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QUARTIER, Katelijn, CHRISTIAANS, Henri and VAN CLEEMPOEL, Koenraad

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## **Retail design:**

lighting as an atmospheric tool, creating experiences which influence consumers' mood and behaviour in commercial spaces.

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**Katelijan Quartier**, University College of Hasselt, Belgium.

**Henri Christiaans, PhD**, University College of Hasselt, Belgium.

**Koenraad Van Cleempoel**, Hasselt University Belgium.

## **Abstract**

Retail design is no new discipline, but a scientific approach is of rather recent date. Since atmosphere has been proven to have an influence on consumer's behaviour from a marketing point of view, this Ph.D. focuses on the designers' perspective. This paper addresses one aspect of atmosphere: lighting and its influence on consumers' mood and buying behaviour. Following an introduction in the discipline of retail design, we discuss the notion of 'atmosphere' and its relationship to lighting. We also develop a theoretical framework as a first part of a three-part process: literature review, experiments and validation. This first part includes the development of hypotheses and research questions. We will summarise a long tradition of research into architectural physics and psychology in both retail and work environments.

Additionally, we also attempt to describe the applied research category: research by design. The set-up of the first experiment, currently undertaken, is explained via its method (participants, instruments, procedure) with an analysis of the preliminary results. Furthermore, the second part - the experiments and a design - and the third part - the development of guidelines - are briefly described.

## **Keywords**

Retail Design; Lighting; Consumer Behaviour; Research By Design; Mood; Atmosphere

The urge for differentiation trend the shift in our economy and shopping behaviour of consumers led to a professionalisation of the discipline of retail design, its definitions and its methodology. Research showed that a retail environment can become an important factor in influencing consumers' perception and behaviour in that environment. Furthermore, within this retail environment atmospheric elements have been the focus of scientific research from a marketing point of view, but never from the experience they can create. We also see that the literature has not paid much attention to the specific role of lighting and its role in creating atmospheres. Consequently, lighting is approached as a way to create an experience that can influence, conscious or subconscious, the consumers' mood and behaviour in retail environments.

The choice to undertake this research in commercial spaces is twofold: commercial spaces are suitable environments to experiment with lighting, humans, their behaviour and emotions; furthermore, since most research has been done in office settings, there is a gap in research for retail settings, it is only logic to develop hypotheses -for retail settings- based on what is already been studied -in office settings.

## **Retail design?**

Retail design is a fast emerging discipline that has already found its way into the design world. After America, the UK is following quickly and the rest of Europe tries to catch up. Although the expression itself might not sound familiar, the practice most certainly does. We already know retail design in its most basic, primitive level for ages, such as market merchants trying to sell their products by drawing attention through clever displays that look appealing to the eye and, in case of food, look fresh. To stand out and to differentiate from the fellow merchants a market merchant also uses his voice. These simple elements are already a way to brand itself. While the market merchant nowadays and in the past, has very few resources to brand, big brands of today have unlimited possibilities. Either way, their goal remains the same: customer binding.

Although retail design is no new discipline, research into retail design is a rather recent phenomenon. We are familiar with research being done (mostly in America) in shops from a marketing point of view. Several developments led to a professionalisation of the discipline, its definitions and its methodology. A first development, for example, is the urge for differentiation. So, throughout the history of the relationship between design and marketing, one of the key roles for design has been to 'make the difference'. While looking at the merchandise carried by competitive retailers, the atmosphere in a store becomes more important when the merchandise itself is perceived as similar. Therefore, creating a unique environment can become a necessity for customer binding.

A second development highlights another shift in our economy, which makes the consumer the centre point of the attention. He is no longer seen as only a buyer of products, he is also seen as a consumer with a personality, feelings and longings. This perspective requires different (marketing) approaches and new retail concepts with more attention to the designed environment.

Thirdly, because of the rise of the experience economy and the changing shopping behaviour of the consumers, retail design has become much more complex. Therefore, retail designers have to be familiar with several disciplines, such as psychology, ergonomics, sociology and semiotics. It is of particular importance that all these elements come together in an harmonious design that meets the needs of the brand and the consumers, as shown in the figure 1.

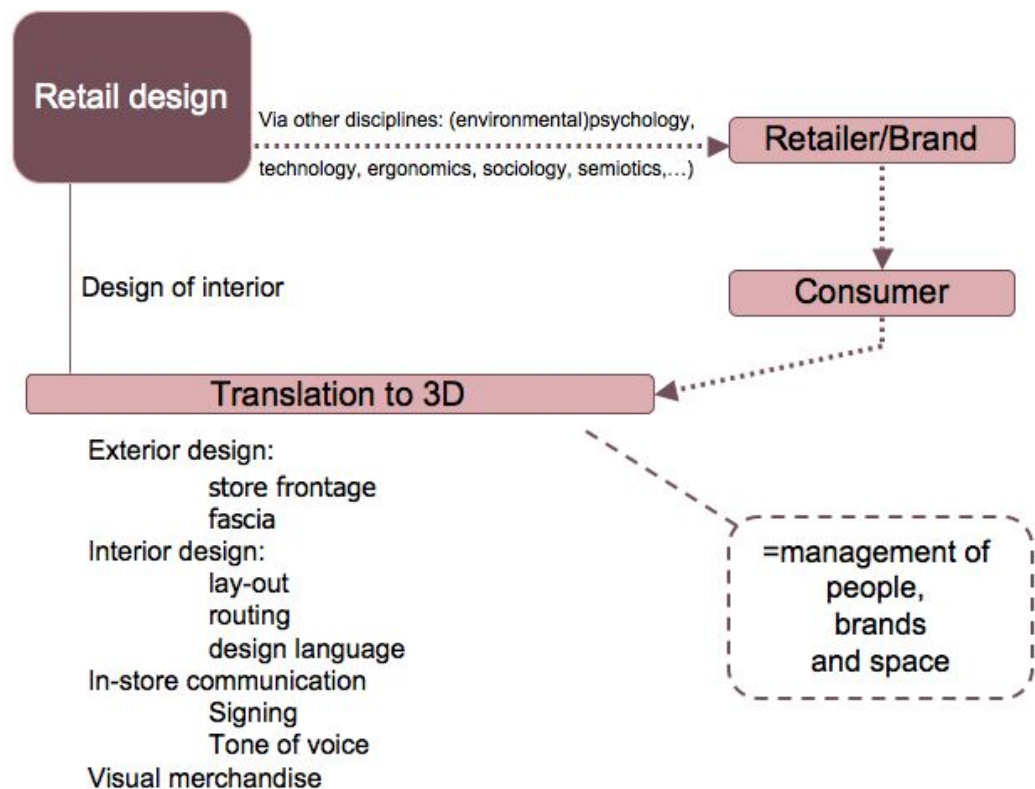


Fig 1. The complexity of retail design

## Research by design

### ***Research problem: Atmospheric tools***

Since the rise of the discipline, research in atmospherics has been at the centre of most of the scientific approach to retail design. Atmospherics was initially defined by Kotler (1973, p. 48) as "the effort to design buying environments to produce specific emotional effects in the buyer that enhance his (/her) purchase probability". He referred to a five-dimensional experience, based upon our five senses. Later research re(de)defined the term atmospherics to 'ambient factors' that emphasized sound (e.g. music), feel (environmentally based, not product based, e.g. crowding, arousal), smell (overall odour) and sight (environment related, e.g. wall colours).

Within this framework a distinction should be made between research in retail environments on a micro level and research on a molar level, based on the theory of Hull and Harvey (1989). They define micro characteristics as the physical characteristics of the environment that create a particular atmosphere, such as colour, music, light and sound. Molar characteristics are defined as "emergent properties" that result from the sum of the micro characteristics, as atmosphere is. Not much research has focussed so far on the influence of molar characteristics on consumer behaviour because of the difficulty of analyzing a sum of characteristics, which are synergetic and holistic.

Whether lighting can be framed within the definition of 'atmospherics' remains vague in research up to now (e.g. Baker, 1986). Bitner (1992) defined

lighting as an interior aspect, while Turley and Milliman (2000) include lighting in their review of atmospheric research in retail environments. Both opinions are valuable, but within this research, lighting is defined as an atmospheric tool that operates below the level of our immediate awareness and has an influence on consumers, beyond perception. Lighting, therefore, is considered as one of the micro characteristics of atmosphere. It is important to consider the holistic nature of architecture. Therefore, results of research on isolated matters such as lighting, should always be set back to its context before they can become fully supportive in the design process.

### ***Aims of the study***

The concentration lies on the influence of lighting on the physiology of the human being operating on mood and consumer behaviour through the perceptual system, beyond the conscious level. So, the association between the in-store lighting and consumer behaviour will be examined.

Bitner (1992) analysed how consumers respond to a retail environment and noted that consumers can react to a retail store in a cognitive, emotional and biological way. Our research project aims to analyse two of these aspects: the emotional factor (experience based) and the biological factor. This second factor is included as lighting also has a purely natural, physiological influence on peoples' behaviour.

So, atmospherics have been analyzed on a micro level for their influence on buying behaviour and sales numbers, but never from the experience they can create. 'Experience' as such, however, was studied from a more environmentally point of view. Therefore, the goal of this study is to develop guidelines for designing lighting in the retail environment from a designers' perspective.

### ***Methodology***

As mentioned before, there are three parts in this study. To develop a theoretical framework and to provide a broader look on the research matter the first part included in depth interviews with selected experts (1) and a survey of the literature (2). As a result, certain hypotheses and a research model were developed (3), as well as an exploring experiment (4).

1. In depth interviews with twelve selected experts in Belgium and the Netherlands, all with a different background, were conducted.
2. A theoretical framework that included a wide scope of all aspects of retail-interior design was inducted. So far, no research has been dedicated to the influence of lighting on consumers' mood and behaviour in retail settings. Therefore a thorough literature review conducted in the area of lighting in architectural places was necessary. It builds on a long tradition of investigation into lighting in architectural physics and psychology to outline the theoretical framework. Because of the scarce literature in commercial spaces, this body of knowledge forms a huge step in this Ph.D. research and forms a key component. Evidently, the Ph.D. dissertation will be valued for 50% of the Ph.D. programme.

3. The hypotheses are developed based on existing literature on mood, consumer behaviour and lighting. Each of those three has been the topic of research, but a connection between them has never been exploited.

4. The exploring experiment will help to get a grip on the impact of lighting on product choice. It also will help to determine the lighting that will be tested in our lab.

The second part contains experiments in a controlled environment and in real shop environment. These experiments are largely based on qualitative research. With a 'controlled environment', we refer to the construction of a retail lab at our campus. Although the design enhances flexibility in use and purpose, for this study, the lab will be set out as a mini-supermarket. We expect to produce results with strong internal validity, but with limited external validity. Therefore, experiments in a real shop environment will be conducted in cooperation with a retailer.

Finally, the third part will be the development of guidelines for lighting design in commercial spaces, based on the results of the experiments. Eventually the thesis will present sets of design parameters to assist retail designers as well as other stakeholders.

### **3. Theoretical framework**

#### ***Interviews***

The following selection was made: four lighting developers of four different lighting manufacturers (two Belgian, a Dutch and a German company); three independent retail designers (a Dutch and two British designers); two independent lighting designers (active in Belgium and the Netherlands), two designer of large retail businesses (a Belgian supermarket and a Dutch department store) and finally, one Belgian theatre lighting designer. This empirical study provided a broader look on how lighting is applied in retail spaces and how this research can be an added value to the design process of retail lighting. The results show that there is a need for scientific development for lighting in food retailing. Even more, lighting is acknowledged to have an incremental added value to the retail environment, store branding and maybe even customer binding. Some other interesting conclusions are drawn from the interviews: the difference between the way a lighting manufacturer thinks and how independent designers think. Manufacturers tend to believe in the amount of lux and try to avoid shadows in retail spaces. Designers –retail or lighting- approach lighting more in terms of spheres and they try to create tension between 'darkness' (rather shadows) and light.

#### ***Literature review***

##### **Atmosphere?**

As mentioned before, a theoretical framework that included a wide scope of all aspects of retail-interior design was included. There seems to be a lack of studies that focus on the experience which atmosphere can create. 'Experience' as such, however, was studied from a more environmentally

point of view: their influence on buying behaviour and sales numbers. These studies show that shop environments create 'retail experiences' that strongly influence consumers' purchase behaviour (Babin & Attaway, 2000; Moye & Kincade, 2002; Sherman, Mathur & Smith, 1997). Moreover, keeping shoppers longer in stores is likely to result in increased browsing behaviour, which in turn is likely to cause increased impulse purchasing (Beatty & Ferrell, 1998). Some research even suggests that up to two third of purchase decisions are made in stores (POPAI, 1998). This strongly suggests that retail environments can become an important tool, it can even have as much effect on the consumer as the quality of the goods themselves (Inman & Winer, 1998; Underhill, 1999). So, the importance of good shopping environments can no longer be denied. Positive shopping experiences will lead to satisfied consumers, who in the long run will stay loyal. But also, negative shopping experiences can lead to quite severe negative consequences: most consumers do not complain when dissatisfied, they just shop elsewhere.

The marketing has focussed on atmosphere via its micro characteristics, more specific on the environment-emotion link (Lam, 2001; Massara, 2003; Ng, 2003). Big contributions are made in the study of, for example, music in relation to the volume of purchases made (Hui, Dubé, & Chebat, 1997; Millman, 1982); the relation between colour and the approach and avoidance behaviour (Breneman, 2002); also the affect of odour on time spent in store (Spangenberg, Crowley & Henderson, 1996), and the relation between crowding and shopping satisfaction (Machleit, Kellaris & Eroglu, 1994). Turley and Millman (2000) give a complete review of the influence of atmospherics on consumer behaviour. They concluded that the individual atmospheric variables were shown to have a demonstrable affect on the outcome of evaluations (e.g. store image, judgments of brands, quality of merchandise), of perceptions of price and behavioural responses such as time spent and 'impulse buying'. Several years earlier Tai and Fung (1997) already noticed, in their literature review, two important patterns: atmospheric elements have been proven to have a variety of physical and physiological effects on people which in turn will affect consumer behaviour. They suggest when these elements are skilfully manipulated, they will lead to consumer behaviour favourable for the retailer.

### **See the light**

Many design features -either individually or integrated- exert influence on behaviour in retail environments. Although every aspect of the atmosphere deserves special attention, this paper is limited to the factor 'lighting' and its relationship to the consumer.

When reviewing the literature regarding the influence of lighting in retail environments, several aspects have been studied from a marketing point of view, not from the experience they can create, as mentioned earlier. Boyce (2004) concludes the same by highlighting in his review of lighting research that we are not so well endowed with knowledge of lighting research on a more experience-based level: how do people perceive a lit space, how do they react emotionally and physically? Do they do this with or without the interference of cognition? These questions count for both workspaces and retail environments and form the basis for this study. Moreover, researchers

have demonstrated increased interest in what is called the indirect effects of lighting – the impact of lighting on mood, arousal and consumer behaviour.

So, a first apparent aspect in the literature on lighting retail environments deals with consumer behaviour on a very basic level: people are drawn to light (Taylor & Sucov, 1974). A second aspect handles on a more product-based level, which in turn also influences people's behaviour: light can draw attention to products (LaGuisa & Perney, 1974); Under 'bright lighting' conditions products are more often examined and touched than under 'dim lighting' conditions (Areni & Kim, 1994; Summers & Hebert, 2001); lighting influences the attractiveness of products in a store (Magnum, 1998). So, products under high light levels were found to be more appealing than products under lower light levels with the same spectral distribution. Along the same line, Summers and Hebert (2001) showed that more belts were touched and picked up with the addition of display lighting. Subsequently, they conducted consumers spent significantly more time at the display with the additional accent lighting. A third aspect regarding light in retail environments comes from an environmental psychology based model (Mehrabian & Russell, 1974), which proved that emotions, evoked by shop environments, are related to consumer behaviour, and one step further, to buying behaviour. But Mehrabian and Russell only make assumptions specifically about the lighting and remain very vague about its possible influence on emotions and consumer behaviour.

There are two American studies that tried to isolate the influence of lighting on a company's profit (Boyce, Lloyd, Eklund & Brandston, 1996; Cuttle & Brandston, 1995). Both were conducted in real retail environments: Cuttle and Brandston (1995) studied the link between lighting and profit via the influence of energy-efficient lighting in two furniture stores; Boyce et al. (1996) studied the link via the effect of new and approved lighting on sales performance of a supermarket. Since the aim of this research project is also to connect the influence of lighting to sales numbers, an analysis of the methodology, used in the American studies is essential.

Cuttle and Brandston partly changed the old lighting, existing out of filament spotlights, of two furniture stores into a more energy-efficient solution. The general strategy was to provide ambient lighting by applying indirect light with the use of fluorescent lamps. Halogen lamps were used for accent lighting. Next to the monitoring of the energy and the sales numbers, small questionnaires (only 4 questions) were spread among consumers and employees. During a five-month period the sales and energy bills of selected furniture lines were compared: the sales figures of the previous year of the furniture line displayed under the old lighting were compared to the five-month period sales figures of the furniture installed under the new lighting. Although the energy costs decreased with 25 percent in both stores, there was an increase in sales of 35 percent for only one of the two furniture stores. Furthermore, customer and staff attitudes were reported as positive. These seem promising results but there are some methodological flaws: the low-volume/high price nature of the merchandise; influence of trends and season during the time span; and different furniture displays. Nevertheless, this research was an important step forward in establishing a correlation between



lighting and profit in a retail environment, with its methodology was too weak to make a strong case.

The second study, conducted by Boyce et al. in an independent supermarket, aimed at measuring lighting on the atmosphere it can create. The impact of lighting was measured via consumer opinions and merchandise sales. A questionnaire was used among consumers, one before the lighting modifications and one after the lighting modifications. The questions handled specifically about lighting and the influence it had on the perception of the space. The results show that consumers considered the new lighting as making the store look brighter, more comfortable and more pleasing to the eye. Unfortunately, more than just the lighting was renewed: a total remodelling of the bakery including daylight through skylights. Sales increased significantly, as well as the number of items sold in the bakery. The sales figures of the rest of the products showed no difference. The authors acknowledge this might be due to the small impact of the new lighting system, placed in the rest of the supermarket. More lux was projected on the products, but this had no influence on the perception of the space.

This study also tried to quantify the benefits of good lighting. Although the sales figures of the bakery are clear, the methodology used is again questionable. It would be incorrect to connect the increase in sales solely to the lighting as it concerns a complete redesign of the interior. Moreover, asking consumers about the lighting before and after the renewal is only preference based.

### ***Hypotheses development***

Several statements, derived from research in work related environments form the basis of the development of the first hypotheses:

- It is explained how moods influence the way people think and the way they behave (Babin, Darden & Griffin, 1992; Clark & Isen, 1982; Donovan & Rossiter, 1982; Isen, 1987; Isen, & Baron, 1991; Sherman, Mathur & Smith, 1997)
- It is known that the visual environment as well as the atmospheric elements, are able to influence the mood of people (Babin & Babin, 2001; Babin & Darden, 1995; Baron, Darden & Griffin, 1992; Belcher & Kluzny, 1987; Brengman, 2002; Brengman & Geuens, 2003; Donovan & Rossiter, 1982; Dubé & Morin, 2001; Greenland & McGoldrick, 1994; Rook, 1987; McCloughan, Aspinall & Webb, 1998; Sherman et al, 1997).
- Lighting is an atmospheric element of the environment as explained before.

So, the interior design and within that, the lighting, may become an important actor to induce the right mood for increasing buying intentions and shopping experience in general. Consequently the next main hypothesis is stated:

*H1a: Lighting has an influence on the mood of consumers in retail environments.*

Gardner's review (1985) revealed that there is a direct and indirect link between mood states and behaviour:

*H1b: Lighting has an influence on the people's behaviour as measured by their purchase behaviour.*

Lighting manufactures specialized in retail lighting claim lighting has an influence on the preference of product choice. Therefore, a sub-hypothesis is developed to test this wide spread adopted theory:

*H1c: Lighting has an influence on people's product preference in retail environments.*

It is proven positive affect, of any kind, encourages a shopper to stay longer in store (Dawson, Bloch & Ridgway, 1990; Hui & Bateson, 1991). As mentioned above, lighting can induce positive affects. So, the next hypothesis is stated:

*H2: Lighting has an influence on people's behaviour as measured by the time people tend to stay in the shop.*

Sherman (Sherman et al, 1997) found that positive moods were correlated with spending levels. Clark and Isen (1982), and Gardner and Siomkos (1985) argue that consumers experiencing a positive mood are more likely to make mood- congruent evaluations of their surroundings. Kahn and Isen (1993) even suggest that positive affect encourages the subjects to seek more variety among products in a store. Furthermore, since staying longer in a retail environment increases browsing behaviour as mentioned above:

*H3: Lighting has an influence on people's behaviour as measured by the sales numbers of the retail environment.*

## **Research model**

To map all influences lighting might have on consumers in retail environments, a model is developed which brings all aspects together (Figure 2). Considering and comparing previous studies regarding human (consumer) behaviour, mood and environmental psychology- lead to model used. Here is a brief survey:

There has been one study, that found no direct influence of lighting on mood, but it only reported a difference between the perceptions of the light in the room (Knez, 2001). An earlier study shows the same contrasting results (Baron, Rea, & Daniels, 1992). Knez indicated that these results and the divergent results of his previous studies as well, might be inconsistent by the use of an inferior measuring model. He points to a need for more precise and sensitive models to measure the influence of lighting on mood. When reviewing the methodology used in both studies, the same method to measure mood is exploited, namely the PANAS (Watson, Clark & Tellegen, 1988) -a self-report of positive and negative mood method. Both researchers also acknowledge this method might not be effective for mood-measurement in lighting research. Furthermore, Knez emphasized the problem of today's psychological lighting research: we still do not know if the light effects cognition via emotion or if the light effects emotion and cognition independently.

Therefore it is necessary to measure both mood and behaviour (buying-, approach and avoidance-). Based on the SOR-model – stimuli, organism, response - of Mehrabian and Russell (1974), mood and behaviour are measured via observation, time measurement, products bought and mood

measurement (PAD-model – pleasure, arousal, dominance - of Donovan and Rossiter (1982)). Figure 2 shows the model used.

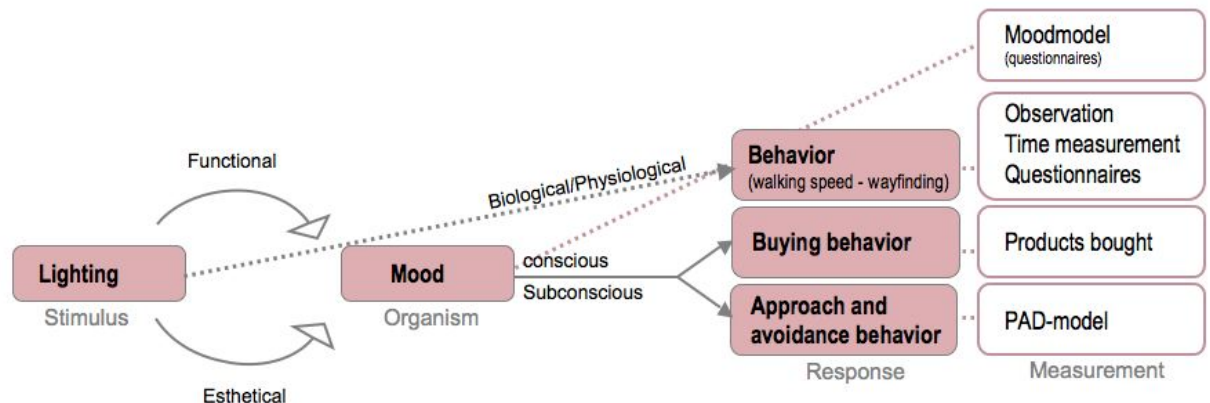


Fig 2. Conceptual model developed based on the SOR-model of Mehrabian and Russell (1974)

### Exploring Experiment

A small empirical experiment is set-up and currently executed, to do a first test of our hypotheses -H1c. This experiment will in addition help determining the lighting that will be used and tested in our lab.

To analyse the impact of lighting on product choice several criteria, which play a role in costumer's product choice, are developed: freshness, attractiveness, appetite and price perception. Furthermore, literature on lighting design in workspaces shows a difference between gender and age. These criteria, fortified with extra personality characteristics are taken into account for further analysis.

### Method

**Participants:** this experiment is firstly carried out in The Netherlands and subsequently in the Flemish speaking part of Belgium because both countries are similar in economy, language and retail landscape. But whether the Dutch and Flemish consumers also show the same consumer behaviour, is tested.

60 people in the Netherlands, 30 woman and 30 men, aged between 18 and 55 participated in a computerized test. Furthermore, their education level, their shopping frequency and the places where they shop for groceries (market, specialised stores, supermarket...) are used for further analysis. A similar representation is currently tested in Belgium.

**Instruments:** six different products (apple, lettuce, orange juice, bread, meat and paprika) were photographed under eight different lighting types. Figure 3 shows two examples. The lighting is determined via the help of experts in the field: halogen (50 Watt); TL (TL830 and TL840, both 36 Watt); high-pressure discharge metal halide lamps (CRI 830, and CRI 942, both 50 Watt); high-pressure discharge sodium lamp (CRI 825, 50 Watt). Both high-pressure discharge lamps are also tested with a red filter, used for lighting meat. All lights were placed at a distance of 70 cm above the displayed product. The photographs were taken with professional help.

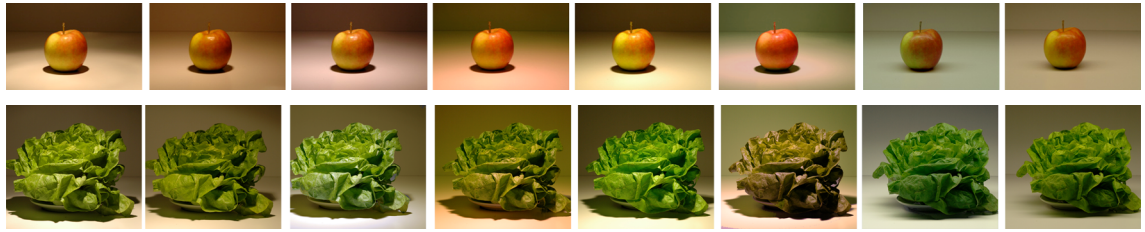


Figure 3. Apple (used for the pilot study) and lettuce under eight different lighting conditions: halogen, CDM 830, CDM 942, SDW 825+red filter, SDW 825, CDM 942+red filter, TL840, TL830 (all Phillips light bulbs).

Procedure: without knowing what the experiment is about, the respondents are asked to rank the photographs in an order of favour regarding the developed criteria (freshness, attractiveness, appetite and price perception). Two images of the same product are shown at the same time. So, when viewing each pair, the respondents are asked to choose which product meets best the developed criteria. When they cannot see any difference, or both types of light are equally preferred, the respondents can opt to select the option 'no preference'. A computer programme was designed to include a random generator that shuffles the combinations of the pictures randomly. The programme also makes it relatively easy to save the results accurate and ready for analysis.

### Upcoming results

When all photographs are viewed and ranked, an analysis is made for each product. Because of the ranking system, it can be identified which type of light gained most preference for which product. Furthermore, by importing all results in excel it is possible to connect the personal characteristics with the results. With the help of statistics, an analysis will be conducted. We look for preferences in relation to, among others, gender, age, level of education.

The analysis of the pilot study, tested with 10 respondents, showed us which adjustments are necessary to fine-tune the experiments. Although the analysis is not complete, an interesting difference between the lighting conditions that gain preference to light a specific product is already pronounced in the preliminary results. The analysis of the actual results –which is currently finalised– will be presented in the conference presentation.

### Discussion

Although there are no analysed results yet, there are some interesting points to make. A first aspect is rigour: photographing lighting, as done in the first exploring experiment, remains questionable. Although every effort to create similar lighting conditions (Wattage, brightness...) is undertaken, it is still difficult to catch the light with a lens of a camera in the same way it reaches the lens of the eye. Anyhow, the results can be used to guide the further development of the experiments in our retail lab.

A second aspect handles 'ethics'. For this and the following experiments: the researcher must be aware of the ethics that come along with experiments where variables are manipulated to influence the consumer. The ethical

criteria must be respected and the respondent must be informed of his/her participation in an experiment.

While conducting the experiments a third aspect became clear which confirms our suspicion: consumers are not aware of differences in lighting. Because the respondents did not know the experiment was about lighting, they found it quite often difficult to choose between the two options displayed. After the completion of the test, our researchers asked for their perception of the test. Most people indicated that it took them some time to realise that the objects were all the same and that the difference came from the different lighting sets.

At this stage it is too soon to pronounce any definite conclusions about the influence of lighting on consumers' mood and behaviour. What can be stated is that via the literature review and the interviews the importance of lighting in retail settings became quite clear.

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### **Katelijin Quartier**

Formerly an interior designer, graduated in Belgium, she specialized in retail design at the Piet Zwart Academy (Rotterdam) in association with Plymouth University, where she got her Master of Arts degree. After worked in Belgium, The Netherlands and London, in several retail design offices, she now turned to scientific research. Next to being a Ph.D. candidate in Architecture at the University College of Hasselt, she also teaches retail design at the interior design department –both theory and practice– for 50 percent of her time. Her research and teaching are both in line with one of the focus points of the Academy, where her duty lies in expanding and supporting research in retail design for both Master students and other research projects of the research group Arck. Furthermore, she also teaches a course at the Piet Zwart Academy in Rotterdam (research methodology).

After ending the first stage of the Ph.D. research, she began publishing in several national journals and actively participated in several national symposia, with several international symposia coming up.

### **Henri Christiaans, PhD**

As associate professor working at the Faculty of Industrial Design Engineering of University College of Hasselt, he graduated at the Faculty of Psychology, University of Amsterdam. His major in MSc. was in the area of research methodology. He received his PhD at the Faculty of Industrial Design Engineering, Delft University, on the topic 'Creativity in Design: the role of domain knowledge in designing'.

Furthermore, as Head of the Master Programme Integrated Product Design, Faculty of Industrial design Engineering, TU Delft, he is also teaching in several areas: Research Methodology (BSc), Applied Research Methods and



Techniques in Design (MSc), and Design Didactics (MSc, optional course). He is, moreover, a visiting professor at the University of Dar es Salaam in Tanzania, the Korean University of Technology in South Korea, and the Faculdade de Arquitectura de Lisboa, Departamento de Arte e Design in Portugal.

The areas of research he is active in are (with quite a number of publications): Creativity in design, Information processing in conceptual design, User cognition in product operation and Cultural diversity.

The special assignments he obtained are: Editor-in-Chief of the Journal of Design Research, and being a member of the board of Management PATON B.V. Postgraduate Technical Courses.

### **Koenraad Van Cleempoel**

Koenraad Van Cleempoel supervises this Ph.D. research and is establishing a retail research center at the department of interior architecture at the university college of the Hasselt University (Belgium).