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Red or blue meeting rooms: does it matter?
The impact of colour on perceived productivity, social cohesion and wellbeing

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ABSTRACT
The purpose of this research is to establish the influences of the colours red and blue on perceived well being, social cohesion and productivity in complex real life work conditions during regular meetings.
Methodology: Seven regular government teams held seven regular meetings in a red, blue and reference meeting room. In literature it is often mentioned that red is a warm and blue a cool colour. To be able to test the warmth and coldness effects we have amplified the warm and cold qualities with light colour and colour of the table top desk. We asked employees to complete questionnaires concerning perceived well being, social cohesion and productivity. Fifty two subjects completed three questionnaires, at the start, the end and two or three days after the meeting. Data were analysed with SPSS 16.
Our findings didn't show any effects of the red and blue environment on perceived well being, social cohesion and productivity. We assume the processes in real life work situations are too complex to measure influences. **Practical implications** are that statements frequently mentioned in literature concerning influences of red and blue might be not valid in real life meeting settings. New ways of testing the impact of colours should be reconsidered. Because lab situations are too simplified and artificial, we suggest testing influences of colour in an isolated setting in relation to art.
The originality of this research concerns testing colour influences in complex real life work settings like meetings.
Keywords: meeting rooms, colour influences, red and blue, perceived productivity

1 Introduction: Impact of colour on people

The physical environment has influence on how people function and experience the world with their senses (Schneider, 1987). People constantly interact with and reflect on their surroundings (Ford, 1987 in Franzen, 2004). Colour plays an important role in this interaction. Although many research projects have been accomplished in search for the physiological, affective and cognitive effects of colours on people, there is still a lack of knowledge about the exact effects of specific colours on human beings and their behaviour (Tofle et al. 2004, Elliot and Maier, 2007). A number of studies concern effects of healing environments in search for optimal environmental solutions to reduce pain, medication and length of stay (Dijkstra et al, 2009). In work environments, influences of colours on performance, productivity and mood have been investigated as well (Kwallek and Lewis, 1990; Stone, 2003). However, findings and conclusions are contradictory and not clear (Tofle et al, 2004). Different causes may play a role here. Researchers use different methods in different situations and also different colours even if those colours bear the same name. Moreover, different researches did not find any strong evidence about clear influences.

Looking at colour is very complex. Goethe already mentioned that our eyes strive to totality (Goethe, 2004), a fact that has been confirmed nowadays neurologically and physiologically (Hubel, 1990). Without knowing in what way and how long a subject observes colour and due to the complex processes in our retina, we are not able to define quantitatively which colour information is sent from the retina to the visual cortex. The results of our visual system also depend on our personal experience and knowledge (Gregory, 1998), that Plotinus already claimed in the 3rd century (Ferwerda, 2005). Furthermore, it is unknown in what way people really observe their environment on a conscious or unconscious level. Many people hardly take notice of their environment (Dijksterhuis, 2007) and don't know on a conscious level which colours surround them. So, it is unknown if and to what extent colour is experienced on a conscious or unconscious level.

Moreover, it is not clear yet which cognitive, affective and emotional processes take place in human brains and how these processes interact. At the same time many areas in the brain are active (Andreasen, 2002). Just for the treatment of visual information simultaneously thirty different areas play their specific role (Ramachandran, 2006). The thalamus filters information and coordinates the stimuli from sensory, emotional, higher cortical, motoric and memory areas (Andreasen, 2002). Each human being is a specific creature with his own associations, memories, constitution and emotion, which complicates a clear comprehension of our brain processes. In addition, people might react differently due to the moderating role of the stimulus screening ability: low screeners are more sensitive and react more intensely than high screeners who can easily screen out the sensation of the environment (Mehrabian, 1994). Also mood plays a role: when people are more anxious or dissatisfied they react more strongly to their environment, both physiologically as psychologically (Damasio, 1994 in Goleman, 1996). So, it is impossible to establish a clear interaction between colour and the influence on human beings.

Another interesting issue concerns the context dependent effects of colour. For instance 'red' plays a different role in different contexts (Elliot and Maier, 2007). Regarding the construct of avoidance motivation (when people are aware of red they are more afraid to make mistakes) red can play a different role than in other cognitive tests (Metha and Zhu, 2009). The way we use and experience the environment is mainly defined by our perceptions (Plotinus, ± 260 in Ferwerda, 2005; Kepler ± 1620, in Lombardi, 2007).
In colour research some tension fields can be observed. First we can't separate colour from its form, texture and other surroundings. Secondly, testing colours in lab situations is risky because of the complexity of real life settings. Thirdly, the observation process of human beings is complicated by complex human variables such as constitution, attention, sensitivity and brain functions, which can differ per subject.

1.1. Testing effects of red and blue in a real life setting

In order to improve our understanding of the influence of colour we tested the impact of red and blue on perceived productivity of meetings in a real life situation. Working people spend a relatively large amount of time in meetings. In the Netherlands on average meetings take 25% of the working time (Vink, 2009). Therefore, it is important to know if and how colour affects people during meeting sessions. Because real life meetings are complex processes, with many interacting and intermediating social, emotional and rational variables, organizational influences, and different intrinsic motivations, testing in real working situations is preferable.
Many colour tests have been conducted in labs, using students in artificial environments (for instance Guilford and Smith, 1959 in Verhoeven, 2008; Dijkstra, 2008; Metha and Zhu, 2009; Moller, 2009, Rutchick, 2010, Roberts, 2010). But lab situations are simplified imitations of a complex world. Colour is an integrated part of the environment and influences of colour can only be observed in its context (Elliot and Maier, 2007). In lab situations applied test devices have their constraints and environmental aspects are artificially isolated, so testing colour effects in lab situations bears the risk of losing insight in the mutual and complex coherences between entities. Moreover, using students as test subjects does not correspond to the complexity of real work situations (Vonk, 2003). For this reason we conducted a colour test in a governmental organisation during regular meetings of regular teams. The main research question is: what are the effects of the colours red and blue in a real life meeting situation on perceived productivity, in connection to the intermediary constructs 'social cohesion' and 'wellbeing'?

1.2 Why red and blue?

In the literature the warm and cold effects of red and blue are mentioned quite frequently. Warm colours are believed to evoke more arousal than cool colours (Jacob and Suess, 1975 in Dijkstra, 2009; Stone and English, 1998, in Dijkstra, 2009; Kaya and Epps, 2004, Yildirim, 2011). Warm colours are supposed to stimulate the senses, with cool colours showing the opposite effect (Mahnke, 1996, in Tofle, 2003). These different effects are often related to the differences in wavelength. Long wavelengths like red are connected to arousal, short ones like blue are supposed to calm down (Kaya and Epps, 2004; Adams and

Osgood, 1973, in van Hagen, 2009; Jacobs and Suess, 1975, in Dijkstra, 2009). On the contrary, brain research shows that in comparison with red light, blue light leads to more arousal, which is expressed by the results of AAC (alpha attenuation coefficient) and the mean power of the alpha band (Yoto et al, 2007). Also, wavelengths showed to influence humans' emotional state (Crowley, 1993, in Verhoeven, 2008; Kaya and Epps, 2004). However, other researchers didn't find evidence for a relation between colour effects and wavelengths (Fehrman and Fehrman, 2004 in Elliot and Maier, 2007, Mikkelides, 1990 in O'Connor, 2011), nor evidence for the relationship between colours and mood (Ainsworth et al, 1993, in Kaya and Epps, 2004).

Research findings regarding the effects of the colours red and blue on performance do not match as well (Elliot and Moller, 2007). Many researchers did not find any relation between colour and performance (Ainsworth et al, 1993 in Elliot and Moller 2007; Etnier, 1997), whereas other researchers pointed out that red enhances cognitive performance (Kwallek and Lewis, 1990 in Metha and Zhu, 2009) or, the opposite, reduces cognitive performance (Soldat and Sinclair, 1997, in Metha and Zhu, 2009). Blue was found to stimulate systematic thinking (Soldat, Sinclair and Mark, 1997 in Metha and Zhu, 2009) and being preferable in creativity tasks (Metha and Zhu, 2009). Also blue light showed to improve cognitive performance (Lehrl et al, 2007 in O'Connor, 2011). Red was found to stimulate avoidance motivation and to improve cognitive performance concerning detail orientated tasks (Metha and Zhu, 2009). On the contrary, red impairs performance on complex tasks (Elliot and Moller 2007) and tasks that require exactness (Goldstein, 1942).

Even the word 'red' showed to undermine intellectual performance (Lichtenfeld, 2009). In addition to effects on intellectual performance, other effects have been investigated as well. In some sports, wearing red instead of blue clothes was found to enhance the chance of winning (Hill and Barton, 2005, in Dijkstra, 2008). Whereas red is related to avoidance motivation, blue is related to approach motivation. But this issue seems to be context dependent as well, because in shops no relation was found between colour and approach orientation (Bellizi, Crowley and Hasty, 1983).

Cognitive, emotional and physiological processes are closely interacting. Blue light was found to reduce physiological arousal, blood pressure, galvanic skin response, respiration rate and eye blink frequency (Gerard, 1957, in Verhoeven, 2008), whereas warm colours showed to increase physiological and psychological arousal (Jacob and Suezz, 1975 in Dijkstra, 2009). Seeing red leads to more right cortical activity in EEG's (Elliot and Maier, 2007). Blue was found to have an endocrine based strengthening effect on muscles (Ott, 1979 in Elliott and Moller, 2007). Other researchers didn't find any different effects of red and blue illumination on physiological processes (Caldwell and Jones, 1985 in Tofle, 2003). Besides luminance perception varies from person to person (Conway 2007).

There might be various explanations why the results are rather conflicting. The effects of colour are highly context dependent (Elliot and Moller, 2007). Physiological influences are not universal (Van Cranenburgh, 1998). Screening ability may influence the reactions of people on colours as well. Office workers with a low screening ability performed worse in red in comparison to people with a high screening ability (Kwallek, 1997, in Dijkstra, 2008). Attention (Dijksterhuis, 2007) and motivation (Metha and Zhu, 2009) also play a role. People differ in their sensitivity to the environment, which may depend on their constitution (Van Cranenburgh, 1998). For instance, when people easily loose balance, they probably will pay more attention to elements which support stability. Because it is difficult to measure differences in sensitivity and attention, it is also difficult to draw clear conclusions regarding the influences of colour.

Because of the conflicting findings of a considerable amount of research concerning the effects of red and blue on performance, we have arranged a real life test situation with the possibility to observe the testing process in detail. The main research question is: what are the effects of the colours red and blue in a real meeting situation on perceived productivity, directly and in connection to wellbeing and social cohesion?

2 Conceptual model

In order to attain viability and continuity of organisations it is important to maximize productivity (Van der Voordt, 2003; Vink, 2009). An important function of meetings is to strengthen involvement and cooperation. Therefore, in addition to productivity, social cohesion is a second issue to be investigated. Thirdly, it is important employees feel comfortable, so perceived wellbeing is the third issue. Building on analyses of meeting processes in which productivity, social cohesion and wellbeing are discerned as important issues (Briggs et al, 2006; Hengst, 2006, Post et al, 2008, Duivenvoorde et al, 2008), a conceptual model has been developed to be used as a starting point for data-collection and data-analysis (Figure 1). The model visualizes the assumption that colour i.e. red and blue has an influence on people's productivity, directly and in interaction with social cohesion and wellbeing.

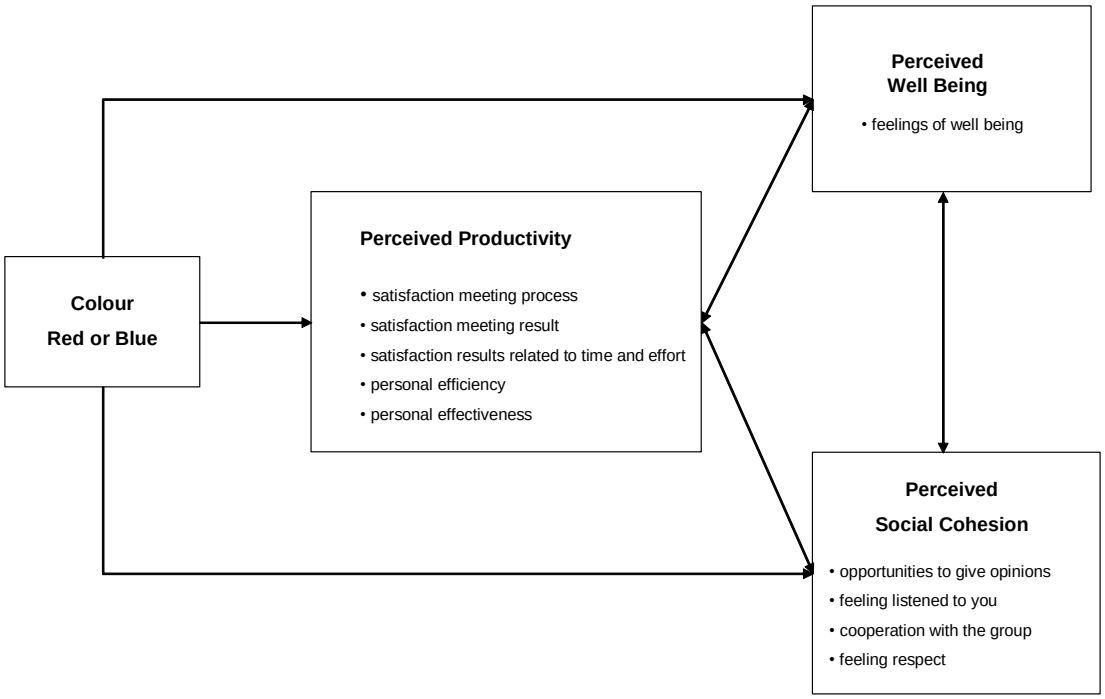

Fig.1 .

3. Research design

3.1 Test environment

The test is accomplished in a governmental building in Rijswijk in the Netherlands. Three identical meeting rooms were used with a size of 3.300 x 6250 mm; height = 2400 mm. Both long sides of the room have a window to the inner corridors (double corridor access), made of glass, 3300 mm (width) x 1900 mm (height). To measure the influence of red and blue and the related colour effects 'warmth' and 'coldness' two meeting rooms on the fifth floor were adapted (see figure 2). In each room, three walls were painted in a red or a blue colour, respectively. To strengthen the warmth and coldness effects of red and blue, we also modified the colour temperature of the lighting and the top desks of the tables. As such, we primary focussed on the warm and cold effects and not specifically on only the colours red and blue. On the third floor a neutral room, which was identical to the meeting room the respondents usually use, was used as a reference room. In the red meeting room we applied warm illumination of 3500 K and a wooden top desk (beech print, Ahrend, code 61). In the blue meeting room was cold illumination of 5300 K and a white/ grey top desk (Ahrend, code 52). Colours of the reference room were greenish, codes S

1010- B70G (light greenish) and S 2020- B30G (dark greenish) (Figure 2). To prevent the room appearing too reddish or too bluish – which might cause an unnatural and disharmonious situation - a combination was made of the main colour and a grey supporting colour in each room. Also, by choosing a specific grey tone, we attempted to enhance the effect of red and blue, respectively. In the red room the red code S 3560-Y80R was used on the long sides and one short side. The other short side (with a whiteboard), was coloured grey (code S 6502-R). In the blue meeting room, the blue code S 3560-R90B was used on the two long sides and one short side. The other short side had the grey code S 6502-B. The reference room had exactly the same features as the blue and the red room, apart from the table form. In the reference room the table was placed against the short side of the meeting room. This position was highly disapproved by the employees and also not standard in government meeting locations. To prevent that this fact would influence the coloured rooms in a too negative way, here a standard table form (with an extra bow) and standard location with free space around was applied.

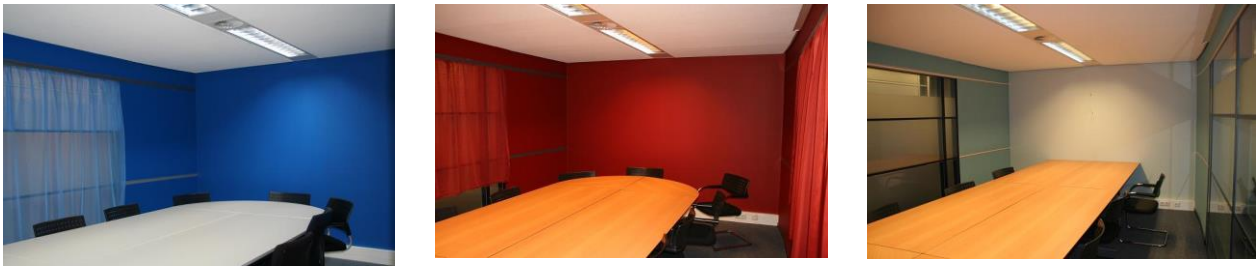

Figure 2: The blue, red and reference meeting rooms

Floor finish was dark grey carpet. Seat covers of the chairs were all black. The white ceiling was a modular system. Lighting consisted of three neon tubes (58 W) situated in the centre in one line above the table, incorporated in the ceiling**.** There was neither daylight, nor plants, nor art. The indoor climate was standard, with an estimated office temperature of 21-23 degrees Celsius and a standard Relative Air Humidity.

During seven regular meeting sessions of seven different teams (totally 49 sessions) the employees used the blue meeting room, the red one and the standard reference meeting room (see table 1). Team characteristics were: a permanent chairman and a meeting frequency that varied from one to three weeks. Each team had its own starting time and meeting time, which were both the same throughout the colour testing period. The time between two meetings was minimal a week. Because we didn't expect any order effects, we tested the seven team sessions in the same order: Red, Blue, Reference, Red, Blue, Reference and Red Room. The first session in the red room only served as a habituation process. The results of this first test meeting are not used in the statistical analyses and not included in the tables. Before starting the test, all subjects were informed about the test set up, the process, targets and period. During all 49 tests the researcher was present to observe the meeting process and to report anything out of ordinary. This made it possible to check the responses to the questionnaires against the data from observations. All subjects received a small gift after each meeting for their extra effort completing the questionnaires.

3.2 Participants and team sessions

The test subjects were all government employees, aged between 26 and 56 years. Education level varied between middle level vocational education and university. During the sessions totally 250 times opinions about all items were collected (see table 1).

Table 1: Number of participants per team and per meeting; data from the first test were excluded

	meeting 2 Blue	meeting 3 Reference	meeting 4 Red	meeting 5 Blue	meeting 6 Reference	meeting 7 Red	Total excl. meeting 1
team 1	7	8	8	10	8	8	49
team 2	5	3	6	7	5	6	32
team 3	7	8	4	5	4	7	35
team 4	9	6	8	8	5	7	43
team 5	4	3	3	4	5	4	23
team 6	11	7	7	9	4	7	45
team 7	4	4	4	4	3	4	23
	47	39	40	47	34	43	250

3.3 Research methods

To collect employees' opinions four questionnaires (Q1-Q4) were used. Questions have been adopted from earlier research concerning the different variables playing a role in meetings - with productivity as the main topic - plus an additional questionnaire (Q5) to assess individual colour preferences regarding favourite colour and colour preferences for clothing, different types of rooms and different moods. The results of Q5 will be published in a separate paper. All questionnaires were first tested in a pilot and than adapted. The first questionnaire (Q1) was completed at the beginning of each meeting, the second one at the end (Q2), both inside the meeting room. The same questionnaire was again completed two or three days after the meeting session by e-mail (Q3). Based on research concerning meeting productivity (Briggs et al, 2006; Hengst, 2006, Post et al, 2008, Duivenvoorde et al, 2008) for all three questionnaires the 7-points Likerst scale is used. When all meeting were finished, a fourth questionnaire (Q4) was sent out by e-mail to probe personal opinions related to the colour testing process and to ask which aspect of the environment respondents find most important for a meeting room. Also during the process Q5 was sent out to collect individual colour preferences (see figure 3, below). Data were analysed with the statistical programme SPSS16. Furthermore we examined whether subjects filled out the questionnaires in a consistent way.

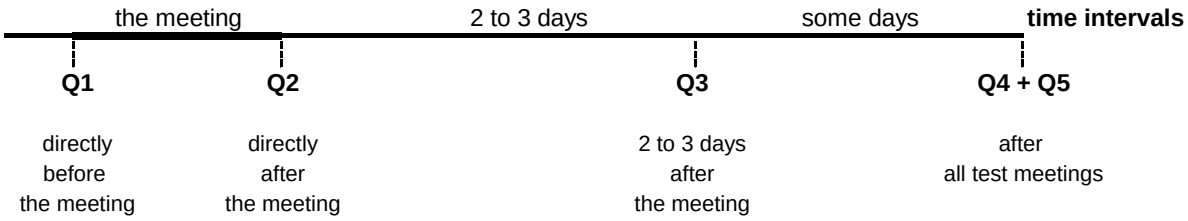

Figure 3: questionnaires Q1 to Q5, filled out in time intervals

4 Results

4.1 Impact of red and blue

Analyses of variance did not show any significant effect of the red and blue environment on perceived productivity (α =0.05; p= 0.673; F= 0.396), nor on the different items of productivity (α=0.05; p = 0.207 to 0.588 ; F = 0.533 to 1.587), nor on the different items of social cohesion (α=0.05; p= 0.358 to 0.658; F= 0.419 to 1.032], nor on well being (α=0.05; p=0.656; F= 0.422). Also, no significant relation was found between the colour of the room and the judgements of the subjects regarding the meeting room *(question: I experienced the meeting room as pleasant (Q2 and Q3)* (α=0.05; p= 0.770; F= 0.262).

A consistent behaviour was observed regarding the answers in the questionnaires. Score 5 was mostly used. There were rather small differences between the results of the questionnaires which were completed immediately after the meeting and two to three days after the meeting. In all cases the scores

in the last questionnaire (Q3) were lower. Judgements regarding meeting results and meeting productivity showed the largest reduction, namely 0.6 (see table 2); the employees showed to be most critical about meeting result and productivity. Regarding all productivity aspects the means were highest in the reference room and lowest in the red room. But the differences are all not significant.

Table 2: Means and Standard deviations (S.D.) per productivity aspect mentioned in the questionnaires Q2 and Q3.

Productivty aspect	Questionnaire	Red Room		Blue Room		Reference Room	
		Means	S.D.	Means	S.D.	Means	S.D.
well being	Q2	4,6	1,4	4,7	1,3	4,8	1,0
	Q3	4,2	1,8	4,4	1,7	4,6	1,4
personal efficiency	Q2	4,5	1,3	4,8	1,3	5,1	0,8
	Q3	4,3	1,7	4,5	1,7	4,8	1,4
personal effectiveness	Q2	4,6	1,3	4,7	1,3	5,0	0,9
	Q3	4,1	1,8	4,5	1,7	4,8	1,4
giving opinions	Q2	5,0	1,3	5,1	1,3	5,4	0,9
	Q3	4,6	1,8	4,8	1,8	5,1	1,4
listening to you	Q2	4,9	1,3	4,9	1,3	5,3	0,9
	Q3	4,5	1,8	4,6	1,8	5,0	1,4
feeling respect	Q2	5,0	1,3	5,0	1,5	5,4	0,9
	Q3	4,6	1,8	4,7	1,8	5,0	1,6
cooperation	Q2	4,7	1,4	5,0	1,4	5,4	1,0
	Q3	4,4	1,9	4,5	1,8	4,8	1,6
meeting	Q2	4,7	1,4	4,9	1,4	5,1	1,0
	Q3	4,2	1,8	4,4	1,8	4,6	1,6
meeting process	Q2	4,6	1,4	4,9	1,4	5,0	1,1
	Q3	4,2	1,8	4,3	1,8	4,5	1,6
meeting result	Q2	4,6	1,4	4,8	1,4	5,0	1,1
	Q3	4,1	1,8	4,2	1,8	4,4	1,7
meeting productivity	Q2	4,6	1,5	4,7	1,4	5,0	1,1
	Q3	4,0	1,8	4,1	1,8	4,4	1,7

However, in the data base (Q2 and Q3) a strong cohesion was found between employees appraisals of the meeting room *(question: The colour of the walls had a positive effect (Q2 and Q3))* and the appraisals of the wall colour during the test process *(question: I experienced the meeting room as pleasant (Q2 and Q3)* (Cronbach's Alpha= 0.789 (Q2) and 0.886 (Q3)). By contrast there was no cohesion between the judgement of the meeting room and the appraisal of temperature and air quality (*question: I think the temperature was fine and I think the air quality was fine (Q2 and Q3).)* Cronbach's Alpha= 0.385 and 0.402 respectively (Q2) and 0.588 and 0.564 respectively (Q3). This is remarkable, because when the respondents were asked to mark the relative importance of twelve different interior aspects (in Q4, after all test sessions), the highest scores were assigned to air quality and temperature, while wall colour ranked rather low. Apparently, during the test process subjects combine their judgements regarding the meeting room with the knowledge about the test goals, which they were aware of. Moreover, because the colour wall was anomalous from the situation subjects were accustomed to, they would be more critical of the coloured walls.

4.2 Perceived impact of colour and preferred colour

It is interesting that in response to questionnaire Q4, most respondents mention that colour doesn't matter with regard to a number of issues (see table 3). It is striking that the percentage is highest (65%) regarding productivity *(question: In this meeting room, what we achieved was worth time and effort (Q4))* and lowest (31 and 33 %) regarding judgement meeting room *(question: I think the meeting room was*

pleasant (Q4)) and well being *(question: I felt good in the meeting room (Q4))*. It makes sense that the percentage is rather low (31%) in relation to the judgement of the room, because we asked about the physical aspects. When we asked the subjects, who were convinced that colour indeed had influence, about their room preference, most of them prefer the blue and the reference room. The red room was least popular.

Table 3: percentages of subjects saying 'colour doesn't matter' and room preference from those saying colour has influence (Q4)

Themes	colour doesn't matter	Most marked room preference by those saying colour has influence
Meeting room	31 %	Red, blue or reference room
Wellbeing	33 %	Blue and reference room
Personal effectiveness	58 %	Blue room
Personal efficiency	54 %	Blue room
Cooperation	58 %	Reference room
Meeting	44 %	Reference room
Meeting process	52 %	Blue room
Meeting result	58 %	Blue room
Meeting productivity	65 %	Reference room

4.3 Favourite colour and preferred colour for a meeting room

We have asked the subjects about their favourite colour and their colour preferences for meeting rooms in general. Concerning the favourite colour, quite a high percentage prefers 'blue' or respond with 'doesn't matter (DM). The most preferred colour for a meeting room is 'white' (see, table 4).

Table 4: Favourite colours and colour preferences regarding meeting rooms in general in percentages; D.M. = Doesn't matter.

colour	favourite colour	general colour meeting room preference
blue	39%	8%
red	15%	14%
white	0%	36%
various colours	23%	17%
doesn't matter	21%	23%
missing	2%	2%
total	100%	100%

After all meeting sessions the subjects were asked about their preferred test room (see table 5, below). It is striking that most subjects (55 %) don't have any preference for a specific meeting room.

Table 5: Preferred test room; in percentages

	prefered test room
blue room	17%
red room	12%
reference room	16%
doesn't matter	55%
total	100%

Next, subjects were asked about their preference in two different situations: a work situation with the subject having a strong position (case 1), and a situation (case 2) where the subject had a weak position. The preferences in different situations (strong versus weak position) had no relation with someone's favourite colour or preferred colour in the meeting room

5 Discussion

The effects of the colours red and blue and specific their warmth and coldness effects, are tested in a real life work setting. No effects were found on perceived productivity, perceived social cohesion and perceived well being. Some questions can be asked if certain phenomenon's have played a role to diminish the effects of colours. What can be said about the data: are the entities like 'feeling respect' or 'personal effectiveness' properly used in the constructs 'social cohesion' respectively 'productivity' and are the questionnaires completed in a serious way? And if no effects on perceived productivity, social cohesion and well being can be seen, have the subjects told the truth? And has the phenomenon colour itself something to do with the difficulties to create a transparent research process? After working out these questions, an advice can be given which type of colour research can learn us more about colour effects.

5.1 Validation of the conceptual model

In the conceptual model, productivity is composed of six items: personal efficiency, personal effectiveness, meeting process, meeting result, the meeting and finally 'meeting productivity'. Regarding the statement: 'What we have achieved it was worth the time and effort' we asked the subjects directly to value the meeting productivity. In this paper we consequently make a distinction between meeting productivity (concerning the statement mentioned above) and productivity (a more general estimation). The cohesion within the productivity construct has been checked with Cronbach's alpha (0.915). All six items contributed to the total concept productivity.

In the conceptual model, social cohesion is composed of four items: 'sufficient opportunities to give opinions', 'being convinced colleagues have listened to you', 'cooperation' and 'feeling respect'. The Cronbach's alpha is 0.945, which indicates a high correlation. Besides important elements as the opinions concerning meeting, cooperation, feeling respect and well being, also are strongly correlated with a Cronbach's alpha of 0.861.

Combining the items of productivity with well being, Cronbach's alpha = 0.918. The relation between personal entities (personal efficiency and effectiveness) and well being showed to be stronger (Cronbach's alpha = 0.885) than the relation between well being and meeting productivity (Cronbach's alpha = 0.666). The influence of productivity on well being is mostly caused by satisfaction about the individual effort (personal efficiency and personal effectiveness). Regarding the relation between social cohesion and well being, we found a significant cohesion with a Cronbach's alpha of 0.924. We may conclude that the conceptual model we used seems promising.

5.2 Attention, perception, and process of completing the questionnaires

The test results pointed out that red or blue coloured walls in meeting rooms have no influence on perceived well being, social cohesion or productivity. On a conscious level subjects didn't experience different influences, assuming that they actually focussed on their real feelings and experiences and not on learned cultural associations or organisational and social features. The process of completing questionnaires existing out of reading the questionnaire, thinking about the answers and completing the questionnaires, is not transparent, because it is based on an individual way of thinking, while emotions and cognitions are mixed together. The differences between emotions and cognitions are hard to make (Damasio, 2006). Moreover, attention is a crucial factor in the process of experiencing the environment. People don't experience their environment on a conscious manner (Dijksterhuis, 2007). Next, the subjects paid their attention to a complex meeting process with social, cognitive and psychological aspects that influence each other in a dynamic way (den Hengst, 2006). So attention is focussed on this process and not on the physical environment. During the test, the participants are observed while completing the questionnaires directly before and after the meeting. One third of the subjects looked around before completing the questionnaires, which means that these subjects needed visual information to define their

opinions at that moment, information they apparently didn't have in their minds before. Because of the questions in the questionnaire they started to look on a conscious level at the wall colour and the question can be asked if they just used their personally and culturally learned associations.
The questionnaires forced the participants to give their opinions. These opinions are based on personal perceptions which may differ from facts and actual measurements. Researches about the effects on productivity by plants for instance, have pointed out that when subjects think their productivity has increased, in reality this does not have to be true (Larsen et al, 1998). Moreover, subjects may give socially desirable answers corresponding to what they think people are expected from them (Vonk, 2003). So one may wonder if the responses actually indicate colour effects or should be seen as expressions of diffuse combinations of personal perceptions, social norms and values, cultural features and organisational characteristics. Besides, the fact that many people are convinced that colour has no to little effect, can be seen as a risk to estimate the value of colour as too low. No effects of colour on conscious level could be observed. This doesn't imply that colour didn't have effect on unconscious level.

6 Concluding remarks

Based on the results, the next conclusions can be made:

a on conscious level no effects of colours could be found on perceived productivity, perceived social cohesion and perceived well being
b people were influenced by their awareness concerning the test process
c a relative high number of the subjects had the opinion that colour doesn't matter
d no relations were found between personal colour preferences, preferences for colours of meeting rooms in general and preferences for a specific meeting test room.

When we really want to analyse the effects of colour, we have to distinguish the objective colour quality (Steiner, 1984) and the subjective colour feeling (Oegema van der Wal, 1956). Colour judgement is not only effected by objective colour qualities; personal aspects like experience, memory and constitution play a big part. These aspects define our colour cognitions and associations. The objective colour quality has nothing to do with our culturally and personally constructed associations. It is much more interesting to relate the objective colour quality to our affect (Zajonc, 1980).

We have tried to test the influences of a red and blue meeting environment on perceived well being, social cohesion and productivity during regular meetings in a real life work environment. In the data that have been collected according to the validated conceptual model, no evidence has been found that colour affects perceived well being, social cohesion or productivity. This does not mean that colour has no effect. The only thing we can conclude is that reality and real working processes are too complex to be able to measure colour influences on a conscious level in a clear way The mutual influences of different interior components, group processes and last but not least human factors such as attention, observation, brain processing and consciousness, make it almost impossible to analyse the colour influences. Testing colours in a lab situation might give more clear results. However, the question is whether these results can be transferred to a real work situation. Colour "communicates" with its surroundings and people never experience the colour separately. So we may wonder whether it is possible at all to test the influences of colour. Only in particular circumstances it is possible to test colour in a solitary position without any influences of other aspects, material, textures, or form. As a solution to test the effects of colours in a way worthy to the topic, art will be introduced.

6.1 The colours of Turrell

A very interesting work of art from the colour- and light artist Turrell (Bridget's Bardo, Ganzfeld Piece) could give us the unique possibility to test the influences of colour on its own. Turrell designed a spatial construction with a 'viewing space' and a 'sensing space' where colour is disconnected from material and form (see figure 4). So we can experience colour here on its own without any influence of other aspects.

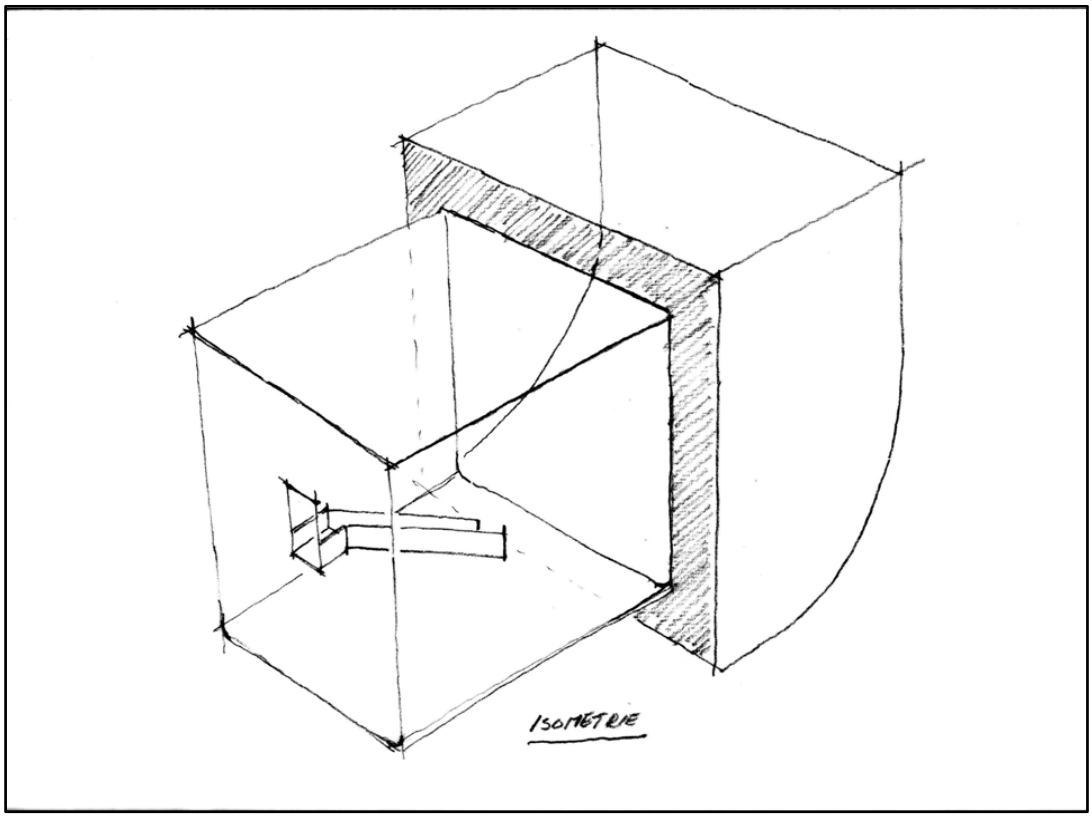

Figure 4: Isometry of Bridget's Bardo (drawing: Jan de Boon)

It would be challenging to test the psychological and physiological effects of colours in such an environment without the influences of other aspects of the environment. At the same time, testing colours this way would mean to testing a situation completely different from common reality. So what is actually needed is to design future colour research with integration of knowledge and parameters from cognitive and behaviouristic psychology, neurology, physiology, physics, biology and art.

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