THE INFLUENCE OF COLOUR AND LIGHT ON THE EXPERIENCE AND SATISFACTION WITH A DUTCH RAILWAY STATION

Colour and light on the platform: two virtual experiments

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Contribution to the European Transport Conference
6-8 October 2008 Noordwijkerhout, The Netherlands

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SUMMARY
Various studies have shown that colour and light influence our emotions and behaviour. In this paper the results will be presented of research into the combined effects of 5 different colours and 2 different intensities of light for Leiden station.

Two experiments in a virtual Leiden station show that although colour and light are perceived subconsciously, the combination of the two does in fact have significant effects on both a number of affective aspects and the perception of the wait.

Significant differences were found with regard to reactions to colour and light between men and women, between those in a hurry (i.e. must passengers) and those who were not (i.e. lust) passengers.

Most of the passengers also appeared to rather overestimate the waiting time on the platform, which concurs with results from earlier fieldwork. Also time would appear to pass more quickly with dimmed as opposed to stronger lighting.

The second experiment showed that lust passengers are more receptive to environmental stimuli than must passengers. They particularly prefer warm colours in combination with dimmed lighting and estimate the waiting time as being shorter than when cooler colours and a more intense lighting are used. The evaluation of the wait and how useful passengers experience the waiting time determine both their attitude to and their opinion of the platform.

Also apparent from the second experiment was that the perception of the wait comes extremely close to the basic emotions of pleasure, arousal and dominance. With regard to the station environment, feelings or emotions evoked by the wait can be added to these basic emotions.
KEY QUESTION
Colours strongly determine how we feel. In public spaces, such as stations, we are surrounded by them. Many studies of influencing the environment focus on the effects of temperature, smell, sound and décor. Changing these factors can influence both perceptual and emotional reactions as well as the actual behaviour (Kotler, 1973). By giving stations certain colours, NS can also exert influence on the emotions experienced by customers. The key question in this paper is: How can NS specifically deploy colour and light in stations so as to positively influence emotions? The objective is to win more happy customers.

SERVICE ENVIRONMENT
According to Parasuraman, Zeithaml and Berry (1985), three aspects play a role in the service environment: intangibility, the simultaneous course of the production and consumption, and the heterogeneity of the service. Through the intangibility of the service, people cannot feel, taste, see or smell it. They can only experience the service. Owing to a lack of tangible proof, customers perceive other aspects of the environment to evaluate the service and determine its quality (Bitner, 1992; Aubert-Gamet & Cova, 1999; Brady & Cronin, 2001). A service environment comprises all the objective factors that can be controlled by an organization with the aim of prompting employees and consumers to a specific behaviour. Baker (1996) divides the physical environment into three components: design elements that are visually and tangibly present, ambient elements that are intangible and often present in the background and as such are often perceived subconsciously, and social elements, the people present in the service environment, such as customers and personnel. Colour and lighting belong to the intangible elements of the surroundings. Whereas all aspects of the service environment play a role at the station, a special place is occupied by the intangible factor ‘time’, because the train’s departure is scheduled.

STIMULUS, ORGANISM, RESPONSE
This research employs the model of Mehrabian and Russell (1974) to investigate whether colour and light influence the degree of pleasure, arousal and dominance that determine behaviour. This relationship between environmental variables and approach or avoidance behaviour was named by Russell and Mehrabian (1974) as the stimulus-organism-response (SOR) model:

- **Stimulus (environment):** all ambient aspects such as colour, light, smell, sound etc.
- **Organism (emotions):** emotional reactions on the basis of pleasure, arousal and dominance (PAD model).
- **Response (behaviour):** the degree to which consumers show approach or avoidance behaviour.
Many studies have focussed on the influence of pleasure on behaviour (e.g. Bellizzi & Hite, 1992). Also the relationship between arousal and behaviour has been shown. However, little attention has been paid in literature to the degree of dominance (Bellizzi & Hite, 1992). Imperative for a station environment is a sense of control, and thus dominance; likewise for emotional aspects such as feelings of uncertainty and pressure, how easy it is to orient oneself and how one experiences the wait. These aspects will thus be included in this research.

LITERATURE OVERVIEW OF COLOUR AND LIGHT

Colours with a short wavelength are specified as cool colours (blue and green), whereas those with a long wavelength are warm (red and yellow). Light comprises the light intensity and the spreading of the colour tone. Bright or dimmed light is determined by the light intensity. Little research has been conducted on the combination of colour and light (Valdez & Mehrabian, 1994; Brengman, 2003). The majority of studies of the effects of colour in the retail environment was conducted in a laboratory setting. In so far as we know, no research has yet been conducted on the usage of light and colour in a station.

Colour
In an environment a colour must be used that certainly incorporates the element “pleasantness”. All colours that are perceived as pleasant will generally result in positive emotions. Cool colours, such as blue and green, have a relaxing effect, whereas colours with a long wavelength, such as orange and red, are stimulating (Jacobs & Suess, 1975; Adam & Osgood, 1973; Walters, Apter & Svebak, 1982; Valdez & Mehrabian, 1994 and Wexner, 1954). Warm colours are perceived as being protective (Wilson, 1966). Clear and saturated colours are experienced as more pleasant (Guilford & Smith, 1959), but on the other hand are sooner associated with fear than cool colours (Jacobs & Suess, 1975). Dark colours are perceived to be more dominant and sooner provoke hostility and aggression. So, with the environment and state of mind determining the effects of colour, red in the cinema foyer will exude a warm, festive aura whereas the same colour in a hospital can have a negative influence on the state of mind of the already anxious visitor.

Research into using colour in a retail environment has shown that it influences buying behaviour (Belizzi & Hite, 1992), purchasing speed (Belizzi & Hite, 1992), time spent in the shop (Belizzi & Hite, 1992), pleasure (Belizzi & Hite, 1992; Crowly, 1993), arousal (Crowley, 1993), image of shop and merchandise (Belizzi, Crowley and Hasty, 1983; Crowley 1993), and the possibility to draw customers (Belizzi, Crowley and Hasty, 1983). Blue and green are perceived to be the most pleasant in a retail environment (Eysenck, 1941; Jacobs & Suess, 1975) and are also evaluated higher than shops with a warm (orange) interior (Babin, Hardesty & Suter, 2003; Crowley,
The results for pleasure strongly resemble the scores for arousal. From research by Kwallek et al. (1988; in Stone & English, 1998), it appeared that people who performed a business task in red surroundings later scored higher for stress and anxiety. Colours with a short wavelength cause a person to be more externally oriented and to show forceful and extrovert behaviour.

From the study by Belizzi et al. (1983), it appeared that respondents, irrespective of their colour preference, felt more drawn physically to warm colours yet perceived surroundings in warm colours as less pleasant (Belizzi, Crowley & Hasty, 1983). Warm colours are apparently successful when it comes to drawing people in (entrance, shop window), but less so when it comes to making them feel at ease. In situations where people experience some kind of mental pressure, it is better to keep the colours cool; with their calming effect people are prepared to remain longer in such surroundings. Brengman (2003) showed respondents photos of a shop in which the colours were manipulated. Her conclusion was that people will spend more time and money in a shop if they find the colours agreeable (Brengman, 2002). Blue and yellowish red are perceived as pleasant, as are light colours. Using these effects pave the way for approach behaviour and the desire to explore. Red and yellowish green, just like bright and dark colours are perceived as less pleasant; these colours lead to tension and stress and cause a distasteful feeling. Such negative stress leads to avoidance behaviour (Brengman, 2002). She recommends that in future research the results be tested in a conditioned environment, which after all is different than judging photos (Brengman, 2003).

**Light**

Social psychologists state that light has a tremendous influence on human behaviour. Baker and Cameron (1996), Hopkinson et al. (1966) and Küller et al. (2006) indicate that there is a basic level of how people experience light as the most pleasant. A preference for light intensity depends on the situation, the task and one’s surroundings (Biner et al., 1989; Butler & Biner, 1987; Van Bommel, 2004).

Light has a strong effect on the degree of arousal (Gifford, 1988; Kallman & Isaac, 1977; Miwa & Hanyu, 2006; Baron, Rea & Daniels, 1992; Daurat et al., 1993). Light also influences a shop’s image and the stimulus to look at and scrutinize the merchandise (Baker, Levy & Grewal, 1992; Areni & Kim, 1994; Baker, Grewal & Parasuraman, 1994, Brengman & Geuens, 2003).

**Colour and light**

Valdez and Mehrabian (1994) have shown that it is not only colour that determines the evoked emotions but also the saturation and intensity thereof. It appears, for example, that although there is hardly any difference in the way men and women react to colour, women are more sensitive to the colours’ brightness. In a study of non-chromatic colours (black-white-grey), it appeared that the brightness strongly determines their degree of stimulation and dominance (Valdez & Mehrabian 1994).
Mehrabian suggests that “brightly lit rooms are more arousing than dimly lit ones” and that light, besides colour, has a strong influence on arousal (Mehrabian, 1976, p89). From a scenario study (Babin, Hardesty & Suter, 2003), in which a blue and an orange shop were compared, it appeared that the blue shop was preferred the most and that it generated a greater willingness to shop or buy there. A well-lit orange shop was perceived as having the greatest adverse effect. However, when soft lighting was introduced to this orange shop, it became almost as well rated as the blue one. With a blue shop the effects are even more positive in a well-lit variation. The combination of light and colour seem to qualify the perceived effects quite convincingly. A restriction, however, is that this was a scenario study and its results should be tested in a realistic setting (Babin, Hardesty & Suter, 2003). Generally speaking, the studies of the effects of colour have predominantly focussed on the wavelength of the colour and hardly at all on the light intensity and the saturation of the colour (Valdez & Mehrabian, 1994; Brengman 2002). Light and colour combined have seldom been investigated.

**COLOUR, LIGHT AND TIME PERCEPTION**

Smets demonstrated how people estimate the length of an interval as being shorter after having seen a red as opposed to a blue colour (Smets, 1969). Under red light time would appear to pass more slowly and objects seem bigger and heavier, whereas under blue light time seems to pass more quickly and objects look smaller and lighter. Casinos use this information and opt for red as basic colour which excites the customers without their realizing that they are wasting a lot of time there (Singh, 2006). Research into the waiting time of downloading internet pages in various colours, with different levels of saturation and brightness, revealed that respondents felt more relaxed by particularly the bright colours and that time passed more quickly. Conversely, tension and stress when downloading seems to slow down the passing of time, which means that it is not so much the colour that plays a relevant role in raising spirits but its brightness and degree of saturation. Analogous to other studies of the usage of colour, it would appear that blue screens have a more calming effect than red or yellow ones (Gorn et al., 2004).

Markin et al. suggest that dimmed light calms customers, causing them to move more slowly through the shop, which means they can then scrutinize the merchandise at leisure (Markin et al., 1976). In order to stimulate impulse buying, Birren recommends using glaring lights (Birren, 1969, p. 91). This suggests that the shopkeeper can use the intensity of light to keep customers in the shop for a longer or shorter period of time. As pleasant and stimulating colours combined with bright lighting appears to lengthen the perceived waiting time (Baker & Cameron, 1996), it would be better to opt for softer lighting so that people do not overestimate the actual wait.

**Influence of colour and light on behaviour**
Besides the influence of colour on the emotions in the PAD model, colour and light also influence people’s behaviour in a service environment. The assumption is that the three emotions affect the perception of the station on the following aspects: crowding, perceived safety, time perception, uncertainty and behaviour. Crowding, or rather the perceived crowding, is influenced by one’s sense of control (Hui & Bateson, 1991), whereby the space is experienced as less busy when the colours have a short wavelength (Russell & Mehrabian, 1974). The perceived safety is influenced by the degree of arousal (Wilson, 1966), the perceived waiting time by arousal and pleasure (Bellizzi, Crowley & Hasty, 1983; Gorn et al., 2004; Singh, 2006), feelings of uncertainty by the degree of control (Averill, 1973; Taylor, 1994), and the eventual behaviour by pleasure, arousal and dominance (Russell & Mehrabian, 1974).

Hypotheses
On the basis of the literature, various expectations can be outlined with regard to the research findings. The hypotheses for colour:

1a On a platform, colours with a short (long) wavelength have a positive (negative) influence on the degree of pleasure, arousal, feelings of safety perceived crowding, perceived waiting time and on approach behaviour.

1b On a platform, colours with a short (long) wavelength have a positive (negative) effect on the degree of dominance and perceived crowding.

The hypotheses for light:

2a On a platform, a greater (lower) intensity of light has a positive (negative) influence on the degree of pleasure, dominance and uncertainty.

2b On a platform, a lower (higher) intensity of light has a positive (negative) influence on the degree of arousal and the perception of the waiting time.

2c On a platform, a higher (lower) intensity of light has a positive (negative) influence on the perceived crowding, perceived safety, orientation possibilities and on approach behaviour.

STUDY 1 VIRTUAL LABORATORY
Method
The effects of colour and light can be studied best by changing the colours and the intensity of light in an existing station. The disadvantage is that all kinds of interference, such as bad weather or delayed trains, can influence the results. Adapting the colour and lighting in an existing station, moreover, costs a lot of time and money (Hui & Bateson, 1992). An alternative method is thus to use a controlled environment which precludes disruptive influences. There are various possibilities: paper scenarios, a mock-up of a station, audio or visual simulations, such as photos or videos of a station (Bitner, 1990; Surprenant & Solomon, 1987; Eroglu & Machleit,
The choice was made in this study for a virtual station because it affords easy manipulation of colours and intensity of light and the respondent can find his/her way through the station at his/her own pace. This is imperative for a complex environment such as a station, because the sense of control can thus be copied as realistically as possible (Averill, 1973). The ecological validity of the use of virtual environments has already been shown (Loomis, Blascovich & Beall, 1999; IJselsteijn et al., 2000; Mania & Robinson, 2005; Riva, 2007). In sum, the findings in a copied environment are comparable with an actual environment. The advantage of a VR environment is that it also meets the recommendation of Hui and Bateson (1992) to imitate ambient sounds that strengthen the ecological validity.

**Design, participants and procedure**

The hypotheses were tested with a $2 \times 2$ (red versus blue) x (high versus low intensity of light) design, beside which also a baseline measurement was conducted (grey, high intensity of light). The experiment was carried out in the Virtual Reality Laboratory at the University of Twente (NL).

In total, 142 respondents, all students or PhDs at the University of Twente, took part in the experiment. Of these, 130 (65 men and 65 women; average age 22; range 18-29 years) questionnaires were included in the final analysis. Twelve respondents dropped out owing to either colour blindness, because they started to feel sick or because the wrong set-up had been used.

The experiment ran for four days, during which the different conditions were arbitrarily distributed among the respondents. Respondents who indicated they wished to take part in the experiment were first shown a test for colour blindness, after which they could practise navigating. Subsequently the respondents entered the VR lab where the final instructions were given. After the simulation the respondent was led to the questionnaire. Following completion, he/she was thanked for his/her time.

**Measurement instrument**

A questionnaire was used to measure station perception. First measured were several questions about the subjective time perception of time spent in the station and on the platform. The questions ‘How long do you estimate the time (in minutes)’ and ‘How long did you think this time took (1 = very long, 7 = very short)’ were asked for both the station and the platform.

- **Emotions** were measured on the basis of the PAD model (Russel & Mehrabian, 1974) whereby with a semantic differential 19 opposites were set against each other.

- The **behaviour** was measured on the basis of the ‘approach’ and ‘avoidance’ scale of Russel & Mehrabian (1974).
• The **impression of the platform** was measured on the basis of a combination of 3 scales (Bitner, 1990; Senta, 2005), whereby a 12-item scale was developed with the aid of a 7-point Likert scale.

• **Perceived safety** was measured on the basis of the standardized scale of Blobaum and Hunecke (2005). The scale comprises 5 items which measure not only the emotional state but also have a behaviour-related bias.

• **Perceived crowding** was measured with the aid of the perceived crowding scale (Harrell, Hutt & Anderson, 1980), which consists of 7 items.

• The **degree of uncertainty** was measured with the scale of Taylor (1994) whereby 4 items enquire after how calm one feels, how at ease, anxious and uncertain.

• **Affective waiting time** was measured on the basis of the shopping values (Batra & Ahtola, 1991), which measure both the hedonic and utilitarian consumer attitude with an 8-item, 7-point Likert scale.

• **The degree of orientation** was measured on the basis of 5 items on a 7-point Likert scale. The items pursued how well one could find his/her way and available information.

• One item was also included in the questionnaire to measure cognition, or rather which expectations did one have of a station and which colours and intensities of light does one deem appropriate (Babin, Chebat & Michon, 2004). This question meant presenting the respondents with pictures of 10 different situations in which 5 colours and 2 intensities of light were combined. Several manipulation checks were included in the questionnaire about the perceived colour, perceived intensity of light and the simulation. Also included were a number of demographic variables.

**RESULTS**

In order to ascertain whether there are any differences between the actual and the coloured platforms, an ANOVA test was conducted with all aspects of station perception as dependent variables, and colour and light as independent variables. The results show no significant differences, with the exception of the utilitarian consumer attitude. Time spent on the grey platform, in other words, is experienced as being more useful than time on the coloured platform.
On the basis of a multivariate variance analysis, we then looked to see if there were any main and interaction effects of colour and type of light on various aspects of station perception. Table 1 shows the results per colour and type of light for all aspects of perception. Although no main effects came to the fore with regard to either colour ($F(8, 238)=.88, p= ns$) or light ($F(8,118)=1.06, p= ns$), the analysis does show an interaction effect ($F(8,118)=1.86, p=.07$) for colour x light. The presence of the two aspects together appear to determine the scores for pleasure, the attitude with regard to the appearance of the platform, orientation and attitude to the waiting time. Figure 1 shows the found interaction effects. The results reveal two tendencies. Figure 1 shows a comparable picture for pleasure and the two attitude measurements, which is not the case for orientation. With pleasure, the attitude to the environment and the attitude to the time spent on the platform, the blue platform tends to score highest with the dimmed lighting whereas the opposite effect is the case for the red platform. In other words, with a low intensity of light one prefers blue as opposed to red surroundings. As the intensity of light increases, a shift occurs and the red environment is found to be more pleasant. The score for the three aspects of station perception is highest with the red platform with the high intensity of light; even higher than the blue platform with the lower intensity.

For orientation another tendency can be observed. On the blue platform one can orient oneself best with a high intensity of light, whereas on a red platform the most
positive results are achieved with dimmed light. The highest score, however, is achieved with the blue platform with the higher intensity of light where one can hence also orient oneself best.

From the literature it was assumed that passengers have an idea of what they find suitable and appropriate on a platform and that cognition influences the way a person assesses an environment. A large number of the respondents stated they found the blue platform with the high intensity of light the most suitable (n=40, 30.8%), followed by the grey platform with the higher intensity of light (n=18, 13.8%). Various one-way ANOVA tests show that the cognitive choice has no influence on station perception. That is to say that when one prefers blue on a platform, he/she does not appreciate that platform more than someone who has a cognitive preference for another colour.

Time perception was included as a separate aspect in this study. Generally speaking, respondents estimate their time spent on the platform as significantly longer (M=4:54, SD=1:57) than the actual time (M=3:18, SD=0:49; t(129)=-11.03, p<.00). Four univariate variance analyses with the objective and subjective time, the overestimated length of time and how the time was experienced were carried out as dependent variables. No main effect for light comes to the fore from these analyses, nor does an interaction effect for colour x light. A main effect for colour did appear,
however, for the subjective time ($F(2,121)=4.72, p=.0$), the overestimated length of time ($F(2,121)=3.36, p=.04$), and how the time was experienced ($F(2,125)=3.86, p=.00$). Post hoc analyses for the subjective time show that the time on the blue platform ($M=5:09, SD=1:36$) was estimated as being significantly longer than the time on the red platform ($M=4:28, SD=1:16$) and the grey platform ($M=4:03, SD=1:13$). No significant differences were apparent between the grey and red platform. These results can partially also be found for the overestimated length of time and how the time was experienced. With the overestimated length of time it occurred significantly more often on the blue platform ($M=1:46, SD=1:14$) than on the grey platform ($M=0:54, SD=0:51$). There appeared to be no difference between the blue and the red platform. With time perception we see a marginal difference between the blue platform ($M=4:66, SD=1:46$) on the one hand, and the red ($M=3:98, SD=1:79$) and grey platform ($M=3:86, SD=1:42$) on the other. All these results show that on a blue platform time passes relatively slower than on a grey or red one.

Owing to the novelty of the method used, various classification tree analyses were conducted to ascertain whether other influences were manipulating the results. It appeared that the frequency of playing computer games and gender indeed influence different aspects of perception, such as the degree of pleasure, arousal, uncertainty and various aspects of time. People who are used to playing computer games appear to navigate the station easier than those who without this experience. As men and women react differently to colour and light, the Dutch Railways can take this influence into account when introducing new measures.

Finally, correlation and regression analyses were performed to ascertain which aspects of perception ultimately influence one’s judgement. The evaluation of the platform is largely determined by one’s attitude to the platform. Also various aspects of time influence how one assesses the platform, including the behaviour item ‘I avoid travelling with NS as much as possible’. On discerning which factors determine the attitude to the platform, it becomes apparent that the impression one has of the platform is to a large extent dependent on the degree of uncertainty. Also the affective waiting time, or how one experiences the wait, determine the attitude as well as three items of behaviour. In order to achieve the goal of optimal station perception, it is important to anticipate feelings of safety, of uncertainty and the perceived waiting time.

**STUDY 2**

**Design, participants and procedure**

A 5 (colour: grey vs blue vs red vs green vs yellow) x 2 (light: high vs low light intensity) x 2 (time: off-peak vs peak) x 2 (kind of passenger: must vs. lust passenger) design was marked out to answer the specified hypotheses. The model, as used in study 1, was converted to an online version which was put to the NS panel.
In total 57,139 participants of the NS panel were invited by e-mail to participate in the survey. Ultimately 2,292 questionnaires were deemed fit for analysis (4%; 56.9% men, 43.1% women).

Panel members received an e-mail in which they were asked to cooperate with the survey. Respondents arrived via a link at an introduction page in which they were asked to download the software VirtuoCity 2.4, which was essential to run the virtual model. After further instructions and reading a scenario plus assignment, the respondents were redirected to the virtual station. There, they were arbitrarily presented with 40 conditions. After a minimum of 10 and a maximum of 50 respondents, the condition changed. Each respondent was assigned to one of the 40 conditions. When the assignment had been completed, the respondent was redirected to the questionnaire and on completion thanked for his/her time.

Measurement instrument
The questionnaire given to the participants after the virtual station is almost identical to the one used in the virtual lab. As the construct ‘behaviour’ proved unreliable in the first experiment, it was decided to add 3 extra items to it. Also an extra question on waiting time was added, namely ‘The time I spent on the platform was (1) acceptable to (7) unacceptable’.

RESULTS
Also in study 2 an ANOVA-test shows no difference between the baseline (grey platform) and the coloured platforms, with the exception of a marginal difference in how pleasant one has spent the time. That is to say that the time spent on the coloured platforms were experienced as more pleasant than time spent on the grey one.

In order to ascertain interaction affects between colour and light, a multivariate analysis was carried out on the various aspects of station perception with colour, intensity of light, kind of passenger and moment of measurement as independent variables. The analysis yields a main effect for brightness and an interaction effect for colour x brightness. The results for the intensity of light show a difference in the degree of pleasure (F(12,2198)=4.49, p=.03), behaviour (F(12,2198)=6.01, p=.01), and in how useful one found the time (F(12,2198)=3.11, p=.08). The results show that in more dimmed lighting people not only feel better but that they are also more inclined to approach behaviour. Moreover, they stated to have experienced the time as more useful than if they had been on a more brightly lit platform. The interaction effect was found in the degree of pleasure (F(48,8469)=1.94, p=.10), degree of dominance (F(48,8469)=2.33, p=.05), the attitude to the platform (F(48,8469)=2.55, p=.04), and the attitude to the waiting time (F(48,8469)=2.06, p=.08). The significant
interaction effects ‘dominance’ and ‘attitude to platform’ are specified in graphs 2.1 and 2.2. For both the degree of ‘dominance’ and for the degree of ‘pleasure’ the results show that colours with an extreme wavelength (blue and red) achieve the highest score with a lower intensity of light. With a platform with an medium wavelength (green), however, the highest score is reached with a higher intensity of light. With the baseline, or rather the grey platform, the intensity of light makes no difference. The results for the attitude to the platform show that the intensity of light with the blue and green platforms makes little difference. However, the red platform is deemed better with a higher intensity of light. This effect is the opposite of the yellow platform, i.e. on a platform with a yellow colour the platform is appreciated more when the light is less bright. Also noticeable here with the baseline measurement is that the intensity of light has little influence and causes no major differences. The marginal effects for the attitude to the waiting time show another picture: a platform with a short to medium wavelength (blue and green) is valued more positively than a platform with a higher intensity of light. On a platform with colours that have a longer wavelength (yellow and red) the attitude is better with less brightness.

![Figure 2 Interaction effects colour and light for dominance (A) and attitude platform (B)](image)

Also in study 2 were the aspects of time included in the research. On average respondents spent 7:09 minutes (SD=3:50) at the station, of which an average 3:54 minutes (SD=2:58) were on the platform. A t-test revealed a significant difference between the objective and subjective time on the platform (t(2244)=44,88, \(p=.00\)). The time at the station appears to be significantly longer than the actual or objective time. In order to ascertain whether the environmental or personal variables influence the subjective time factor, a multivariate variance analysis was performed with the subjective time factor of platform and station as dependent variables and type of colour, type of light, time of measurement and kind of passenger as independent variables. These analyses produce a main effect for colour and light as well as an interaction effect. The main effect for colour shows that there is a marginal difference present (F(20,7085)=2.11, \(p=.08\)) with regard to the subjective time factor of the platform between the grey (M=1.13, SD=.73) and the blue platform (M=1.22, SD=.80). This demonstrates that passengers estimate the time spent on the grey
platform as being shorter than time on the blue one. The main effect for the intensity of light applies to the time perception of the station \(F(5,2136) = 4.37, p = .04\). This main effect demonstrates a difference between the station with the higher intensity of light \((M=4.11, SD=1.52)\) and the station with less light \((M=4.26, SD=1.49)\). The time spent at the station with the lower intensity of light was perceived as being significantly shorter than at the more brightly lit station. The interaction effect, finally, influences how time spent on the platform was perceived \(F(20,7085) = 2.41, p = .05\), as well as how acceptable one found it \(F(20,7085) = 3.18, p = .01\). The graph for the perception of time on the platform demonstrates that time was perceived as being shortest on the blue, yellow and red platform when the intensity of light was higher. With the grey and green platforms, however, time was perceived to pass more quickly when the lighting was more dimmed. This inclination also applies to how acceptable one found the time. On the green platform time was more acceptable with dimmed lighting, whereas the opposite was the case on the yellow and red platforms. The grey and blue platforms show little difference between the two intensities of light. See the graphs 3.1 and 3.2 below for the interaction effects.

![Graph 3A](image1.png)  ![Graph 3B](image2.png)

**Figure 3** Interaction effects colour and light for perception platform (A) and time acceptable (B)

Besides the main and interaction effects also effects were found for kind of passenger and time of measurement. These effects complement and broaden our previous findings. Must passengers are serious and plan their journey beforehand. Consequently, this group demands fewer external stimuli. Lust passengers, on the other hand, are more relaxed, more spontaneous and whimsical, which becomes apparent from their greater need of stimuli. According to the Theory of Psychological Reversals, a desire for stimuli goes hand in hand with a preference for colour. Must passengers prefer colours with a short wavelength (blue), whereas lust passengers tend to opt for more stimulating colours, i.e. with a long wavelength (yellow and red).

Study 1 yielded influences caused by gender and the frequency of playing computer games. Playing games again appears to determine the score for various aspects of station perception. Respondents with gaming experience felt significantly more pleasure and – albeit marginal – that they had a greater sense of control over the
situation; they also scored higher for behaviour and perceived time as being spent more enjoyably. Conversely, they experienced the platform as being more crowded and felt a greater sense of uncertainty. With regard to gender it appears that men feel significantly more content, are more excited, are more prone to approach behaviour, feel more safe, feel less crowded, are less uncertain, perceive the time as more agreeable and shorter, and can orient themselves better than women. A correlation and regression analysis shows that the constructs are strongly connected. Three new constructs arose from a factor analysis: (1) the perception of the wait, comprising pleasure and arousal and the emotions regarding the (waiting) time; (2) station assessment, comprising the appreciation of both station and platform; and (3) perception of control, comprising the perceived crowding, orientation, safety and one's sense of control. The regression analysis shows that the waiting time perception strongly determines the evaluation of the station and is largely determined by the perception of control.

CONCLUSION
Although passengers have a definite cognitive preference for the colour blue in a well-lit environment, it appeared that only one third of the respondents could indicate which colour was dominant on the platform. In all situations the colour one thought to have seen most often was grey. Despite people indicating they also preferred well-lit surroundings, the results particularly show effects with dimmed situations. Apparently, passengers cling to the image they have of a platform. This confirms that colours and intensity of light are perceived subconsciously. For station evaluation, affective effects are thus more important than cognitive ones. After analysing the results per scenario, the preference for colour appears not to depend on the location but on whether one is a must or lust passenger (and thus in a hurry or not). The findings from this research support the Theory of Psychological Reversals of Walters, Apter and Svebak (1982), which alleges that people under pressure prefer cool colours and in a relaxed situation incline towards warm ones. Needing a colour thus appears to be dependent on the demand for stimuli, whereby lust passengers prefer warm colours and must passengers cool ones. Also apparent from both experiments is that women react differently to colour and light than men. This concurs with findings of other studies (Yildirim, Akalin-Baskaya & Hidayetoglu, 2007; Knez, 1995; Knez & Kers, 2000).
Both experiments also show the strong influence of waiting time perception in a station environment. Most people tend to overestimate the waiting time on the platform, as was also found in earlier research (Hornik, 1984; Moreau, 1992, Maltha 2006; Van Hagen, 2007). How the wait is rated and how useful passengers find it determine both the attitude to the platform and the impression thereof. In most situations, time in dimly lit surroundings appears to pass more quickly than when the lights are brighter. This confirms the results of Baker and Cameron (1996). In contrast to results found in the literature, time in a blue environment appears to pass
more slowly than in a red one. One explanation might be that passengers who feel stressed not only desire cooler colours but also pay more attention to the time, which makes it seem to pass more slowly (Zakay, 1989). From the second experiment it appeared that the perception of waiting time closely approaches the basic emotions as defined by Mehrabian and Russel (1974). These researchers state that the three emotions ‘pleasure’, ‘arousal’ and ‘dominance’ can adequately measure ‘a large variety of emotional states’ (Mehrabian & Russel, 1974). In the case of the station environment, feelings or emotions evoked by the waiting time can be added to these basic emotions.

The results show that manipulations in a virtual retail environment successfully allow effects with colour, light, crowding and time pressure to be demonstrated. These findings offer an initial insight into the way colour and light work in a station. However, both experiments were conducted in a virtual station which might influence the outcome. The question arises whether these findings would also be found in a real station. The disadvantages of a virtual environment, such as navigating through the space with a mouse and projecting oneself into a scenario, would thus be prevented. Further research in a real-life situation in which colours and light are manipulated can hence verify the findings.
LITERATURE:


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1 Ecological validity means that the applicability of the laboratory situation is identical to an actual situation (McKechnie, 1977).