice, I became restless, it was chilly and I did not felt comfortable. The red light was, surprisingly, stimulating and I felt more alert, I thought that was funny to witness."*

Participant 18 (female):

*"The orange light completely calmed me down. It was a feeling of total relaxation."*

Participant 20 (male):

*"I felt the second color, the soft white light was most pleasant. It made me think of the sun."*

Participant 23 (male):

*"The orange light was kind and warm. When the orange light came on I started yawning and became more relaxed."*

## Preference and mood

As mentioned earlier, four participants preferred blue colored light and three participants preferred orange colored light to relax in. Here, we take a look at the effect of light color preference on mood. Figure 19 shows an graphical overview of the mean scores of the four persons on energetic arousal who preferred the blue light. In the figure all three light conditions are depicted as well as the average score of all participants (n=23). It shows that indeed the four participants score higher on energetic arousal compared to the average score of all participants. However, one participant has a higher score in the baseline measure. But the overall pattern seems to indicate that participants who prefer blue light have higher scores on energetic arousal compared to the orange and white light condition.

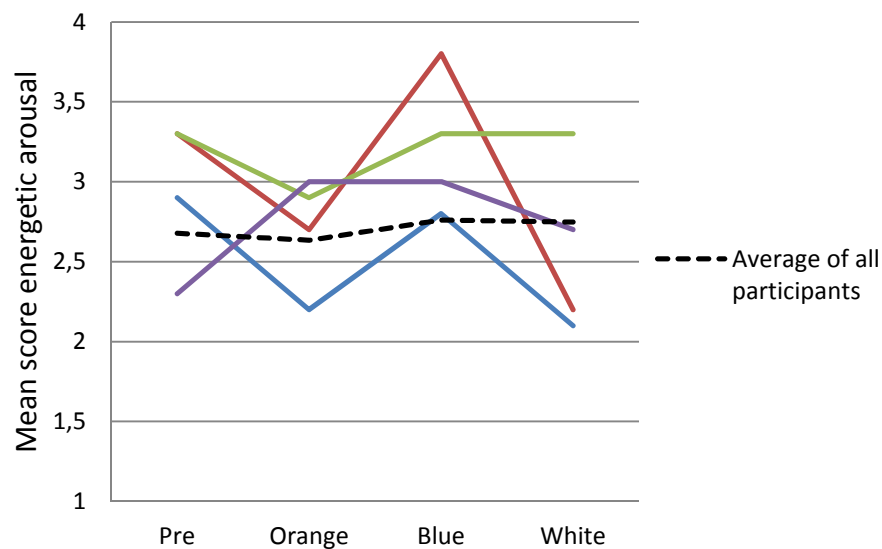


Figure 19. Graphical overview of the mean scores on energetic arousal of the four participants who chosen blue as their preferred color

Figure 20 shows an graphical overview of the mean scores on tense arousal of the four persons who preferred the blue light. In the figure all three light conditions are depicted as well as the average score of all participants (n=23). There is only one participant who has a low score on tense arousal (indicating that he or she is more relaxed) in the blue light condition compared to the other conditions. Another participants shows the reversed pattern, with a very high score on tense arousal in the blue light condition compared to the other light conditions. Overall, there is no clear pattern visible depicting a relation between the preferred light color blue and participant's mean scores on tense arousal.

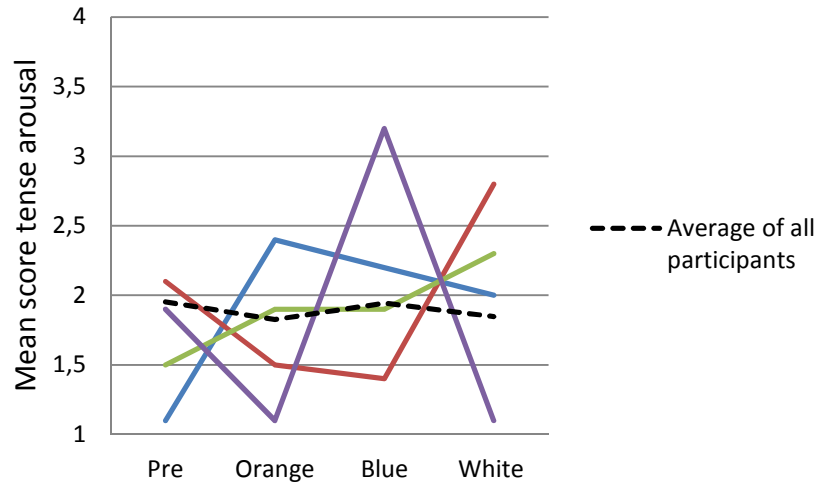


Figure 20. Graphical overview of the mean scores on tense arousal of the four participants who chosen blue as their preferred color

Figure 21 shows an graphical overview of the mean scores on energetic arousal of the three persons who preferred the orange light. In the figure all three light conditions are depicted as well as the average score of all participants (n=23). There is one participant who has the highest score on energetic arousal in the orange light condition. The other two persons have a low score on energetic arousal in the orange light condition. In short, there is no clear pattern visible depicting a relation between the preferred light color orange and participant’s mean scores on energetic arousal.

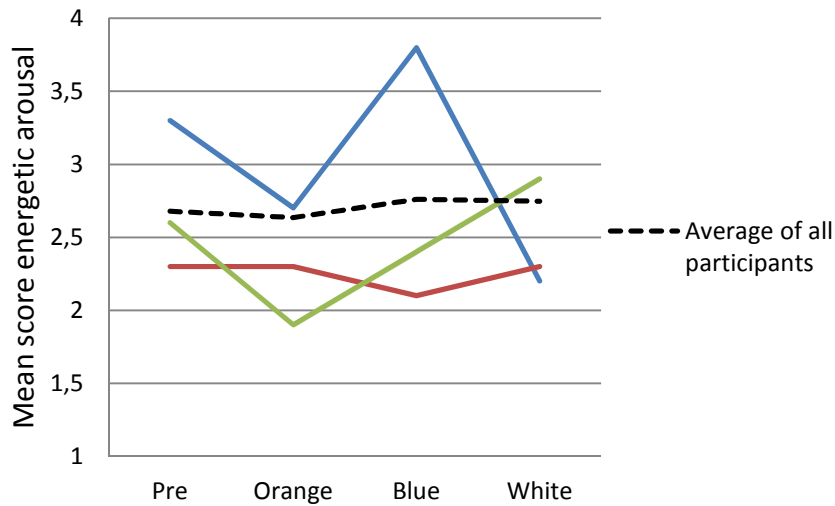


Figure 21. Graphical overview of the mean scores on energetic arousal of the three participants who chosen orange as their preferred color



Figure 22 shows a graphical overview of the mean scores on tense arousal of the three persons who preferred the orange light. In the figure all three light conditions are depicted as well as the average score of all participants (n=23). Two participants have the lowest score on tense arousal compared to the other conditions. There is one participant who has a lower score on tense arousal in the blue condition but the baseline and white light condition measurements are higher compared to the orange light condition. The overall pattern seems to indicate that participants who prefer orange light have lower scores on tense arousal compared to the blue and white light condition.

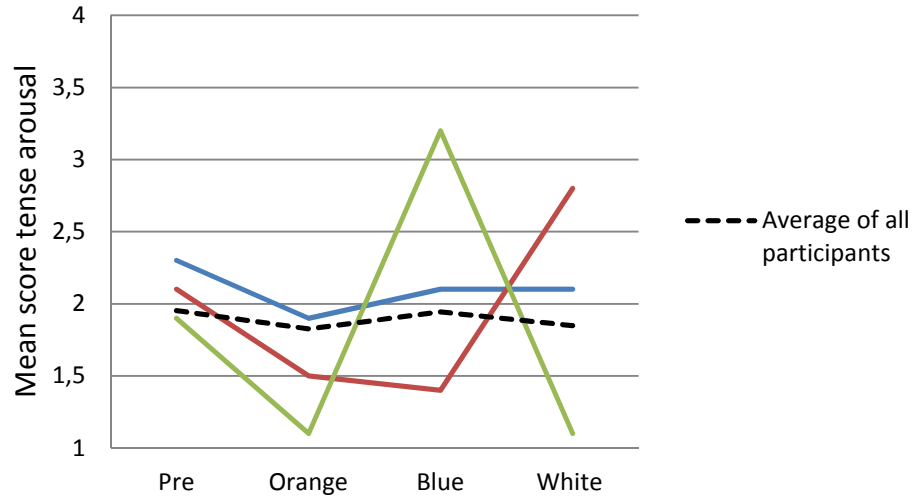


Figure 22. Graphical overview of the mean scores on tense arousal of the three participants who chosen orange as their preferred color

### Atmosphere perception

All participants indicated that the atmosphere in the room was influenced drastically by the different light colors. Under the white light many participants indicated that the room felt more formal, chilly and cold. The blue light made the atmosphere more threatening, cold and scary. In contrast, the orange light made atmosphere in the room warm, cozy and pleasant. In general, the orange light color influenced the atmosphere in the room positively while the blue and white light influenced the atmosphere negatively.

Participant 5 (female):

*"With the orange light I noticed while filling in the questions that the light changed the room into a more friendly place."*

Participant 7 (male):

*"The orange light was most pleasant because it was warmer, and I noticed this because the environment felt different, but my mood did not differ."*

Participant 10 (male):

*"At some point in time the blue light became almost like a horror movie, with scary elements."*

Participant 14 (male):

*"To my opinion, the blue light was too bright, it becomes dominant and I find that unpleasant."*

Participant 17 (female):

*"The blue light on the wall was pretty, but the rest of the room became unpleasant, a little bit threatening. If you look at the room it is very dark, the curtains became very dark and that is unpleasant. The orange light, on the other hand, was pleasant, because the room was also illuminated in that way, which is very warm."*

### **Separation experience**

Twelve of the twenty-three participants (52%) had experience with the separation room. When asked about the influence of light in a separation room or in a client room there were mostly positive reactions. Participants mentioned, after experiencing it themselves, that colored light could definitely help them calm down in the separation room. Yet, some were more reluctant, because they said that since they were recovered it was, fortunately, hard to go back to the state of mind they were in while being separated. Therefore, these participants found it hard to say anything about the influence of colored light during separation. Overall, people seemed surprised about the positive influence of the light colors on them and were therefore often convinced that the light could contribute positively to the separation room.

Participant 1 (male):

*"I now notice that light influenced me, how I feel and act, my behavior, my attitude, my mood. I think it is similar to how people are influenced by the weather. But you cannot control the weather. A calming light color could definitely work positively especially when your mood is already down. Because when you are being separated you are already under a lot of stress."*

Participant 14 (male):

*"When separated you are unable to communicate, I think that is the main problem. I think you, then, need something soft, something calming. But it is hard to answer, it might be positive as a distractor or negative as overstimulation."*

Participant 17 (female):

*"For me it would not make a difference if there was a different color light in the room. I completely panicked when separated, that would be the case with light and without light because it still remains a separation room."*

Participant 18 (female):

*"In my opinion, the use of orange light would be pleasant. I was just thinking about the fact that my emotions often change that I might buy such a lamp myself. I think it would work best in the separation room because a lot of things are already limiting you. And if you are then able to be calmer at the beginning due to the light, it would be a great way to help. I also think that it would have less of an impact in your own room, because you can leave your room at any time."*

### **Dynamic light**

In addition, participants were asked about their opinion concerning the use of dynamic light in the separation room. There were mixed reactions to the use of dynamic lighting. Some thought that it would be a positive distractor while others felt that it would be very unpleasant and restless. Some participants stated that, having experienced a psychotic episode, that they would need a very good explanation for the movement of the light in order to feel accepting towards it. Overall, half of the participants agreed that it could be a positive contribution while the other half thought it would have a negative impact.

Participant 4 (male):

*"Movement seems an adequate alternative, a good distraction. But only after the stimulus of the psychosis has been processed."*

Participant 7 (female):

*"At the moment you are in a crisis, I do not think dynamic light will be pleasant, but it will be very restless. And that it is way too intense."*

Participant 12 (female):

*"I would find it very pleasant. I would see it as distraction and look at it frequently. I used to have a lava lamp and I often looked at that lamp. And especially in the periods that I was very depressed, I could watch the lamp for hours. Yes, I think it would really help me, that there is a little movement in the room and that it does not become boring. For me it would have a very positive influence."*

Participant 13 (female):

*"For me, movement would be restless, I would be unable to cope with it. I would definitely choose a light that would not move. For instance, I have been unable to enter the clothing store 'The Sting' for a very long time, because there is a lot of dynamic light and sound. I became extremely restless being in that shop and became totally unable to focus on anything else."*

### **Recommendations**

Finally, participants were asked about their recommendations for the separation room in general. Some had none and just stated that the separation room should not be used for any person,

because it is such a degrading and humiliating resort. Others mentioned that playing a game would be a way of distraction and might help them to become active again. Others mentioned that the opportunity to create an own personal space would be very beneficial. Many participants mentioned the negative effect of uncontrollability of the light that they had experienced during their former separations. Therefore a sense of control would definitely help them calm down but, perhaps equally important, was the fact that somebody on the outside should not have control over the light in their room. There were some who suggested that creating a friendly environment by not having white clinical walls but make it homier would also be a positive change. Light was also seen as a way of introducing new stimuli and of helping clients by activating them and helping them focus on different aspects. In sum, most participants felt the separation room should not be used at all, but creating a friendlier and more pleasant room with positive distractions would benefit the overall experience.

Participant 4 (male):

*"The autonomy of a patient is hard to find. Therefore, it would be pleasant to control the light yourself. Light could also be used in the sense of slowly introducing a new stimulus, after somebody has been separated. This stimulus could be used to activate people and to let them consider again."*

Participant 5 (female):

*"That you, for instance, could create a small corner that you find pleasant. That you could make your own corner darker, like it is really your own place. I think that would be really pleasant."*

Participant 10 (male):

*"I would like the hinge joints of the doors to be eliminated in the high care department. I think people can really hurt themselves. And I think it is a very bad idea that the light can be influenced from outside. Only changing the intensity of the light can instigate a psychotic episode."*

Participant 21 (female):

*"I remember that I there used to be carpet in my treatment room, with a blue and red color, I remember that I felt that it was very friendly. Just making the room a little more homelike would have a great positive influence on the space."*

## 6. Discussion

The current research was aimed at exploring the effect of ambient colored light on experts' of experience judgment of a person and their state of mind. It was investigated whether warm colored (orange) ambient lighting increased relaxation and perceived social support more than cool colored (blue) ambient lighting and neutral (white) ambient lighting.

### Effects of colored light on likeability

First, it was found, that orange light significantly increases positive judgments of another person compared to white light. Likewise, a trend was found that indicated that orange light increased positive judgments of another person more compared to blue light. Both effects are as expected by the prior hypothesis and preceding research. For instance, it was found that red light (most related to orange light) is associated with social situations (Biner et al., 1989). Likewise, it was found that people judge a person to be more emotional under red lighting compared to white lighting (Takahashi, 2009). Both studies seem to be reflected in the results. The fact that only 23 people participated in the study might explain the fact that there was only one significant observable effect. However, it is encouraging that, despite the small number of participants, the discovered effects confirm the hypothesis. The larger 95% confidence interval concerning the likeability towards the fictive persons in the blue light, is an indication that the overall results are less distinctive in this light condition compared to the orange and white light condition. This could, partly, account for the reason that no significant difference between the orange and blue light condition were found. Furthermore, the blue and white light condition did not differ significantly from each other, indicating that they are perceived more alike. This could be due to the fact that these light colors have similar characteristics, like being referred to as cool. This seems to be confirmed by the interview, in which a significant number of participants described the blue and white light in similar ways: both were cold, chilly and distant. Also, looking at the qualitative data from the interview, the majority of the participants was unaware of the effect of light condition on their perception of the fictive persons. This is, perhaps, equally important because it indicates that participants did not fill in the likeability questionnaire in a deliberate intent to influence the results of the questionnaire. Another issue to shed light on, is the fact that only 4.2% of the variance in the data can be explained by the difference in light condition. This means that a large part of the variance in the data remains unexplained. This indicates that colored light may only have a small influence on our perception of another person, but that it does not have the power to change this perception radically. In this light, the results might be explained by the fact that the three fictive persons that were judged were impersonal entities. Participants never met, or will ever meet the fictive persons, had no facial and bodily images, no sound perceptions of them and no shared history. Also, the fictive persons were kept on an equal level by using a same sex manipulation and same amount of corresponding answers. However, taking the research back to its origin, psychotic patients in mental health care often have encounters with caretakers they have known for longer periods of time. Consequently, this probably involves a more stable apperception of the caretaker that the patient has created during the course of several interactions. Furthermore, patients often stay involuntary at these

facilities and frequently believe that the caretakers have locked them up in the facility and are not willing to let them go (Frueh et al., 2005). Therefore, they often have a negative image of the caretakers and it is thus unclear if the colored light would also influence the apperception of the caretaker in the same way that was found in this study. As a consequence, it seems valuable to discover if the results can be replicated in an ecologically valid study.

As mentioned in the results section, the lack of effect of the covariate 'need for affiliation' will be discussed here. There was no main effect of need for affiliation on the affiliation towards the (bogus) person. An apparent explanation is that the study consisted of a within-subject design. Consequently, the measured characteristic was the same in each light condition and therefore did not yield any effect. However, remarkable is the fact that the need for affiliation only correlated positively with the orange light condition. An explanation for this phenomenon might be that the orange light influences the need for affiliation. This could be, because orange light might trigger the release of a hormone or another substance that makes the need for affiliation more salient. For instance, it has been found that oxytocin is essential concerning social contacts: it contributes to a feeling of solidarity, it increases trust in others and is therefore often referred to as the 'cuddle hormone' (Oloff, 2013). Oxytocin is released during all possible forms of pleasant social contact (Oloff, 2013), like a nice conversation, cuddling, twittering and presumably playing a game. Because this study did not measure hormone levels or other substances, this remains unclear. It could also be that because the orange light is associated with warmth and friendliness that this makes the need for a warm interpersonal relation more prominent. Nevertheless, for future research it seems interesting and worthwhile to explore this correlation and underlying mechanisms.

### **Effects of colored light on mood**

Next, the overall mood of participants seemed to be hardly influenced by the difference in light condition. There were no significant effects of light condition on the constructs tense arousal and energetic arousal. There was only a trend that seemed to indicate that the blue light condition increased energetic arousal more than the orange light condition. This is an indication that people tend to feel more activated (awake) in the blue light condition. This might be caused by the fact that the blue light was perceived as very bright by 52.2% of the participants. This was in line with literature indicating that bright light leads to less tiredness compared to lower bright light. According to Leproult et al. (2001) evidence indicates that bright light exposure has activating effects on the central nervous system, compared to dim light. Exposure to bright light has also been found to reduce sleepiness and enhance alertness (Rüger et al. 2006). This is also in accordance with preceding research from Laufer, Lang, Izso and Nemeth (2009), who showed that blue light was described as more activating compared to red light. However, looking at the luminance and illuminance of the three light conditions it is clear that the white light condition was brightest, followed by the orange light condition and the blue light condition was least bright. As mentioned in the results section, most participants mentioned that the blue light was brightest. This might be due to the fact that saturated blues have a brightness that exceeds their luminance (Stockman, MacLeod & Johnson, 1993). Thus, it seems that the perceived brightness of a color does not directly relate to luminance and illuminance, which explains why the blue light condition is seen as brightest and subsequently activates participant most.

Notably, the difference in light condition only explains a very small proportion of the variance (ranging from 2.6% to 3.8%) in energetic and tense arousal. This indicates that mood is barely influenced by colored light, at least during a short time exposure as used during this study. At a glance, it seems that mood is a relatively stable state that remains constant over longer periods of time and is not immediately influenced by colored light. A representation of this phenomenon might be illustrated by the fact that, in general, we do not tend to feel happy one minute and sad the next minute. Objectively this seems to make sense. Even though we tend to believe that light influences our mood (Veitch & Gifford, 1996). Results from this study do not appear to confirm this. Another explanation might be that light has a low salience, in our everyday life we see light all around us, therefore we probably barely notice light anymore. The fact that this study used static light, the kind of lighting we are used to, might have made it inconspicuous. It could also be that the adaptation time of 6 minutes, already made participants less aware of the initial impact of the light. Overall, the study seems to indicate that colored light does not influence mood.

### **Effects of colored light on atmosphere perception**

The effects of colored light on atmosphere perception seem to be more robust than on mood and likeability, and have been confirmed in prior studies. This study found significant effects of colored light on the atmosphere perception constructs coziness, detachment, and tenseness and found a trend on the construct liveliness. Coziness is experienced significantly more in the orange light condition compared to the blue and white light condition. Both detachment and tenseness are experienced significantly lower in the orange light condition compared to the blue and white light condition. And liveliness seems to be experienced more in the orange light condition compared to the white light condition. Additionally, the variance in the data explained by the difference in light color was moderately large for coziness and detachment (respectively 22.9% and 18.9%). While only a small part of the variance in tenseness and liveliness was explained by the difference in light condition (6.4% and 2.1%, respectively). Overall, the results are in accordance with previous research. Vogels (2008) found that summer and autumn light settings (orange and red) were rated as cozier than winter and spring light settings (blue and white). Furthermore, she found that warmer toned light, yellowish and orange light, increased the pleasantness and relaxation experienced in an environment compared to blue and white light. At the same time, Baron, Rea and Daniels (1992) showed that people describe a room with warm light as being more relaxing and pleasant compared to a room with cold light. This is consistent with the descriptions participants gave in this study about the different light conditions. The room was described as being warm, friendly, pleasant, and relaxing during the orange light condition, while the blue and white light conditions were more often described as tense, chilly, cold, and formal. The descriptions about the blue light condition were most often indiscriminate, because there were also participants who felt the room was friendly, pleasant, and relaxing. Nonetheless, this is not reflected in the results of the atmosphere perception. The orange light also increased liveliness, at a glance this seems contradictory to relaxing (as found by Baron, Rea and Daniels, 1992). However, both liveliness and relaxing have been found to match on positive valence while they differ on arousal level (Schimmack & Grob, 2000; Ekkekakis, Hall & Petruzzello, 2005).

In short, it seems that colored light influences the atmosphere perception strongly and in expected ways. That is, orange light increased coziness and liveliness and decreased tenseness and detachment more compared to blue and white light.

### **The influence of personal preference**

In the results section we took a look at the effect of light color preference on likeability towards the bogus person and mood activation levels. Of the twenty-three participants, we saw that four participants preferred cool blue colored light and three participants preferred warm orange colored light to relax in. It seemed that a blue color preference heightened participants energetic arousal, indicating that they felt more alert during the blue light condition than the white and orange light condition. This is, as mentioned previously, in accordance with preceding research from Laufer et al. (2009), who showed that blue light was described as activating. Furthermore, participants who preferred the orange light had lower scores on tense arousal compared to the white and blue light condition, indicating that they felt more relaxed in the orange light condition. This also corresponds with research from Laufer et al. (2009) who showed that red light (most related to orange light) was described as relaxing. However, there was no indication that the preferred light color blue had an effect on tense arousal. Neither did the preferred light color orange had an effect on energetic arousal. Also, there was no clear pattern visible depicting a relation between the preferred light color of a participant and their scores on likeability towards a bogus person. Overall, the participant perception of another person did not seem influenced strongly by participant's light color preference. However, in accordance with previous research, a preference for cool blue colored light indeed had activating effects while a preference for warm orange light had relaxing effects on mood activation levels. Thus, for further research it seems worthwhile to explore the effects of light color preference on psychiatric patients more. However, we also saw some contradicting results concerning the light color preference of participants and atmosphere perception measurements. Since there were also four participants who choose blue as their preferred light color, because they perceived the blue light as friendly, pleasant, and relaxing. Even though, the atmosphere perception results indicate that orange light was significantly more positively perceived. This difference could be explained by the fact that the orange light had an effect on participants that was not noticeable. While, during the interview, participants had to indicate what effect the different light colors had on them, it is easy to give a logical explanation by mentioning known associations or preferences. This could explain why there were some contradicting results concerning the questionnaire measurements and the post-experiment interview.

Furthermore, in line with previous research (Laufer et al, 2009; Izso et al., 2009), the interview results also indicated that blue and white light was perceived as cold while orange light was perceived as warm. Therefore, it may be concluded, as hypothesized, that warm light enhances the atmosphere perception and likeability of a bogus person more than cool light.

### **Limitations and future research**

Looking at the overall study, the sample was small and limited to experts of experience from near Eindhoven. From that perspective, it would be advisable that future research examines larger samples. Due to ethical reasons and rules it was not possible to perform the study with real patients.



But for ecological validity it would be important to examine the effect of colored light on patients who are still in treatment. First, it remains uncertain if participants are able to predict what kind of effect their light choice would have on them when being in a crisis or during a psychotic episode. Furthermore, this study only focused on short-term effects of colored light on participants; it would be interesting to investigate the long-term effects. Is the long-term effect comparable to the short-term effect or does it differ and if so, how does it differ? Besides, this research concentrated on the effect of static lighting, but the effect of light changes should also be explored. It could be that observable changes in colored light effects people more than a static light color. Wan (2011) found that pulsating orange light was perceived as more pleasant than static orange light or pulsating and static white light. Indicating that dynamic colored lighting might be able to relax psychiatric patients more than static colored lighting.

A possible confound in this study might be the fact that the illuminance of the light conditions were dissimilar. The white light condition had highest illuminance with 212 lx, followed by the orange light condition (130 lx) and the blue light condition had the lowest illuminance with 77lx. However, 52% of the participants mentioned that the blue light was too bright and only 34% of the participants felt the white light was too bright. Furthermore, exposure to bright light has also been found to reduce sleepiness and enhance alertness (Rüger et al. 2006). From the results we can see that people reported highest levels of energetic arousal (feeling awake) in the blue light condition compared to the white and orange light condition. This seems to indicate that the blue light was not perceived as being least bright. Still, for further research it is relevant that the illuminance and luminance levels of the light conditions are more alike.

Despite these limitations, this study seems to indicate that orange colored light positively influence the apperception of a bogus person and the atmosphere perception more. Colored light, though, did not seem to influence mood activation levels. Therefore, this study seems to indicate that it is easier to influence the situation (the environment and the bogus person) with colored lighting than the person's mood. This is conflicting with the perception of many participants who indicated in the interview that the lighting influenced the way they felt. This does, however, conform to previous research by Veitch and Gifford (1996) who tested beliefs about lighting effects on mood. Their results indicated that seventy percent of their participants reported that the type of lighting in a room makes a difference to their mood. As mentioned in the introduction, there are many ambiguities found in research on the effects of lighting on mood, which seem to indicate that it is hard to find steady outcomes of the influence of colored light on mood measurements. Furthermore, participants light color preference did not seem to impact their perception of another person or their mood activation levels. For further research this seems to indicate that light color preference does not have to be taken into account. Despite these findings, it is clear that the atmosphere perception is influenced strongly by colored light. And that the apperception of a bogus person is also influenced by colored light. Both measurements focus on the situation outside the participants instead of their psyche, in short it seems that the environment is more positively influenced by orange light compared to white and blue light. It seems worthwhile to take this in consideration and explore further in future research.

As mentioned, this study seems to indicate that it is easier to influence the situation (the environment and the bogus person) with colored lighting than the person's mood. It might seem logical

to illuminate the caretaker with colored light. However, from previous research it is known that people do not like to be illuminated by chromatic light, but do like the walls and other objects to be illuminated by chromatic light (Vogels, 2009). Chromatic light also seems to make it harder to interpret facial expressions, this would be detrimental for the relation between the patient and caregiver in the high care department. Hence, colored light might be used to illuminate the walls and other objects in the room, but should not illuminate the caregiver. Since this study also indicated that orange light is seen as warm light and blue and white as cold. It might be advisable for further research to explore the effect of illuminating the caretaker with warm white light. As white light does not seem to reduce the perception of a person's facial expressions.

### **Implications**

To the best of our knowledge, this is one of the first studies that reports on the effects of colored lighting in the mental health care setting or on the support of psychiatric patients. Findings of this study seem to indicate that utilization of colored light in the mental health care setting is promising. Orange colored light could enhance a cozy and lively atmosphere and positively influence the apperception psychotic clients have of their caretakers. Participants confirmed in the interview that orange colored light could positively influence the environment by making it more pleasant, warm and kind. They also confirmed that orange light was seen as warm while blue and white were perceived as cold. Many participants thought that colored light could help in calming down the clients and eventually prevent separation. However, colored light was often mentioned as one aspect of the environment that could improve the situation. A combination of light, sound, smell and pictures was often recommended.

A positive stimulus, like light, may offer positive distraction or have a calming effect and consequently can help reduce the amount of escalating behavior that transpires. This study shows that colored light can potentially positively influence the apperception of the caretaker, subsequently enhancing the social bond between client and caretaker. As mentioned before, anxiety is a prevalent symptom during all phases of a psychosis and social support has been frequently reported to help alleviate anxiety and is seen as a coping mechanism to deal with psychological turbulence. For that reason, findings of this study seem promising in improving the perceived social support by improving the social bond between the patient and caregiver and subsequently reduce the number of separations. Findings also indicate that the atmosphere is more positively influenced by orange colored light compared to blue and white light. As indicated by many participants, the environment becomes more pleasant, relaxing, warm, and kind. Which could enhance a calming effect on clients. Even though effects on mood activation levels were not found in this study, participants did indicate that colored light could positively influence the mood of clients and help them calm down. Especially when the clients would be in control of the colored light. Many participants suggested that a client would choose their own preferences beforehand, when they were in a 'normal' state of mind. When clients would slip into a crisis, the preferred color could be applied in the support or separation room, of the crisis center of psychosis, in order to calm the clients down. Clients should be involved in this process, as people who suffer from psychosis could become suspicious and stressed when they do not understand why certain colors are projected in the room. Customization of the light is very important, especially since there

were also participants who indicated that they would prefer to have very dim light or no light at all. Because overstimulation could make a psychotic episode worse, it is also important to consider that clients are capable of putting out the light at any moment, even when they preferred to have it on in the past.

Overall, there are many aspects that need to be considered when applying colored light in the support and separation rooms, because people differ in their needs. Even though the prospects are promising, implementation of colored light should be done carefully and with guidance.

## 7. Conclusion

Although certain matters remain unclear, some results stand out: the majority of the results seem to match the effects found in the general population. Also, it seems clear that it is easier to affect the context with colored light than to affect a person's state of mind. This study aimed at gaining more knowledge about what type of colored light could be applied in high care mental health departments to help reduce the anxiety of patients by creating an environment that is relaxing and enhances the social bond between patient and caregiver. Findings from this study show that colored light affects the atmosphere, for instance by, creating a cozy and lively atmosphere with the use of orange ambient light. However, the atmosphere does not automatically influence a participant's mood. The findings do suggest that affiliation towards a person can be increased by the use of colored light. This indicates that the social bond between patient and caregiver can be positively influenced by employing warm ambient lighting. But, on the grounds that light predominately works as a situational cue, it would be more effective to only illuminate the environment and caretaker. Overall, the findings are promising concerning the effects of colored light in the mental healthcare setting. Still, the paths that are taken throughout this exploration are novel and pioneering. Therefore, this paper is only the start of research concerning the effects of colored light in mental healthcare settings, and not the final product.

If colored light is to be utilized in the future, it will be important to understand more of the fundamentals and the mechanisms at work. However, the success of colored light used at high care mental health departments depend on the setting in which it is used and on the person it is used for: some people think they benefit from colored light, while others do not think it will have a positive impact and several others are scared it might be able to cause psychosis, if applied at the wrong time. Overall, the trick is not just to use properly customized colored light, the match between the situation and the state of mind determines the course and quality of the influence of light.

## 8. Literature

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## 9. Appendices

### Appendix 1 – Need for affiliation questionnaire (in Dutch)

Geef aan welke uitspraken op u van toepassing zijn (d.w.z. in welke mate beschrijft elke uitspraak u als een persoon).

*Geef antwoord aan de hand van de onderstaande schaal door een kruisje te zetten in het vakje dat het best van toepassing is:*

helemaal niet kenmerkend voor mij    1    2    3    4    5    6    7    heel kenmerkend voor mij

	1	2	3	4	5	6	7
Ik wil met anderen praten over wat ik voel, wat ik innerlijk meemaak.							
Ik vind het vervelend om raad te moeten vragen.							
Ik vind het beter om me emotioneel in te houden.							
Als ik in moeilijkheden zit, heb ik behoefte aan hulp en steun van anderen.							
Emotionele problemen houd ik liever voor me.							
Verdriet probeer ik zelf te verwerken.							
Ik wil m'n gevoelsleven delen.							
Als ik met iets zit, stap ik graag naar iemand toe.							
Gevoelens zijn m'n eigen zaak.							
Juist wanneer ik het moeilijk heb, wil ik graag tegen iemand aanleunen.							

## Appendix 2 – Mood questionnaire (in Dutch)

Geef aan hoe je je op dit moment voelt.

*Geef antwoord aan de hand van de onderstaande schaal door een kruisje te zetten in het vakje dat het best van toepassing is:*

	Voel ik helemaal	Voel ik enigszins	Voel nauwelijks	ik	Voel ik helemaal niet
Levendig	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ontspannen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Krachtig	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Moe	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Suf	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Zenuwachtig	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Alert	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Onrustig	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Slaperig	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Energiek	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Op m'n gemak	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Nerveus	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Kalm	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Relaxed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Warrig	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Actief	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Rustig	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Vitaal	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Futloos	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Gespannen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



### Appendix 3 – Affiliation towards the (bogus) person (in Dutch)

Geef bij de onderstaande uitspraken aan in hoeverre je het hier mee eens bent.

*Geef antwoord aan de hand van de onderstaande schaal door een kruisje te zetten in het vakje dat het best van toepassing is:*

	Helemaal mee eens	Mee eens	Neutraal	Oneens	Helemaal mee oneens
Deze persoon is vriendelijk.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Deze persoon is warm.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ik zou deze persoon om advies vragen.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Deze persoon is vergelijkbaar met mij.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Deze persoon is aardig.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Deze persoon is toegankelijk.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ik zou graag vrienden zijn met deze persoon.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Deze persoon is intelligent.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

#### Appendix 4 – Atmosphere perception questionnaire (in Dutch)

Geef bij de onderstaande term aan in welke mate de verlichting van toepassing is op de atmosfeer van deze ruimte.

Geef antwoord aan de hand van de onderstaande schaal door een kruisje te zetten in het vakje dat het best van toepassing is:

	Helemaal van toepassing	Enigszins van toepassing	Neutraal	Nauwelijks van toepassing	Helemaal niet van toepassing
Behaaglijk	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Levendig	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Gespannen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Koud	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Geborgen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Stimulerend	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Formeel	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Warm	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Intiem	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Beangstigend	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Kil	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
prettig	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
inspirerend	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
bedreigd	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
zakelijk	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Onprettig	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

## Appendix 5 – Interview questions

1. Would you like to show me the light color, with the lamp, that relaxes you most?
2. And why do you prefer this light color?
3. What did you thought of the light colors? Did you feel different?
4. Did you think the light influenced the way you felt?
5. Did you felt the light influenced the way you thought about the other person?
6. Did you felt the light influenced the atmosphere of the room?
7. Do you have any idea why we have chosen these three light conditions?
8. What do you think the goal of the experiment was?
9. Do you have experience with the separation room?
10. If so, what if you could choose a certain light color in the separation room, what would you choose and why would you prefer it?
11. Do you think that dynamic light could also be relaxing?
12. And why?
13. What did you think of the experiment in general?
14. Do you have any questions for me?

Appendix 6 – Flow chart experiment

