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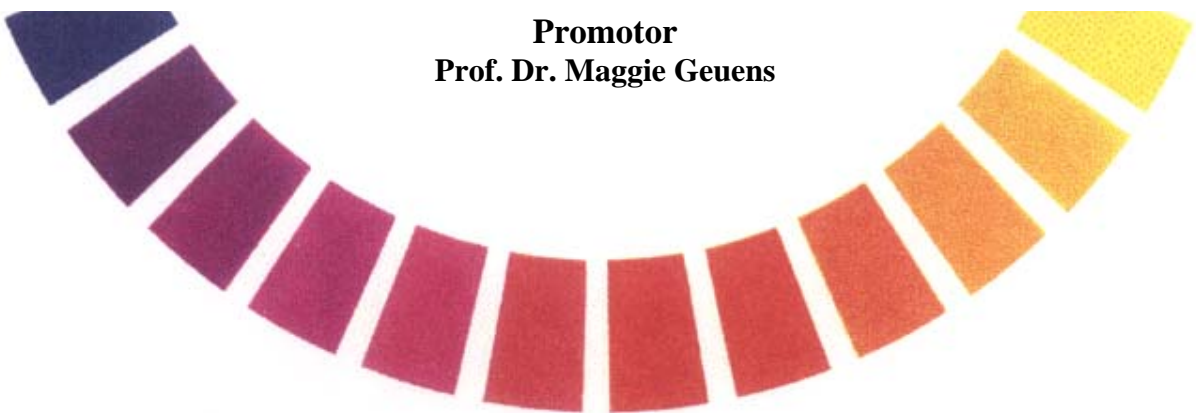


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**The impact of colour in the store environment.
An environmental psychology approach.**



**Promotor
Prof. Dr. Maggie Geuens**

DOCTORAL DISSERTATION

**submitted to the Faculty of Economics and Business Administration
in candidacy for the degree of Doctor in Applied Economic Sciences**



The Impact of Colour in the Store Environment



***The Impact of Colour
in the Store Environment***

Preface and Acknowledgements

“Time is God’s way of making sure everything doesn’t happen at once...”

Anonymous

However, there are times that everything has to happen at once. At such times you lock yourself out, you cut yourself loose from the world around you, but paradoxically, at the same time you also come to appreciate the people around you the most. The last six months of this research endeavour have been such a time for me. Studying environmental psychology, I acknowledge the importance of my environment, which has been very supportive to me during the tedious process of accomplishing this dissertation. Therefore, I would like to thank everyone around me, my friends and colleagues, my neighbours, my family and especially my parents and Gunter, my partner, for being there, for their good cheer, for their understanding and moral support, for their love and care...

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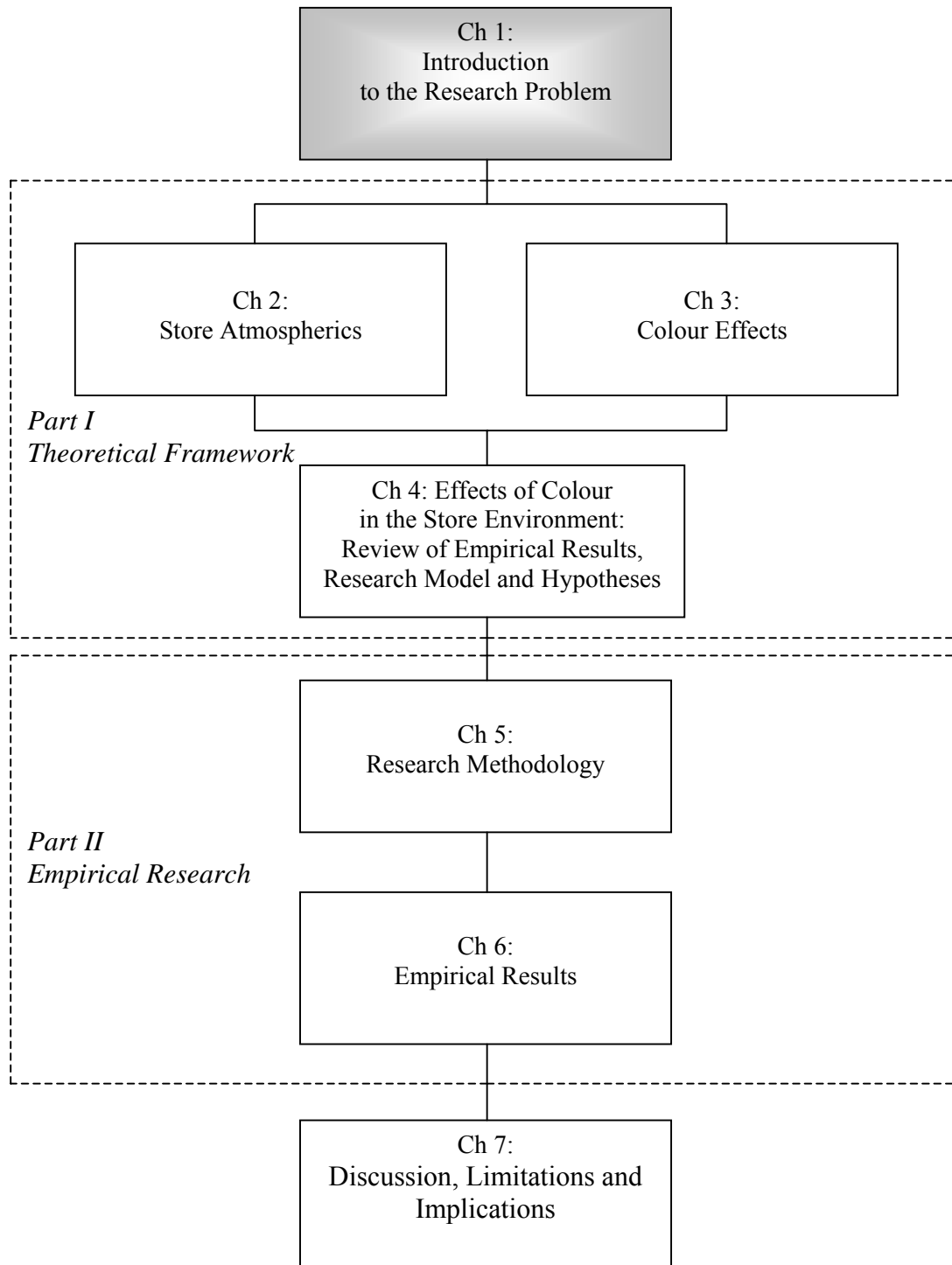
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Chapter 7

Discussion, Limitations and Implications

Chapter 1

*Introduction to
the Research Problem*



CHAPTER STRUCTURE

Chapter 1: Introduction to the Research Problem

- 1.1. Introduction
- 1.2. Research Justification
 - 1.2.1. Importance
 - 1.2.2. Shortcomings of Existing Research
- 1.3. Research Objective
- 1.4. Methodological and Empirical Contributions
- 1.5. Structure

1.1. INTRODUCTION

In this doctoral dissertation the impact of colour in the store environment is examined, applying an environmental psychology approach. This initial chapter is devoted to the introduction of this particular research problem. In section 1.2., a justification for this study is provided. First of all, the importance of the store environment in affecting in-store consumer behaviour is outlined in paragraph 1.2.1. Next, in paragraph 1.2.2., the shortcomings of existing research with regard to the effects of colour in the store environment are assessed, as well as the shortcomings with regard to the prevalent colour-affect research in general. Moreover, the need to study colour in context is emphasized. Subsequently, section 1.3. proposes the resulting research objectives and in section 1.4. the consequent methodological and empirical contributions of the current study are presented. Finally, in section 1.5., the structure of this study is depicted.

1.2. RESEARCH JUSTIFICATION

1.2.1. IMPORTANCE

The recent finding that more than two thirds of purchase decisions are made in the store (POPAI Europe, 1998) has evoked a renewed interest for “*Place*”, a long neglected instrument in the marketing-mix. The ‘place’ where a product is bought or consumed is, according to Kotler (1973), one of the most significant features of the ‘total product’. Three decades ago, Kotler (1973) introduced the term ‘*atmospherics*’ to describe “*the effort to design buying environments to produce specific emotional effects in the buyer that enhance his(/her) purchase probability*”. He identified ‘atmospherics’ as a highly relevant marketing instrument for retailers and argued that ‘*spatial aesthetics*’ should be consciously used by marketing planners. Markin, Lilis and Narayana (1976) also acknowledged that the store environment can be an important element affecting and shaping in-store customer behaviour. Kotler (1973) contended that, as other marketing tools become neutralized in the competitive battle, ‘atmospherics’ would be likely to play a growing role in the unending search of firms for *differential advantage*. More recently, Bitner (1990) confirms that atmospheric planning can make the difference between a business success or failure. The effect of the store environment on retailer performance, has actually been demonstrated by Kumar and Karande (2000).

In fact, there has been a growing recognition among practitioners and marketing researchers that store interiors and exteriors can be designed to create specific feelings in shoppers, that can have an important cueing or reinforcing effect on purchase (Donovan and Rossiter, 1982; Grossbart et al., 1990; Donovan et al., 1994; Greenland and McGoldrick, 1994; Sherman, Mathur and Smith, 1997; McGoldrick and Pieros, 1998; Babin and Attaway, 2000; Babin and Babin, 2001; Dubé and Morin, 2001; Moye and Kincade, 2002; Sweeney and Wyber, 2002; Retail-Update 2002; Cahan, 2002). In the last two decades, there have been many studies concerning store atmospherics based upon environmental psychology and specifically on the Mehrabian and Russell (1974) Stimulus-Organism-Response model, which has first been applied to the study of store atmosphere by Donovan and Rossiter (1982). In this context it has been proposed that approach/avoidance behaviours of customers are largely determined by individual internal (cognitive, emotional and physiological) responses to the store

environment (Bitner, 1992). The accumulated empirical evidence, as reviewed by Turley and Milliman (2000), clearly shows that shoppers can be induced to behave in certain ways, based on the atmosphere created by retail management. Out of 28 articles examining the effect of the atmosphere on sales, cited in their review, 25 found some significant relationship between the environment and customer purchasing behaviour. The review presented by Turley and Milliman indicates that atmospheric variables influence a wide variety of consumer evaluations and behaviours. Turley and Milliman (2000, p209) conclude: *“Although there may be some debate about whether the atmosphere can influence time spent in an environment, there is enough evidence to be able to clearly state that the atmosphere has an effect on consumer spending and that variations of atmospheric variables affect the amount of money people spend and the number of items they purchase”*. Consequently, the current study aims to add to this increasingly important stream of research.

1.2.2. SHORTCOMINGS OF EXISTING RESEARCH

Intuitively aware of the importance of the store atmosphere, store managers invest huge amounts redecorating their stores. In order for them to invest their money wisely, it is of the utmost importance first to develop a comprehensive understanding of how stimuli from the store environment affect the consumer. In this context Kotler (1973) first called the attention to the great need for further research into the subject of optimal atmosphere. One particular research question he found important to be investigated was how different atmospheric elements work and what messages are communicated by particular colours, sounds, odors and textures (Kotler, 1973). Although many atmospheric variables have been extensively examined, Turley and Milliman (2000) draw, in their suggestions for further research with regard to atmospheric effects on shopping behaviour, the attention to store interior colour, which has not received the attention it probably deserves. In fact, research on the impact of colour in the store environment appears to be scarce and methodologically flawed. Although it has been demonstrated that environmental colour can actually influence the emotions, beliefs, attitudes and behaviours of retail shoppers (e.g. Bellizzi et al., 1983; Middlestadt, 1990; Bellizzi and Hite, 1992; Crowley, 1993), it is still unclear how exactly colour affects approach behaviour. This is a critical shortcoming, especially since store-interior-colours, which could, in practice, be easily adapted at minimal costs, have been proven to be a potentially influential store-design element.

Nevertheless, studies on the subject appear to be flawed, because they failed to provide adequate specifications and controls of colour stimuli, a caveat noted to be common among colour research (Gelineau, 1981, Beach et al., 1988; Valdez and Mehrabian, 1994). Indeed, colour stimuli have not been specified according to a standard colour system, but only vague verbal descriptions have been reported. For exact specification, colours should be described with respect to three different colour characteristics, namely hue, saturation and brightness, where hue refers to the pigment contained in the colour; saturation (or chroma) identifies the richness or purity of the colour (with lower saturation colours containing more grey) and brightness (or value) signifies the depth of tone in the colour or its black-to-white quality. However, in previous studies hue effects have been tested, without controlling for saturation or brightness, this way confounding the effects of the three colour attributes. Moreover, only effects of colour-hue have been investigated in a retailing context, whereas effects of saturation and brightness have been ignored completely. Yet, these neglected colour dimensions may very well be the major determining factors in colour effects on human feelings and behaviour (Valdez and Mehrabian, 1994; Gorn et al., 1997). In fact, Bellizzi, Crowley and Hasty note in their 1983 paper that the fully saturated colours used in their study may be too strong for many design applications and that it still has to be determined whether less saturated versions of these colours would have similar effects. Up to now, however, this simple question still has not been investigated. Indeed the scarce research on the topic published thus far, focused on the effects of hue, without considering effects of brightness and saturation and worse, not even controlling for them. Also Bellizzi and Hite (1992) call for further research into the area in order to develop an understanding of how colour may affect consumers. Bellizzi and Hite also suggest to study the effects of ‘other’ colours, as up to now mainly red and blue seem to have been investigated. They also call for further research with respect to ‘other’ reds and blues, referring to reds and blues with different value and saturation levels, because studies thus far only focussed on fully saturated hues.

Most previous colour research is based on consumer evaluations of colour chips. However, due to several methodological caveats much of this general research on colour and affect has also been noted to be weak (Gelineau, 1981; Beach et al., 1988; Valdez, 1993). Valdez and Mehrabian (1994, p394) point out that “*despite the substantial body of experimental work in this area, results have failed to provide a thorough and general characterisation of relationships between colour and affect*”. According to Valdez (1993), the methodological shortcomings in this regard can be grouped into two major categories. A first major area of

caveats concerns, as already mentioned, the failure of many colour-studies to provide adequate “*specifications or controls of colour stimuli*” (e.g., absence of controls for saturation and brightness, while investigating effects of hue). A second area of concern involves the failure to use sufficiently reliable, valid or comprehensive “*measures of emotional responses*” to colour stimuli. Furthermore, it is also still unclear whether findings with regard to affective responses to colour patches can be generalized to colours applied to the store interior. According to Norman and Scott (1952), judged preferences for colours presented as small chips reveal little about preferences for coloured objects or environments. Findings by Osgood et al. (1957) also suggest that colour acceptance is defined by the object with which it is associated. Arguing that colours should first be tested, applied to objects, Guilford and Smith (1959) caution their readers with regard to applying their findings to real world situations. Rather sceptical as to the effect of colour in the environment, Beach et al. (1988), point out that studying colours in isolation (e.g. colour boards or colour samples) provides us with little information, other than how a subject at that moment rates a given colour on a given scale. They also argue that colours need to be studied in context, especially in environmental contexts, and feel that even then caution must be taken with respect to the generalizability of the findings. On the other hand, Taft (1997) found few significant differences between affective ratings of colour-chips and objects of the same colour, suggesting that results of earlier colour-meaning research may be generalized and used for colour planning. However, his study did not include colours applied to the environment. Thus, as studies on colour preference and colour meaning still systematically rely on the use of colour chips, and the study of colours in environmental contexts is scarce, it remains a critical question whether preferences for and meanings of isolated colour-chips are generalizable to contextual colours, such as store colour. The current study aims to address the aforementioned caveats.

With regard to the “effects” of colours in the environment, actually, the literature seems to contain mostly anecdotal evidence, revealing a severe lack of systematic empirical research. This has, however, not restrained practitioners from applying specific colours in sports locker rooms, hospitals, jail cells, fast-food restaurants and other places, with the aim of influencing the emotional state of the environment’s occupants.

1.3. RESEARCH OBJECTIVE

The study, presented here, aims to fill this gap in an extensive stream of research concerning the impact of store atmospherics on the consumer. As research on the impact of colour in the store environment is scarce and methodologically flawed, it is our challenge to assess the impact of this store design element more thoroughly. It is our purpose to examine the different effects of store-colour hue, brightness and saturation on the emotions elicited by the store and on consumers' subsequent approach-avoidance behavioral intentions towards the store. Special attention will be devoted to the elaboration of an appropriate methodology.

In the current research endeavour we will attempt to address the vital issues discussed in the previous paragraph. Two basic objectives are contemplated. First and foremost, a more accurate methodology will be proposed for assessing the impact of colour in the store environment on shopper behaviour. Applying an environmental psychology approach, the proposed study aims to assess (1) the direct effect of colour in the store environment on the emotions experienced in the store (notably pleasure, arousal and dominance) and (2) the direct and indirect effect of colour on consumers' approach/avoidance behaviour through the store colour-evoked emotions. In particular, the specific effects of colour hue, saturation and brightness in the store design will be investigated. Moreover, the moderating impact of two demographic characteristics, age and gender, with regard to atmospheric responsiveness will be assessed.

Although Bellizzi et al. (1983) hoped that their initial study would serve as a catalyst to encourage additional research interest in the role of colour in retail store management, they did not have many academic adherents. With this research project we hope not only to gain a deeper understanding of the effects of colour in the store environment, but also to generate some revived academic interest into the subject.

From a more practical point of view, this research is intended to assist retailers in selecting and avoiding certain colours in order to produce desired consumer moods and in-store behaviours. We are convinced that the retailer as well as the consumer may profit from such research, as it could lead the way to better-designed store-interiors.

1.4. METHODOLOGICAL AND EMPIRICAL CONTRIBUTIONS

Guided by our objective to investigate the specific effects of the three colour-attributes, a three-way (hue x value x saturation) factorial between-subjects experimental design is developed. In fact, the factorial design involves eight hues, by two saturation levels (unsaturated versus saturated), by two brightness levels (dark versus light). Based on the Munsell Colour System, accordingly, 32 specific colour-tones are selected by means of a tedious procedure. These colours are applied to an experimental store environment, which has especially been developed in Computer Aided Design to serve as a stimulus in this study. Thus manipulating store-interior colours allowed us to question respondents with regard to the emotions experienced while viewing a picture of the store-interior and to tap their approach/avoidance responses with respect to the store. A total of 874 respondents participated in this study. Respondents were matched as much as possible according to age and gender, so that the moderating effects of these demographic characteristics could be investigated.

1.5. STRUCTURE

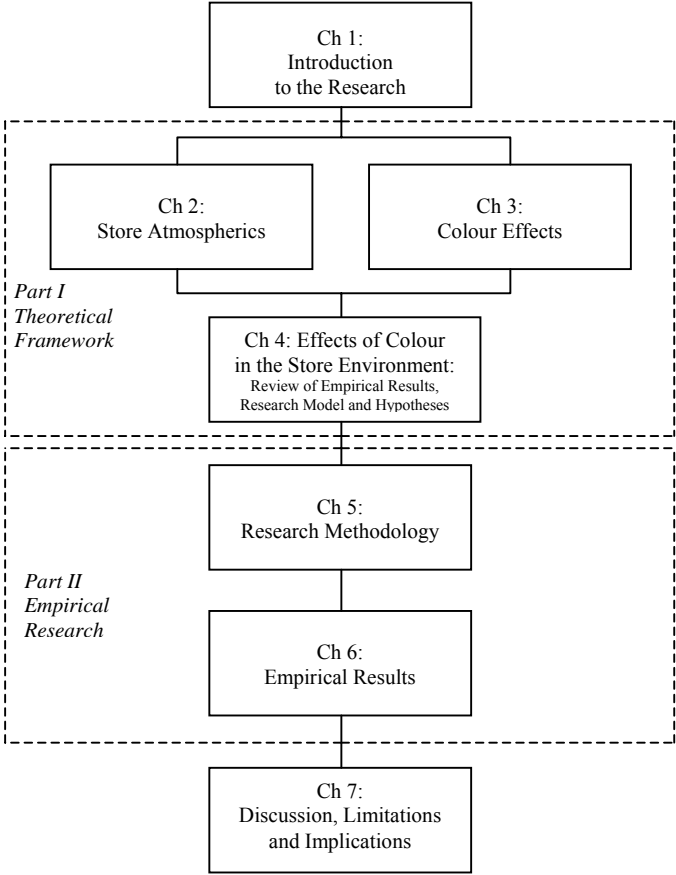


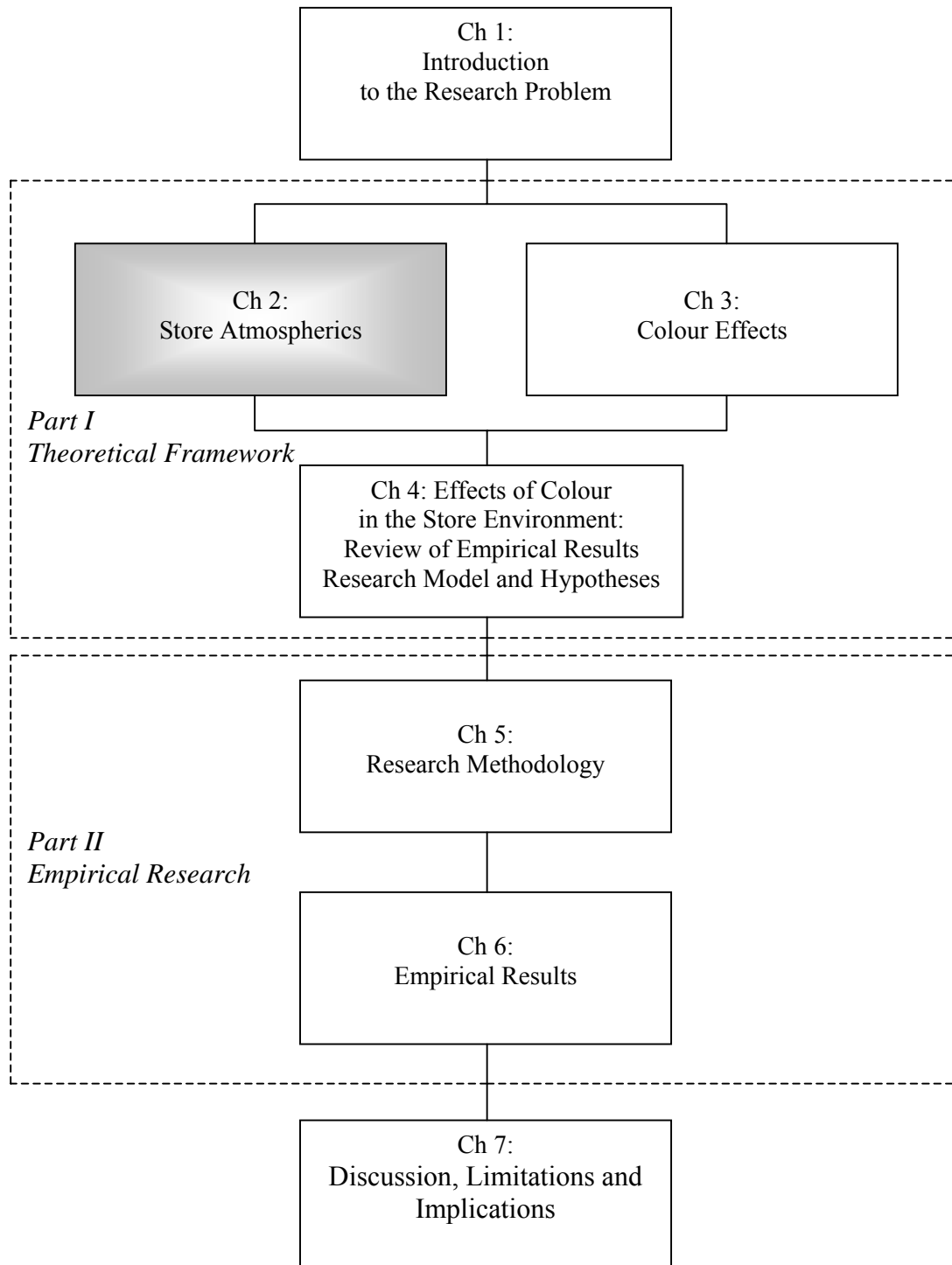
Figure 1-1: Structure of the Study

As illustrated in figure 1-1, this dissertation is composed of two main parts: a theoretical framework and the empirical study. In the theoretical framework, a background and critical review is provided with regard to ‘store atmospherics’ (chapter 2) and ‘colour effects’ (chapter 3). Subsequently ‘the effects of colour in the store environment’ will be elaborated on in chapter 4. This chapter includes, besides a review of empirical results, our research objectives, the research model and the related hypotheses. In part 2, the empirical research of this study will be presented. Chapter 5 describes the research methodology and in chapter 6 the research results will be elaborated. Finally, in chapter 7, the main results of the study will be discussed and its limitations will be pointed out. In conclusion, suggestions for several possible research avenues for the future will be provided and the implications of the findings will be discussed.

Part I
Theoretical Framework

Chapter 2

Store Atmospherics



CHAPTER STRUCTURE

Chapter 2: Store Atmospherics

- 2.1. Introduction
- 2.2. Significance of the Store Environment
- 2.3. An Environmental Psychology Approach to Store Atmospherics
 - 2.3.1. The Mehrabian-Russell Environmental Psychology Model
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- 2.4. The Stimulus: Characterizing the Store Environment
 - 2.4.1. A General Characterization of the Store Environment
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- 2.5. The Organism: Emotional Responses to Shopping Environments
 - 2.5.1. A Discrete Emotions Perspective
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- 2.6. The Response: Approach-Avoidance Behaviours in Shopping Environments
 - 2.6.1. Approach-Avoidance Behaviours : General Conceptualisation
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- 2.7. Emotional Determinants of Approach-Avoidance Responses to Shopping Environments
 - 2.7.1. The Effects of Pleasure on Approach or Avoidance Behaviours
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 - 2.7.3. The Effects of Dominance on Approach or Avoidance Behaviours
- 2.8. Atmospheric Effects on Shopping Behaviour: A Review of Empirical Evidence

2.1. INTRODUCTION

In this chapter a brief overview will be given of the store atmospherics literature. First of all, in section 2.2. the significance of the store environment will be established. Subsequently, in section 2.3. an environmental approach to store atmospherics will be elaborated. In this section the Environmental Psychology Model, proposed by Mehrabian and Russell (1974), will be introduced and the application of this model to store atmospherics will be demonstrated. Next, in section 2.4. the stimulus-part of the model will be extended to the store environment. Two general characterisations of the store environment will be proposed, followed by a classification of specific store environmental characteristics. In section 2.5. the organism-part of the model is elaborated, providing an overview of emotional responses from a discrete as well as from a dimensional perspective and extending these to the shopping experience. Section 2.6. centres around the response-part of the model, and focuses in particular on approach-avoidance responses to shopping environments. In section 2.7. the emotional determinants of approach-avoidance responses to shopping environments are examined. Finally, in section 2.8. a brief review of empirical evidence regarding atmospheric effects on shopping behaviour is provided.

*"Retail space,
i.e. the proximate environment
that surrounds the retail shopper,
is never neutral."*

MARKIN, LILIS & NARAYANA

1976

2.2. SIGNIFICANCE OF THE STORE ENVIRONMENT

Foxall (1993) comments on the “*apparent placelessness*” of the behaviour that many models of consumer choice seek to explain, hereby emphasizing the need to integrate environmental influences. Indeed, Kotler (1973) stresses that atmospheres should not be ignored, since they are a subtle factor present in every buying situation. Markin, Lilis and Narayana (1976) agree that the store environment itself should not be ignored as an important element affecting and shaping in-store customer behaviour and point out that “*retail space, i.e. the proximate environment that surrounds the retail shopper, is never neutral.*” According to Philip Kotler (1973) the ‘place’ where a product is bought or consumed is one of the most significant features of the ‘total product’. He argues that in some cases, the place and more specifically the ‘*atmosphere*’ of the place, is more influential than the product itself in the purchase decision and that the atmosphere may even be the primary product.

As ‘*atmosphere*’ refers to ‘*the quality of the surrounding space*’, Kotler (1973) introduces the term ‘*atmospherics*’ to describe “***the conscious designing of space to create certain effects in buyers***”. He defines ‘*atmospherics*’ more specifically as “***the effort to design buying environments to produce specific emotional effects in the buyer that enhance his purchase probability***”

Markin, Lilis and Narayana (1976) refer to the retail store as “*a bundle of cues, messages and suggestions that communicate to shoppers.*” Kotler (1973) suggests that it is because atmospheres are a ‘*silent language*’ in communication that they have been neglected for such a long time. But he argues that in the future ‘*spatial aesthetics*’ should be consciously used by marketing planners as a real marketing tool. He identifies ‘*atmospherics*’ as a highly relevant marketing instrument for retailers. As other marketing tools become neutralized in the competitive battle, atmospherics – the conscious planning of atmospheres to contribute to the buyer’s purchasing propensity – is likely to play a growing role in the unending search of firms for *differential advantage* (Kotler, 1973). Indeed, Kotler (1973) proposes that atmospherics becomes a more relevant marketing tool as the number of competitive outlets increases. Bitner (1990) confirms that atmospheric planning can make the difference between a business success or failure.

From that moment onwards there has been a growing recognition among practitioners and marketing researchers that store interiors and exteriors can be designed to create specific feelings in shoppers that can have an important cueing or reinforcing effect on purchase (Donovan and Rossiter, 1982; Grossbart et al., 1990; Donovan et al., 1994; Greenland and McGoldrick, 1994; Sherman, Mathur and Smith, 1997; McGoldrick and Pieros, 1998; Babin and Attaway, 2000; Babin and Babin, 2001; Dubé and Morin, 2001; Moye and Kincaid, 2002; Sweeney and Wyber, 2002).

If consumers are influenced by stimuli experienced at the point of purchase, the practice of creating influential atmospheres should become an important marketing strategy for most exchange environments. In this context Kotler (1973) first called the attention to the great need for further research into the subject of optimal atmosphere. One particular research question he found important to be investigated was how different atmospheric elements work and what messages are communicated by particular colours, sounds, odors and textures (Kotler, 1973).

In the last two decades, there have been many studies concerning store atmospherics based upon environmental psychology. The accumulated empirical evidence, as reviewed by Turley and Milliman (2000), clearly shows that shoppers can be induced to behave in certain ways, based on the atmosphere created by retail management. Out of 28 articles examining the effect of the atmosphere on sales, cited in their review, 25 found some significant relationship between the environment and customer purchasing behaviour. The review presented by Turley and Milliman indicates that atmospheric variables influence a wide variety of consumer evaluations and behaviours. Moreover, these studies also show that these relationships occur across a number of different types of retail stores and situations. Even when consumers are not aware of particular facets of the retail atmosphere, these may be influencing their behaviour (Milliman, 1982; Gulas and Schewe, 1994). Turley and Milliman (2000, p209) conclude: *“Although there may be some debate about whether the atmosphere can influence time spent in an environment, there is enough evidence to be able to clearly state that the atmosphere has an effect on consumer spending and that variations of atmospheric variables affect the amount of money people spend and the number of items they purchase”* .

The finding that more than two thirds of purchase decisions are made in the store (POPAI Europe, 1998) has evoked a renewed interest for a long neglected instrument in the marketing-mix: "*Place*". Aware of this fact, store managers invest huge amounts redecorating their stores. In order for them to invest their money wisely, it is of the utmost importance first to develop a comprehensive understanding of how stimuli from the store environment affect the consumer.

*"ATMOSPHERICS refers to
the effort to design buying environments
to produce specific emotional effects in the
buyer
that enhance his purchase probability"*

KOTLER

1973

2.3. AN ENVIRONMENTAL PSYCHOLOGY APPROACH TO STORE ATMOSPHERICS

It is interesting to note that until the 1960's, psychologists have largely ignored the effects of the physical setting in their attempts to predict and explain behaviour (Bitner, 1992). From that time on, the systematic study of environment-behaviour relationships by psychologists has produced a rapidly growing discipline, known as "environmental psychology" (Darley and Gilbert, 1985; Holahan, 1986; Stokols and Altman, 1987). Environmental psychology can be defined as "that segment of psychology concerned with the systematic accounting of the relationship between person and environment" (Russell and Ward, 1982). The classic emotional approach of environmental psychology is based on the fundamental notion that emotions elicited by the environment determine human behaviour (Mehrabian, 1978, p14).

2.3.1. THE MEHRABIAN-RUSSELL ENVIRONMENTAL PSYCHOLOGY MODEL

Mehrabian and Russell (1974) explored an emotional theory of environmental psychology, proposing that a person's behaviour in an environment is influenced "by the emotions that are elicited from him/her by that environment" (Russell and Mehrabian, 1978). According to this theory, an environment evokes emotional reactions in a person, which cause this person to approach or avoid this environment (Mehrabian, 1978, p15).

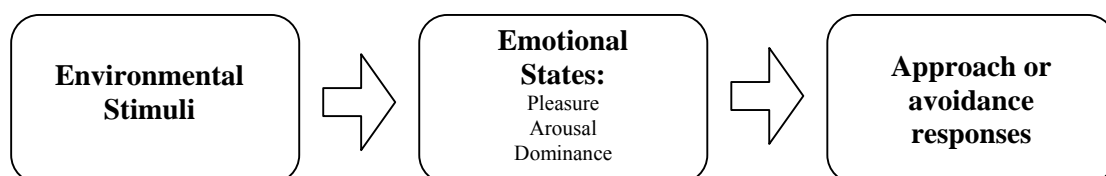


Figure 2-1: The Mehrabian-Russell environmental psychology model
Source: Mehrabian & Russell, 1974

Based on the Stimulus-Organism-Response (S-O-R) Paradigm (Lewin, 1936; Kelly, 1955; Rotter, 1954), Mehrabian and Russell (1974) thus propose a model of environmental psychological behaviour (presented in figure 2-1), relating features of the environment (S) to

approach-avoidance behaviours within the environment (R), mediated by the individual's emotional states (O) induced by the environment. Or stated differently: various environmental stimuli (colours, music, shapes, etc.) engender primary emotional responses, which as intervening variables, determine reactions to that environment.

In environmental psychology, researchers have studied how to most efficiently describe the emotional experience in an attempt to provide better descriptors to assess emotional responses to places and experiences therein (Russell and Pratt, 1980). In accordance with the basic three dimensions of meaning ('Evaluation', 'Activity' and 'Potency') identified by Osgood, Suci, and Tannenbaum (1957), Mehrabian and Russell (1974) proposed that three basic emotional states 'Pleasure', 'Arousal' and 'Dominance' provide a general description of emotions generated by an environment. Pleasure (the emotional counterpart of 'evaluation') refers more specifically to the degree to which a person feels happy or satisfied in a place. Arousal (the emotional correlate of stimulus' activity) refers to the degree of stimulation caused by an atmosphere. And dominance (the converse of stimulus 'potency') refers to the degree to which a person feels in control in a situation.

The various stimuli of the environment can, according to Mehrabian and Russell (1974b), be characterised in terms of "*the information rate*" of the environment (i.e. the quantity of information drawn from, or perceived in, the environment per unit of time). That is, the more varied, complex, novel, surprising and lively the environment is, the higher its information rate will be. The information rate of the environment is assumed to be directly related to the degree of arousal it induces. A "high-load" environment (i.e. novel, surprising, crowded) is expected to make its occupant feel stimulated, excited and alert, whereas a "low-load" environment (i.e. simple and familiar) is expected to make a person calm, relaxed and sleepy.

The emotion-eliciting quality of an environment thus refers to the average pleasure, arousal and dominance engendered by that environment in a representative sample of subjects (Russell and Mehrabian, 1978).

The response to any environment can, according to Mehrabian and Russell (1974), be subsumed in two basic categories of "approach" and "avoidance" behaviours (Wundt, 1905). Approach or convergence means that an individual reacts positively to the environment (i.e. desire to stay, explore, work and affiliate), whereas avoidance is characterised by an aversion

to the environment (a desire not to affiliate in the environment and to leave the environment). These two forms of behaviour are assumed to be opposite.

Mehrabian and Russell (1974) posit that the emotional states (pleasure, arousal and dominance) engendered by the environment, mediate a person's approach-avoidance responses to the environment. More specifically, they hypothesize pleasure to be significantly related to approach-avoidance measures overall, and that arousal has an interactive (multiplicative drive-like) effect with pleasantness such that arousal would be positively related to approach behaviours in pleasant environments, but negatively related to approach behaviours in unpleasant environments. They also hypothesized that dominance would be positively related to approach behaviours.

Thus, according to this model, environmental stimuli are presumed to engender primary emotional reactions in an individual, which mediate approach-avoidance behaviours, such as the desire to affiliate with others in the setting, the desire to stay in, or escape from, the setting and the willingness to spend money and consume there (Mehrabian, 1979; Mehrabian and Riccioni, 1986; Mehrabian and de Wetter, 1987; Mehrabian and Russell, 1975; Russell and Mehrabian, 1976, 1978).

2.3.2. APPLICATION OF THE MODEL TO STORE ATMOSPHERICS

Introducing the concept of store atmospherics, Kotler (1973) gives a tentative explanation as to how the atmosphere of a place may affect purchase behaviour, based on a causal chain shown in figure 2-2.

- (1) A product is surrounded by a space, characterized by certain sensory qualities.
- (2) The consumer perceives certain qualities of this space. This perception is subject to selective attention, distortion, and retention.
- (3) The perceived qualities of the atmosphere can influence the consumer's information and affective state.
- (4) The consumer's modified information and affective state may increase his purchase probability of the product.

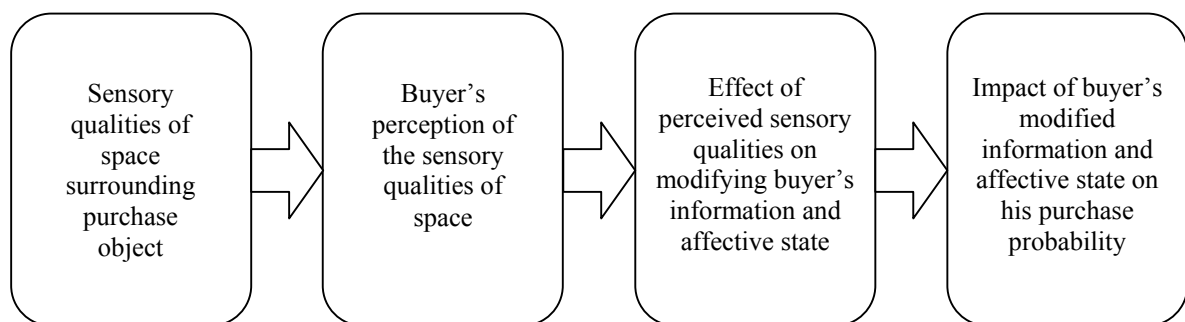


Figure 2-2 : The causal chain connecting atmosphere and purchase probability

Source: Kotler, 1973

Kotler (1973) argues that the atmosphere can have an effect on purchase behaviour in at least three ways: it may serve as (1) *an attention-creating medium*, as (2) *a message creating medium* and as (3) *an affect creating medium*.

It is in particular this last aspect that was elaborated on by Donovan and Rossiter (1982), who introduced the theoretical model of Mehrabian and Russell (1974) to the study of store atmosphere by proposing the store environment as the environmental stimulus. Donovan and Rossiter found store-induced arousal, and in particular store-induced pleasure to be very

powerful determinants of in-store approach/avoidance reactions. Pleasure and arousal were found to influence consumers' stated (1) enjoyment of shopping in the store, (2) time spent browsing and exploring store offerings, (3) willingness to talk to sales personnel, (4) tendency to spend more money than originally planned and (5) likelihood of returning to the store.

As this "emotional" model of environmental psychology has proven to be a valuable framework for generating hypotheses concerning the store atmosphere, it has successfully been applied by many atmospheric researchers since (Darden and Babin, 1994; Van Kenhove and Desrumaux, 1997; Hui, Dube and Chebat, 1997; Sherman, Mathur and Smith, 1997).

In line with Kotler's (1973) more comprehensive conceptualisation of atmospherics, Bitner (1992) extended the original M-R model to service-settings by adding to her framework cognitive and physiological internal responses to the emotional ones originally proposed by Mehrabian and Russell. According to Russell and Pratt (1980) the meaning that persons attribute to an environment can indeed be divided into perceptual-cognitive meaning and affective meaning.

However, as the first level of response to an environment is generally accepted to be affective (Ittelson, 1973, p16), in this thesis the classical emotional environmental psychology model (Mehrabian and Russell, 1974; Donovan and Rossiter, 1982) will be applied, with an exclusive focus on emotional internal responses.

In the next paragraphs we will elaborate this S-O-R conceptualisation of store atmospherics a little further. We will give a more detailed presentation on the store environment (the Stimulus), on the internal emotional responses evoked by shopping environments (the Organism) and on approach-avoidance behaviours in a shopping context (the Response). Furthermore, we will review whether the proposed relations in the model are applicable in a shopping context.

2.4. THE STIMULUS: CHARACTERIZING THE STORE ENVIRONMENT

2.4.1. A GENERAL CHARACTERIZATION OF THE STORE ENVIRONMENT

2.4.1.1. The Information Rate of the Environment

Based on information theory, Mehrabian and Russell (1974) characterize the various stimuli of the environment in terms of “*the information rate*” or “*load*” of the environment, which they define as the quantity of information drawn from, or perceived in, the environment per unit of time, measured by its degree of “novelty” (i.e. newness, unexpectedness) and “complexity” (i.e. the number of elements or features and the extent of motion or change in the environment). That is, the more varied, complex, novel, surprising and lively the environment is, the higher its information rate will be. A direct link is conceived between an environment’s information rate and its arousability.

Actually, the development of an adequate stimulus taxonomy for research in environmental psychology has been a challenge, because of the many stimuli involved in any environmental setting. For this reason Mehrabian and Russell (1974) aimed for a measure of environmental stimulation, applicable across various physical and social settings.

As Donovan and Rossiter (1982) introduced the theoretical model of Mehrabian and Russell (1974) to the study of store atmosphere, they introduced the store environment as stimulus. Nevertheless, they maintained the general (i.e. non-specific) stimulus taxonomy proposed by Mehrabian and Russell (1974).

Bitner (1992) makes a distinction between ‘*lean*’ and ‘*elaborate*’ environments, based on the physical complexity of the ‘servicescape’ (i.e. the physical surroundings of the place where a service is delivered or consumed). In this context, Bitner (1992) describes ‘*lean*’ environments as very simple, with few elements, few spaces and few forms and ‘*elaborate*’ environments as very complicated with many elements and many forms.

In an attempt to explain the affective assessment of outdoor environments, Kaplan (1987) extends the environmental information rate notion of Mehrabian and Russell and contends that preference for, or liking of, a particular environment can be predicted according to three environmental dimensions: its '*complexity*' (i.e. visual richness, ornamentation, information rate), '*coherence*' (i.e. order, clarity, unity) and '*mystery*'.

2.4.1.2. The Behavioural Perspective Model

According to Foxall and Greenley (1999) research on the impact of the environment on consumer behaviour has generated mixed results, because it has lacked a theory-based classification of consumer environments.

With the Behavioural Perspective Model (BPM), Foxall and Greenley (1999) propose a theory-based classification of consumer settings, according to which the emotions elicited by the environment, and thus behaviour, could be predicted more accurately. According to this model consumer behaviour is predictable from two dimensions of situational influence: (1) the scope of the consumer behaviour setting; and (2) the utilitarian and informational reinforcement signalled by the setting as primed by the consumer's learning history (Foxall, 1999).

According to Foxall (1999), consumer behaviour settings, which comprise the stimuli that make up the physical and social surroundings in which the consumer behaves, can differ in the degree to which they promote or hinder specific consumer activities and the extent to which they guide or compell a consumer to act in a certain way.

Thus, consumer behaviour settings can be classified according to their "*scope*", on a continuum from *closed* to *open*. In relatively closed settings, consumers are expected to conform to a certain behaviour pattern in the setting (i.e. purchase and consumption are managed largely by persons or entities other than the consumer). In contrast, in a relatively open consumer behaviour setting, strong physical, social and verbal pressures to conform to a particular behaviour are largely absent. In open settings, "the consumer enjoys a degree of discretion over the physical and social contingencies, or can determine his or her own rules for choosing among the products and brands offered" (Foxall, 1999, p151). Think for instance

about the optician, where you go and explain what kind of glasses you would like. The optician selects some pairs of glasses and you try them on and decide which ones you prefer. A lot of people feel obliged to select one of the proposed models and to order the glasses right away. Therefore, this kind of retail setting can be conceived of as a rather closed setting. On the other hand, there are the more self-service oriented optician chains (e.g. Pearle Vision) where you can walk in, take the glasses off the shelves yourself, try them on, and walk out, without buying, as you please. Assistance is available if you want some, but it is not forced on you. This kind of setting is a more open one. The behaviour in open settings is usually positively reinforced. A store can also have a rather closed setting if it has guided pathways that you have to go through in order to get where you want to be and where you cannot easily skip parts of the store because it doesn't carry any merchandise you need (e.g. IKEA). The "scope" or "openness" of the environment is conceived to be closely related to the dominance it elicits.

Furthermore, settings can, according to Foxall (1999) and Foxall and Greenley (1999), be classified according to the "reinforcement" they provide, which can be *utilitarian* and/or *informational*. Utilitarian reinforcement refers to the utility or economic satisfaction received by consumers as a result of purchase or consumption, whereas informational reinforcement refers to the feed-back received on one's performance as a consumer, or to the level of achievement or social status conferred by shopping in the store. These types of reinforcement are assumed to be independent of each other and can each be high or low, depending on the setting.

		Utilitarian Reinforcement	
		High	Low
Informational Reinforcement	High	ACCOMPLISHMENT	ACCUMULATION
	Low	HEDONISM	MAINTENANCE

Table 2-1: Operant classification of consumer behaviour
 Source: Foxall, 1997, p195

This way four classes of settings can be identified, depending on the relative levels or utilitarian and informational reinforcement they provide, with four corresponding classes of consumer behaviours being accomplishment, hedonism, accumulation and maintenance as illustrated in table 2-1 (Foxall, 1992; 1997).

By subdividing these classes further according to the relative scope or openness of the setting, a matrix of 8 contingency categories (illustrated in table 2-2) is proposed to provide a framework for a systematic investigation of Mehrabian and Russell’s (1974) approach to environmental psychology in the consumer behaviour field (Foxall, 1997; Foxall and Greenley, 1999). According to Foxall and Greenley (1999, p151) this matrix “functionally defines an exhaustive range of consumer situations based on environmental contingencies.

	BEHAVIOUR SETTING SCOPE	
	Closed	Open
ACCOMPLISHMENT high utilitarian; high informational	Fulfilment	Status Consumption
HEDONISM high utilitarian; low informational	Inescapable Entertainment / Amelioration	Popular Entertainment
ACCUMULATION low utilitarian; high informational	Token-based consumption	Collecting
MAINTENANCE low utilitarian; low informational	Mandatory Consumption	Routine Purchasing

Table 2-2: The behavioural response model: contingency category matrix
Source: Foxall & Greenley, 1999

Foxall and Greenley (2000) demonstrate by means of discriminant analysis that pleasure, arousal and dominance elicited by an environment can be predicted by the structural features of consumer situations proposed by the BPM. Consumer behaviour settings characterised by a relatively high utilitarian reinforcement appear to elicit more pleasure. Relatively high informational reinforcing settings evoke more arousal. And reported dominance appears to be higher in relatively open settings.

2.4.2. TOWARDS A CLASSIFICATION OF STORE ENVIRONMENTAL CHARACTERISTICS

One of the limitations of the Mehrabian-Russell (1974) and the behavioural perspective models is the lack of a classification system of specific environmental features (Donovan and Rossiter, 1982; McGoldrick & Pieros, 1998).

As '*atmosphere*' is apprehended through the senses, the atmosphere of a particular set of surroundings can, according to Kotler (1973), be described in sensory terms, with the main sensory channels for atmosphere being sight, sound, scent and touch. Accordingly, colour, brightness, size and shapes constitute the main visual dimensions of an atmosphere; volume and pitch the main aural dimensions; scent and freshness the main olfactory dimensions and finally softness, smoothness and temperature the main tactile dimension (Kotler, 1973).

Baker (1986) developed a more practical framework of environmental factors. She developed a typology categorizing the elements of the store environment into three critical dimensions: ambient, design and social factors:

(1) Store ambient factors are nonvisual, background conditions in the environment including elements such as temperature, lighting, noise, music and scent (e.g., Milliman, 1982, 1986; Ward and Russell, 1981; Wineman, 1982; Yalch and Spangenberg, 1990). Customers may notice ambient factors when they exceed an acceptable range, such as when the lighting becomes too bright or the music too loud.

(2) Store design factors are store environmental elements that are more visual in nature. These elements may be functional and/or aesthetic in nature (Marans and Spreckelmeyer, 1982). Functional store elements include layout, comfort and privacy.

Aesthetic elements include factors such as architecture, colour, materials, style and cleanliness.

(3) *Store social factors* relate to other people present in the store (Baker et al., 1994). Russell and Snodgrass (1987) noted that the physical presence of another person is an important part of any environment. The “people” component of the environment includes both store employees and customers (e.g. Bitner, 1992). The number, type and behaviour of people is proposed to influence consumers’ perceptions of stores.

The Baker (1986) store environment framework has been applied in experimental settings to examine the effects of specific environmental stimuli on emotional states (Baker and Levy, 1993), on price acceptability (Grewal & Baker, 1994) and on merchandise and service quality inferences and store image (Baker, Grewal and Parasuraman, 1994).

Bitner (1992) presents a typology of “*Servicescapes*” (i.e., the physical surroundings of the place where a service is delivered or consumed), which is heavily based on the Baker (1986) framework.

According to Berman and Evans (1995, 2001) “atmosphere” can be divided into several elements of the store environment: the exterior of the store, the general interior, store layout, and interior (point-of-purchase) displays. Berman and Evans (1995, 2001) do not consider the social aspect as part of the store atmosphere, however they do include elements of the store exterior. In this regard, Kotler (1973) also referred to architecture as the atmospheric of the exterior structure of buildings. Everett et al. (1994) point out that it is important to recognize that attitudes and behaviour are influenced by environmental attributes at several levels, from those closest to the consumer, to the external store features (Ward et al., 1992), through to the ‘macro-environment’, for example the town or city. Table 2-3 contains a detailed breakdown of the elements of the store environment, as presented by Berman and Evans (2001, p604).

Elements of the store environment

<p><u>Exterior</u></p> <ul style="list-style-type: none"> - Storefront - Marquee - Entrances - Display windows - Height of building - Size of building - Visibility - Uniqueness - Surrounding stores - Surrounding area - Parking - Congestion 	<p><u>Store layout</u></p> <ul style="list-style-type: none"> - Allocation of floor space for selling, merchandise, personnel, and customers - Product groupings - Traffic flow - Space/merchandise category - Department locations - Arrangements within departments
<p><u>General interior</u></p> <ul style="list-style-type: none"> - Flooring - Colours - Lighting - Scents, sounds - Fixtures - Wall textures - Temperature - Width of aisles - Dressing facilities - Vertical transportation - Dead areas - Personnel - Self-Service - Merchandise - Prices (levels and displays) - Cash register placement - Technology/modernization - Cleanliness 	<p><u>Interior (point of purchase) displays</u></p> <ul style="list-style-type: none"> - Assortment - Theme-setting - Ensemble - Racks and cases - Cut cases and dump bins - Posters, signs and cards - Mobiles - Electronic displays

Table 2-3: Elements of the store environment
Source: Berman and Evans, 2001, p604

Turley and Milliman (2000) complete the typology proposed by Berman and Evans (1995) by including a fifth category of human variables, which is in accordance with Baker's (1986) store social factor.

In an attempt to create some organized and logical structure to the study of atmospheric variables potentially influencing consumer behaviour, we further integrate the various typologies and propose a comprehensive classification of store environmental cues, comprising 7 categories: the macro environment, the store exterior, store ambient factors, interior aesthetic design factors, interior functional design factors or store lay-out, point-of-purchase displays and store social factors, including store personnel and customers. Table 2-4 contains a detailed breakdown of the elements of these categories.

A Comprehensive Classification of Store-Environmental Characteristics

The macro environment

- Surrounding stores
- Shopping center the store is located in
- Surrounding area / neighbourhood, town or city the store is located in
- Parking
- Congestion

The store exterior

- Architecture
- Height of building
- Size of building
- Storefront
- Marquee
- Entrances
- Display windows
- Visibility
- Uniqueness

Store ambient factors

- Nonvisual, background conditions in the environment
- Temperature
- Noise
- Music
- Scent
- Cleanliness

Interior aesthetic design factors

- Interior architecture
- Colour
- Lighting
- Materials
- Style

Interior functional design factors / store layout

- Allocation of floor space for selling, merchandise, personnel, and customers
- Product groupings
- Traffic flow
- Space/merchandise category
- Department locations
- Arrangements within departments

Point-of-purchase displays

- Assortment
- Theme-setting
- Ensemble
- Shelving / Product placement
- Racks and cases
- Cut cases and dump bins
- Posters, signs and cards
- Mobiles
- Electronic displays

Store social factors

- Store personnel
 - Number of salespersons
 - Employee characteristics
 - Employee uniforms
- Store customers
 - Customer characteristics
 - Crowding
 - Privacy

Table 2-4: A comprehensive classification of store-environmental characteristics

Source: Based upon Kotler, 1973; Baker, 1986; Bitner, 1992; Everett et al., 1994; Turley and Milliman, 2000; Berman and Evans, 2001.

2.5. THE ORGANISM: EMOTIONAL RESPONSES TO SHOPPING ENVIRONMENTS

That the first level of response to any environment is affective (emotional) is widely accepted in psychology (Ittelson, 1973). Because positive feelings have been found to lead to more positive product evaluations and vice versa (Bagozzi, Gopinath & Nyer, 1999), marketing researchers have generally acknowledged that emotions play a prominent role in the marketing of products and services. The pervasive influence of emotional response has been recognized in various contexts, such as advertising, product consumption and shopping (Holbrook, Chestnut, Oliva and Greenleaf, 1984; Batra and Ray, 1986; Westbrook, 1987; Batra and Holbrook, 1990; Cohen, 1990). As emotions play a central mediating role in environmental psychology, we will take a closer look at the nature of store-evoked emotions.

In accordance with Lazarus (1991) and Oatley (1992), Bagozzi, Gopinath and Nyer (1999, p184) define emotion as *“a mental state of readiness that arises from cognitive appraisals of events or thoughts, has a phenomenological tone, is accompanied by physiological processes, is often expressed physically (e.g., in gestures, posture, facial features), and may result in specific actions to affirm or cope with the emotion, depending on its nature and meaning for the person having it”*. Furthermore, referring to Valdez and Mehrabian (1994, p407), Mehrabian (1996) proposes the premise that: *“judgments, preferences or attitudes require an emotional foundation and cannot operate in an emotional vacuum”*. According to this premise: *“emotions are the developmental precursors of elementary cognitive judgements and constitute the foundation for the latter”*.

In contrast to “emotional traits”, which refer to personal emotional characteristics or temperaments, which are stable over periods of years or even a lifetime, “emotional states” refer to transitory conditions of the organism, which may vary substantially and rapidly over the course of a day (Mehrabian, 1996). “Moods”, although similar, differ by convention from transient emotions in that a mood is generally longer lasting (from a few hours up to a couple of days) and lower in intensity. Also, an emotion has a clear object or referent (e.g. the store environment), whereas moods are generally non-intentional and global or diffused (Frijda, 1993). Moreover, moods are not as directly coupled with action tendencies and explicit actions as emotions often are (Bagozzi, Gopinath & Nyer, 1999). Although emotions are generally stronger in intensity than moods, they can also vary in intensity (Sokolov and

Boucsein, 2000). In this respect, milder, less intense emotions, which are more common in a marketing context, are also often referred to as feelings or affective responses (Frijda, 1987).

Gardner (1985) (see also Isen et al., 1978; Westbrook, 1980) hypothesized that transient feelings may have special impact in retail or service encounters because they may be natural outcomes of the interpersonal and dyadic nature of the retail environment. Indeed, empirical research has demonstrated that shopping environments can evoke emotional responses in consumers and that such emotions, in turn, influence shopping behaviours and outcomes (Donovan and Rossiter, 1982; Darden and Babin, 1994; Hui, Dube and Chebat, 1997; Sherman, Mathur and Smith, 1997).

2.5.1. A DISCRETE EMOTIONS PERSPECTIVE

One approach to the study of emotions, termed “*the discrete emotions perspective*”, proposes that emotions can be conceptualised as a set of discrete and phenomenologically distinct affective states (e.g., Izard, 1977; see Batra and Ray, 1986).

Plutchik (1980) contends that the eight emotion categories of anger, joy, sadness, acceptance, disgust, expectancy, surprise and fear are at the root of all human emotional responses. According to Havlena and Holbrook (1986), the Plutchik measure has been widely applied in consumer research with regard to the measurement of emotions.

Izard (1977) distinguishes in his differential emotions theory among 10 fundamental emotions, which have also become highly popular among consumer researchers due to the diversity of emotions encompassed: joy, sadness, interest, anger, guilt, shyness/shame, disgust, contempt, surprise and fear. Izard’s measure also includes a number of negative emotions, which according to Machleit and Eroglu (2000) may be pertinent to the shopping experience (such as anger or disgust due to poor interactions with salespersons, guilt over purchase and so forth).

2.5.2. A DIMENSIONAL EMOTION PERSPECTIVE

The second approach to the study of emotions, termed “*the dimensional perspective*”, has suggested that more basic understanding of the impact of emotions can be derived from reducing the various emotion types into a set of underlying dimensions.

Indeed, emotion categories appear to be related to each other in a systematic way (Russell and Lemay, 2000). This underlying structure of emotions has received some renewed interest as researchers attempt to represent the relations among the various discrete emotions (see Diener, 1999; Russell and Feldman Barrett, 1999). Both, factor analysis and multi-dimensional scaling of emotion-related expressions appear to converge systematically in a two- or three-dimensional representation (Russell and Lemay, 2000). Figure 2-3 represents such a circumplex structure of emotions.

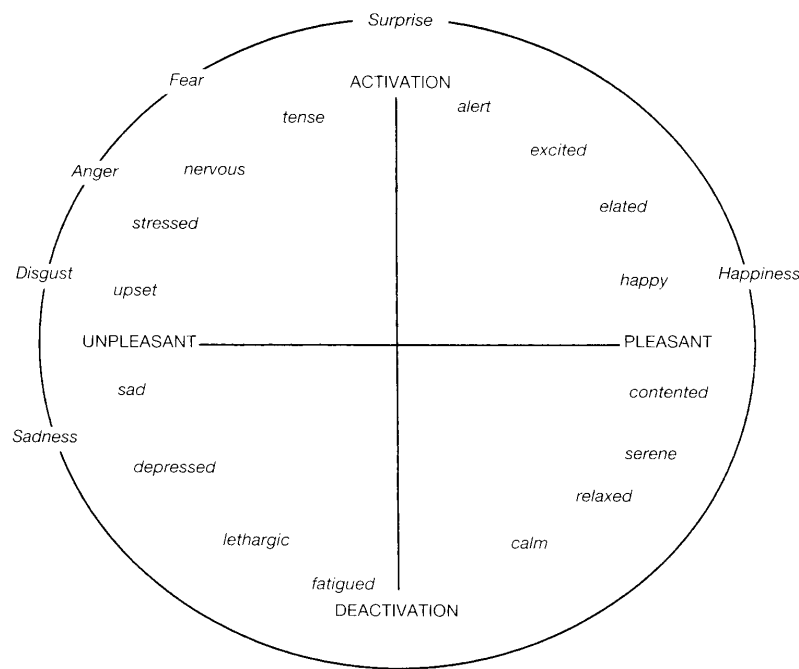


Figure 2-3: A circumplex structure of emotion concepts

Source: Russell and Lemay, 2000

In this two-dimensional circumplex, emotions range along an ‘evaluation’ dimension, from unpleasant to pleasant and, according to the degree of stimulation, along an ‘activation’ dimension from un-aroused and inactive to active and aroused. Whereas Watson and Tellegen (1985) originally questioned the bipolarity of such dimensions, claiming negative and positive affect to be independent of each other (see also Westbrook, 1987 and Mano and Oliver, 1993), they confirmed more recently that evidence supports such bipolarity (Watson and Tellegen, 1999; Russell and Carroll, 1999). Also Thayer’s (1989) two dimensional view of tense and energetic arousal can be integrated into this two-dimensional space when viewed as 45° rotations of one another (Yik, Russell and Feldman Barrett, 1999). The eight combinations of pleasantness and activation identified by Larsen and Diener (1992) also clearly fit this circumplex. Thus, the existence of two basic dimensions, representing respectively hedonic tone and activation, has received extensive theoretical and empirical support (Mano, 1997; Russell and Feldman Barrett, 1999; Yik, Russell and Feldman Barret, 1999). It is argued that various emotions can be plotted as points on the circumplex of these dimensions (Russell and Pratt, 1980; Russell and Lemay, 2000).

From an environmental psychology perspective, Mehrabian and Russell (1974) identified three underlying dimensions of emotions – ‘Pleasure’, ‘Arousal’ and ‘Dominance’ – in accordance with the basic three dimensions of meaning (‘Evaluation’, ‘Activity’ and ‘Potency’) identified by Osgood, Suci, and Tannenbaum (1957). According to Mehrabian (1972, 1996) the considerable generality of these semantic differential factors suggests that they represent the lowest common denominators of cognition and, thus, are associated strongly with affective responses. Mehrabian and Russell (1974) therefore proposed that the three basic emotional states of pleasure, arousal and dominance (abbreviated PAD) provide a general description of the emotions generated by an environment.

- (1) Pleasure-displeasure (the emotional counterpart of ‘evaluation’) concerns the positive-negative quality of emotional states and refers more specifically to the degree to which a person feels happy or satisfied in a place.
- (2) Arousal-non arousal (the emotional correlate of stimulus ‘activity’) refers to a combination of physical activity and mental alertness and concerns the degree of stimulation caused by an atmosphere.

(3) *Dominance-submissiveness* (the converse of stimulus ‘potency’, with higher potency stimuli eliciting lower dominance responses) refers to the degree to which a person feels in control of a situation and feels to have influence over his/her surroundings and others. In other words, dominance concerns the degree to which he/she feels “unrestricted or free to act in a variety of ways” (Mehrabian and Russell, 1974a, p19).

Pleasure, arousal and dominance have been identified as basic dimensions of emotions in studies of verbal descriptions of emotion (Bush, 1973) and in studies of facial, postural and vocal expressions of emotion (e.g. Mehrabian, 1972; Mehrabian and Ksionzky, 1974) (Russell and Mehrabian, 1978). Pleasure, arousal and dominance accounted respectively for 27, 23, and 14 percent of variance in emotional responses to various everyday settings and show considerable independence¹ (Mehrabian and Russell, 1974a, p26). Furthermore, studies have identified physiological correlates of behavioural or verbally reported pleasure, arousal and dominance (cited in Russell and Mehrabian, 1976 & 1978: Olds, 1956; Heath, 1964 – for pleasure; Evans and Day, 1971; Thayer, 1967, 1970 – for arousal; and Pribram, 1962 – for dominance). Thus, according to Mehrabian and Russell (1974), these dimensions, rather than the types per se, drive subsequent consumer responses.

Russell and Mehrabian (1977) and Mehrabian (1995) provide evidence that these three nearly independent bipolar PAD dimensions are both necessary and sufficient to adequately define emotional states. Russell and Mehrabian (1977) demonstrate that most of the reliable variance in 42 verbal-report emotion scales, developed by other investigators, could be accounted for in terms of the PAD dimensions. Although Russell (1980) showed that the two dimensions, pleasure and arousal, could account for a substantial portion of the variance in self-reported affective states, he attributed part of the remaining unexplained variance to social orientation and control (as identified by Sjoberg and Svensson, 1976) and/or dominance (as identified by Mehrabian and Russell, 1974a). In a study with regard to emotional responses towards advertisements, Holbrook and Batra (1987) generated a 94-item scale, to measure 29 emotional indices. Factor analysis revealed three underlying emotion dimensions: pleasure, arousal and dominance. Results reached by Shaver et al. (1987; 2001), who used multidimensional analyses to study 135 emotion terms, also corroborated the PAD Emotion Model. Although they obtained two-dimensional (Evaluation and Intensity) and three-

¹ Absolute values of the intercorrelations among the three scales were .07, .03 and .18.

dimensional (Evaluation, Potency and Activity) solutions, they found the three dimensional representation of affect to be statistically justifiable and highly interpretable and clearly more informative than the two dimensional one. The three dimensional solution helped to differentiate between the separate basic-emotion categories, suggested by cluster analysis (Shaver et al., 1987, p1071; Shaver et al., 2001, p39-40).

Mehrabian (1995 – Study 3) demonstrates that the PAD scales, which accounted for 58% of the total variance (respective PAD cronbach alphas of .97, .89 and .80), exhibit near independence, with inter-correlations among the pleasure, arousal and dominance scales not exceeding .09 in absolute value. However, Mehrabian (1998, p6) notes: *“the PAD scales have exhibited such near independence only when tested against a broad-based and balanced sample of stimuli, such as the sample of 80 situation descriptions given by Mehrabian, Wihardja and Ljunggren (1997). In contrast the PAD scales have tended to intercorrelate significantly when used to assess stimuli that represented limited realms of affective experience (e.g. Mehrabian and De Wetter, 1987; Valdez and Mehrabian, 1994). Difficulty in developing broad-based and emotionally-balanced samples of stimuli may thus help explain the temptation for other investigators to delete the dominance factor and to rely only on the pleasure and arousal factors, or rotations thereof, to describe emotions”*.

A more detailed presentation on the theoretical rationale and experimental foundations for the PAD Emotional State Model is given by Mehrabian (1995, 1996, 1997). Experimental data bearing on the validity of the PAD Emotion Scales were reviewed by Mehrabian (1995). Additional evidence of construct validity of the PAD Emotion Scales was obtained by Mehrabian and Blum (1997).

Thus, specific emotions can be visualized as points in a three-dimensional PAD-emotion space. ‘Bored’, for example, could be represented by its respective PAD-coordinates (-.65, -.62, -.33), representing a highly unpleasant, highly unaroused and moderately submissive state (Mehrabian, 1998).

The generality of the PAD Emotion Model is illustrated by dichotomizing each of the dimensions: pleasure (+P) versus displeasure (-P), arousal (+A) versus non-arousal (-A), and dominance (+D) versus submissiveness (-D). The resulting 2P x 2A x 2D emotion categories are illustrated in table 2-5 (Valdez and Mehrabian, 1994; Mehrabian, 1998) by the following

groups, derived from ratings of 240 emotional states on the PAD scales (Mehrabian, 1978; Russell and Mehrabian, 1977).

+ P + A + D :	admired, bold, creative, powerful, vigorous
+ P + A - D :	amazed, awed, fascinated, impressed, infatuated
+ P - A + D :	comfortable, leisurely, relaxed, satisfied, unperturbed
+ P - A - D :	consoled, docile, protected, sleepy, tranquilized
- P + A + D :	antagonistic, belligerent, cruel, hateful, hostile
- P + A - D :	bewildered, distressed, humiliated, in pain, upset
- P - A + D :	disdainful, indifferent, selfish-uninterested, uncaring, unconcerned
- P - A - D :	bored, depressed, dull, lonely, sad

Table 2-5: Eight PAD-emotion categories
Source: Valdez and Mehrabian, 1994

The PAD-measure has been widely employed in marketing and consumer research for evaluating emotions in various contexts (Holbrook, Chestnut, Oliva and Greenleaf, 1984; Havlena and Holbrook, 1986; Holbrook and Batra, 1987; Olney, Holbrook and Batra, 1991).

Havlena and Holbrook (1986) compared the Plutchnik and the Mehrabian and Russell (M-R) schemes with respect to consumption experiences. Their results showed evidence in favor of the latter, concluding that the three PAD dimensions captured more information about the emotional character of the consumer experience than did Plutchnik's eight categories.

However, Havlena and Holbrook's study focused on emotions concerning the general consumption experience, not the specific shopping context.

2.5.3. EMOTIONAL RESPONSES TO THE SHOPPING EXPERIENCE

Retail environments have been shown to evoke emotional responses in shoppers who actually appear to perceive substantial differences in the affective qualities of different stores (Darden and Babin, 1994).

In line with the discrete emotions approach, Dawson, Bloch and Ridgway (1990) measured seven types of emotions in their study on the effects of emotions in the retail environment: relaxed, content, satisfied, happy, surprised, excited and rewarded. In other studies (e.g. Menon and Dubé, 2000; Klemz and Boshoff, 2001) only a subset of emotion-types is investigated. Comparing the environmental and emotional influences on the willingness-to-buy among small and large retailers, Klemz and Boshoff (2001) focused, for instance, on the store-induced emotions of empathy and assurance. Menon and Dubé (2000) focused on two negative emotions (anxiety and anger) and on two positive emotions (joy and delight), in order to empirically investigate their framework that proposes that greater satisfaction can be ensured when retail managers engineer effective salesperson responses to in-store customer emotions. d'Astous (2000) focused on a negative feeling that may be experienced in the retail setting: irritation.

Yoo, Park & MacInnis (1998) note that extant studies on emotions evoked in a retail context have used standard emotions lists, which were developed for the purpose of studying human emotions generally. While these lists are useful and potentially comprehensive, they may over-represent emotions that are not an integral part of the retail context (e.g., pity), and may under-represent emotions that are (e.g., frustration). It is generally preferred to tap emotions most relevant to the domain of inquiry (Smith and Ellsworth, 1985). Thus, Yoo, Park & MacInnis (1998) feel that developing a list of emotional experiences, tailored to the retail context may be desirable. They decided to focus on retail-specific emotional responses, because of the growing acknowledgement that specific contexts (e.g., the retail shopping context) may have specific effects on consumer outcomes like emotions (Park and Smith, 1989; Huffman and Houston, 1993; Ratneshwar and Shoeler, 1991). Moreover, they were

concerned that general measures of human emotions may not adequately characterize the nature and range of emotional experiences encountered in the retail context (see also Smith and Ellsworth, 1985). For this reason 21 hours of ethnographic interviews were conducted, based on the responses of four informants. Through these ethnographic interviews, Yoo, Park & MacInnis (1998) identified emotions generated in the retail shopping environment that are not typically tapped by standard inventories of general human emotions. These retail-specific emotions can be classified into positive feelings (pleased, attractive, excited, contented, pride, satisfied) and negative feelings (ignored, anxious, nullified, displeased and angry) (Yoo, Park & MacInnis, 1998).

Several interesting observations can be made about these emotions. While Dawson et al. (1990) examined only positive emotions, the ethnographic interviews, conducted by Yoo, Park & MacInnis (1998), revealed roughly equivalent numbers of positive and negative emotions. This finding also differs from the items typically assessed using standard emotion typologies (see Holbrook and Batra, 1987; Edell and Burke, 1987), which typically have a lower proportion of negative to positive emotion items. Several retail-specific emotions identified through the interviews, do not show up on standard emotion typologies. A feeling of nullification, for example, is aroused when shoppers do not achieve what they want, such as when they plan to buy a product but cannot find it in the store. Notably, nullification reflects less frustration (which has a heavy anger component) than a feeling of deflation. Shoppers feel ignored when they are not treated well as shoppers. Pride is also an emotional response that has not been identified in previous work on store emotions. In this particular case, shoppers feel proud when they display their economic ability and social status through shopping (i.e. when they shop in a prestigious department store and purchase high-priced items). It is interesting to note that several of the emotions identified through the interviews are socially oriented. The extent to which shoppers feel ignored, proud or attractive, for example, may be driven by the social benefits or costs encountered in the retail environment. Nevertheless, the interviews were based on a very small sample of consumers and hence the items revealed from the interviews may not comprehensively represent the range of emotional experiences manifest in the shopping encounter. Yoo, Park and MacInnis (1998) subsequently asked 60 Korean students to indicate the extent to which they had experienced each of these 11 emotional responses during a specific shopping episode. Seven-point Likert scales were used as response scales (1 = not at all; 7 = very much). Only the pleasant versus unpleasant factor structure emerged, with two factors clearly representing respectively positive and

negative emotions. Coefficient alphas for each factor were .89 for positive feelings and .92 for negative feelings. In a field study among 294 Korean consumers (Yoo, Park & MacInnis, 1998) the same factor structure emerged.

From a purely hedonic (pleasure-displeasure) perspective, Turley and Bolton (1999) developed a five-item atmospheric affect scale, with each item assessing the affective response on a different category of atmospheric elements. Testing and purification of the scale in a fast-food restaurant setting resulted in a final 4-item scale of atmospheric affect, however they note that future research will have to confirm whether the deleted item is redundant for other types of retail categories as well. The proposed items are: (1) “in general, the outside of this restaurant is pleasing to me”, (2) “in general, the interior of this building is attractive”, (3) “I did not like the arrangement and layout of this restaurant” (reverse scored), (4) “The signs and decorations used in this store are not pleasant” (reverse scored), (5) “In general, I felt comfortable with the people I encountered while eating today”. Deleting item (3) resulted in a coefficient alpha score of .72.

Babin and Attaway (2000) operationalize atmospheric-based affect as two separate, negatively related dimensions: positive and negative affect (cfr. Mano and Oliver, 1993; Oliver, 1993; Bagozzi and Moore, 1994). They do not incorporate a separate arousal component, claiming that, while in general arousal can be either positive or negative, in a retail setting arousal indicators appear to take on rather consistent positive or negative meanings (Smith and Ellsworth, 1985). Babin and Attaway (2000) thus propose that, as ‘excitement’ in a retail setting represents a more pervasively positive reaction, there is no valid reason to include arousal as a separate dimension.

In their study concerning perceived control and the effects of crowding, Hui and Bateson (1991) only measure Mehrabian and Russell’s (1974) pleasure-displeasure dimension, arguing that existing evidence reveals that this dimension tends to produce the most direct and strongest effect on approach-avoidance reactions. However, they did use Mehrabian and Russell’s (1974) dominance scale combined with a scale of helplessness as indicator of perceived control. Moreover, they included 27 emotional terms in their questionnaire, 24 of which were adopted from Havlena and Holbrook (1986) to measure the eight basic emotion components identified by Plutchik (1980). One more component, ‘comfort’, operationalized by three items (calm, peaceful and relaxed), was added to this study. They argue that the 27

emotional terms, used in their study, form a perfect two-dimensional (pleasure-displeasure; arousing-unarousing) circumplex model, as proposed by Russell and Pratt (1980).

Donovan and Rossiter (1982) assessed shoppers' in-store emotional states using Mehrabian and Russell's (1974) PAD scale. However, they adapted the scale a little to the retail setting. Several of the original dominance items (e.g. in control – cared for, autonomous – guided, important – awed) were replaced by more appropriate retail-specific scales (restricted – free, crowded – overcrowded, important – insignificant). According to Donovan and Rossiter (1982) the dominance-submissiveness elicited by a store refers to the degree to which a person feels free to act in the store. Martineau (1958) specifically referred to customers feeling overwhelmed by counters and displays, which are built too high. According to Martineau (1958) customers commented "*They build up the display way over eye level so that things are staring at you and it bears down on you*", or "*On entering that store the whole place gives you the feeling of crushing you.*" He also talks about the "*wage-earner's wife*" who "*is not going to expose herself to the possibility of humiliation by shopping in the quality store, even if she has the money to buy something there*". These feelings could very well be captured by the dominance-submissiveness dimension of emotions (Russell and Mehrabian, 1977).

Nevertheless, Donovan and Rossiter (1982) demonstrated that the dominance dimension failed to predict approach-avoidance behaviours in a retail setting. They found that dominance does not strongly affect in-store behaviour. Moreover, conceptualising affective responses to the environment, Russell and Pratt (1980) deleted the dominance dimension altogether, arguing that dominance requires a cognitive interpretation by the individual and is therefore not purely applicable in environments calling for affective response.

Thus for theoretical reasons (Russell & Pratt's, 1980 conceptualization) as well as for a lack of empirical support (e.g. Donovan & Rossiter, 1982; Greenland and McGoldrick, 1994), several researchers investigating atmospheric effects of the store environment using the Mehrabian-Russell model, have disregarded the dominance dimension and simply researched the pleasure and arousal dimensions (e.g. Donovan et al., 1994; Sherman, Mathur and Smith, 1997; Van Kenhove and Desrumaux, 1997). As a consequence, dominance has received little attention in atmospheric research.

Mehrabian and Russell's (1974) PAD measure, as adapted to the study of store atmospherics by Donovan and Rossiter (1982), was used to capture pleasure and arousal by Flicker and Speer (1990), Donovan et al. (1994), Van Kenhove and Desrumaux (1997)...

In their 1994 study, Donovan et al. observed that several of the six arousal items from the M-R measure may require further investigation for their applicability in retail store environment studies. Anecdotal feed-back from shoppers suggested that some had difficulty relating the items aroused-unaroused, jittery-dull, and frenzied-sluggish to feelings experienced while shopping. Respondent confusion may have led to their failure to observe an unambiguous arousal factor.

Also Van Kenhove and Desrumaux (1997) note, when conducting exploratory and maximum likelihood confirmatory factor analysis using LISREL, that several of the original items from the pleasure-arousal scale do not appear to be good indicators of the pleasure and arousal constructs. They argue (on p306) "that careful inspection of the items selected to test the pleasure/arousal approach/avoidance relationship is needed".

Gröppel-Klein (1998) argues that 'arousal' and 'pleasure' seem to converge in a retail setting as 'positive activation' appears to be implicitly registered in the arousal construct. Nevertheless, according to Gröppel-Klein (1998, p309) "*an optimized store-interior presents interaction of activating and de-activating stimuli*". Empirical studies by Bost (1987) and Gröppel (1991) reveal that consumers in a retail setting can also experience a pleasant state of low arousal (i.e. relaxation). Thus, arguing that also at the point-of-sale, too much arousal can be experienced as hectic and unpleasant, Gröppel-Klein (1998) contends that the emotional dimension of "relaxation" experienced in the shopping environment should not be neglected in further studies. In her study concerning the influence of dominance perceived at the point of sale, Gröppel-Klein (1998) uses a modified version of Mehrabian and Russell's (1974) PAD conceptualization, including the dimensions of 'desire/pleasure' (implicitly a state of positive activation, captured by the items 'joyful' and 'in a good mood'), 'relaxation' (a positive state of low arousal, tapped by the items 'relaxed' and 'not hectic') and 'dominance' (incorporating the items 'superior', 'secure' and 'free'). These three dimensions were found to impact price assessment, assessment of service and assortment and reactions towards the store.

By means of several general human emotion scales (Plutchik, 1980; Izard, 1977; Mehrabian and Russell, 1974), Machleit and Eroglu (2000) also evaluated the nature of emotional responses to the shopping experience. In accordance to Darden and Babin's (1994) call for broadening the range of stores examined in order to show the full spectrum of affective qualities possible across all types of retailers, Machleit and Eroglu (2000) provide a descriptive account of emotions consumers feel across a wide variety of store types. The results of their study indicate that the broad range of emotions felt in the shopping context vary considerably across retail environments. Machleit and Eroglu (2000) also empirically compare the three emotion measures most frequently used in consumer research to determine which best captures the various emotions shoppers experience in retail environments, specifically, Izard's (Izard, 1977) differential emotion scale, Plutchik's (Plutchik, 1980) basic emotion scale, and Mehrabian and Russell's (Mehrabian and Russell, 1974) tri-dimensional scale of pleasure, arousal, and dominance. Their results show that the two emotion-specific scales (Izard, 1977 and Plutchik, 1980) outperform the dimensional PAD scale (Mehrabian and Russell, 1974) in capturing the richness of customers' emotional experience of shopping. However, they do also suggest that across a wide variety of shopping episodes it is not a good idea to combine such discrete emotion types into summary positive and negative affect factors. They recommend that researchers should use caution in constructing such summary dimensions and suggest that confirmatory factor analysis can aid in uncovering an appropriate underlying factor structure. Machleit and Eroglu (2000) do recognize that the M-R measure also has its strengths because it includes an arousal component, which is not adequately represented in the other scales. They also praise the dominance dimension as another benefit of the M-R measure. They argue that this dimension may be particularly relevant "in studies where control over one's environment is at issue, such as retail crowding, waiting time and so forth". Nevertheless, in their study, Machleit and Eroglu (2000) found the M-R measure to account for variance in shopping satisfaction only in terms of a pleasure/displeasure response.

Machleit and Eroglu (2000) emphasize that it is of particular interest which tangible or intangible environmental qualities instigate which types of emotional responses. Yalch and Spangenberg (1988) found, for instance, that environmental music conditions did not significantly affect pleasure nor dominance. They found only arousal to be significantly affected by store music.

Despite of the ambiguity concerning the arousal construct in a retail setting, atmospheric researchers generally acknowledge its potential importance (Donovan et al., 1994; Gröppel-Klein, 1997, 1998; Van Kenhove and Desrumaux, 1997; Gröppel-Klein and Baun, 2001).

As store-evoked arousal had always been measured by means of verbal self-report scales, causing rather ambiguous results, Gröppel-Klein and Baun (2001) conducted an experimental pilot-study using electrodermal activity as arousal indicator. Thus investigating the role of customers' arousal for retail stores more profoundly, they conclude that verbal scales may not be an appropriate measure to capture arousal. An empirical investigation was conducted in the fruit and vegetable department of two Austrian grocery stores. The experimental store (with enhanced atmosphere) was found to evoke higher arousal (electrodermal activity - EDA) than the control store. The pleasing atmosphere of the experimental store also led to a longer duration of shopping in the fruit and vegetable section than in the control store. In order to determine the valence of the evoked emotions, a German version of the positive dimensions of Izard's (1994) Differential Emotion Scale was used, including the dimensions 'interest', 'surprise' and 'joy'. Physical arousal (EDA) appeared to be only significantly correlated with the item 'glad' of the 'joy' dimension. The experimental store was rated as more 'varied', with more 'irresistible products' that 'suddenly caught the shopper's eye', making him/her feel more 'astonished', 'happy' and 'amazed', than in the control store. Moreover, the intentions 'to return to the store' and to 'recommend the store to others' were higher in the experimental store, as well as the 'actual amount of money spent' in the store. Results show that recording EDA at the point-of-sale is a practicable way to measure arousal in a valid manner and, thus, can be used to validate verbal arousal scales. Nevertheless, as EDA cannot reveal the hedonic tone of an arousing situation, verbal control of perceived emotions using a standardized questionnaire remains necessary. Moreover, EDA recording has a major limitation with regard to the time needed to collect satisfying sample sizes ("*not every consumer is willing to be connected to electrodes*") and to screen the output manually (Gröppel-Klein and Baun, 2001).

As 'emotional states' refer to transitory conditions (Mehrabian, 1996), which can vary substantially and rapidly, atmospheric researchers agree that it is difficult to assess emotions induced by the store environment. Donovan and Rossiter (1982) argue that the emotions engendered by the store atmosphere are transient and difficult to recall and verbalize. As Dawson et al. (1990) pointed out in their study, assessment of feeling states within the store

environment may reflect feeling states brought *to* the environment rather than induced *by* the environment. No doubt, emotions measured in the store reflect some combination of these. More research should be undertaken with regard to the pleasure and arousal dimensions prior to entering the store, because some of the motives for spending may have been to relieve negative emotions (cf. Mano, 1999). Therefore, Donovan et al. (1994) suggest that future studies should measure pleasure and arousal dimensions prior to entering the store as well as some time after entering the store. Emotions actually have been measured at different episodes of the shopping experience: before entering the store (Swinyard, 1993), a few minutes after entering the store (Donovan et al., 1994; Van Kenhove and Desrumaux, 1997), after considerable time in the store (Dawson, Bloch and Ridgeway, 1990) or after the shopping trip (Yalch and Spangenberg, 1993).

2.6. THE RESPONSE: APPROACH-AVOIDANCE BEHAVIOURS IN SHOPPING ENVIRONMENTS

2.6.1. APPROACH-AVOIDANCE BEHAVIOURS : GENERAL CONCEPTUALIZATION

The response to any environment can according to Mehrabian and Russell (1974) be subsumed in the two basic categories of “approach” and “avoidance” behaviours (Wundt, 1905). Approach or convergence means that an individual reacts positively to the environment, whereas avoidance is characterized by an aversion to the environment. Mehrabian and Russell (1974) posit that the emotional states (pleasure, arousal and dominance) engendered by the environment mediate approach or avoidance behaviours, such as the desire to affiliate with others in the setting, the desire to stay in or escape from the setting, and the willingness to spend money and consume there (Mehrabian, 1979; Mehrabian and Riccioni, 1986; Mehrabian and de Wetter, 1987; Mehrabian and Russell, 1974; Russell and Mehrabian, 1976, 1978).

Approach-avoidance behaviours as reactions to an environment can be framed within the more general notion of “*action tendencies*”, referring to “*a readiness to engage in or disengage from interaction with some goal object*”, including “*impulses of ‘moving towards’, ‘moving away’, and ‘moving against’*” (Frijda, Kuipers and ter Schure, 1989, p213). In this regard some theorists (e.g. LeDoux, 1996) also maintain that “*action tendencies*” in general are automatic “prewired” responses connected to emotions (Bagozzi, Gopinath and Nyer, 1999).

Approach-avoidance behaviour as response to a situation was conceptualized and measured by Mehrabian and Russell (1974) and Russell and Mehrabian (1976, 1978) as a generic single uni-dimensional bipolar construct, composed of intercorrelated factors of preference, exploration, work performance and affiliation. Approach behaviours, thus, are seen as positive responses to an environment such as a desire to stay in a facility and explore it, the desire to work in the situation and the desire to affiliate there (i.e. seek contact with others). Avoidance behaviours include not wanting to stay or to spend time looking around or exploring the place, not wanting to solve problems or work in the situation and not wanting to affiliate there with others. In fact Mehrabian and Russell (1974 - experiments 1, 2 and 3) found only ‘affiliation’ to constitute a different subfactor within the approach-avoidance

construct. The desire to stay, work in and explore the situation were found to be highly intercorrelated and appeared to define a single 'preference' subfactor of approach/avoidance. Both approach/avoidance subfactors, 'affiliation' and 'preference', also appeared to be significantly correlated. Nevertheless, it was suggested to analyse the four approach-avoidance indices separately when the object of a study is to obtain detailed answers for the particular environmental influences on each of them (Mehrabian and Russell, 1974, p144). This was also the approach taken by the authors in subsequent analyses. Based on their empirical findings, Russell and Mehrabian (1976) also conclude 'approach toward the setting itself' to be a separate factor from 'interpersonal approach' or the 'desire to affiliate'. Thus, Mehrabian and Russell (1974) and Russell and Mehrabian (1976, 1978) empirically demonstrated approach/avoidance to constitute a single 'bipolar' construct, composed of two interrelated subfactors 'preference' and 'affiliation'.

In contrast, Foxall (1990, 1997, 2000) suggests that approach and avoidance do not constitute a single dimension of consumer behaviour. In his argumentation he refers to Alhadeff (1982) who pointed out that consumer behaviour in any given situation is the outcome of two opposing learning histories: *"the strength of approach is a function of the individual's learning history with respect to prior approach behaviour and their consequences, while the strength of avoidance/escape is a function of his or her history with respect to prior avoidance/escape responses and their consequences. The strength of consumer behaviour is, therefore, a vector quantity, which cannot be represented psychometrically by a single continuum from escape/avoidance to approach."* (cited from Foxall, 1997, p514).

In his (1997) study, Foxall measured approach/avoidance by six of Mehrabian and Russell's eight statements for these items (those on thinking out a difficult task and working in the situation were deemed inappropriate). Selected "*approach*" statements were: 'How much time would you like to spend in this situation?', 'Once in this situation, how much time would you enjoy exploring around?', 'To what extent is this a situation in which you would feel friendly and talkative to a stranger who happens to be near you?'. Approach responses were scored from 1 (minimal approach tendency) to 7 (maximal approach tendency). Selected "*avoidance*" items were: 'How much would you try to leave or get out of this situation?', 'How much would you try to avoid any looking around or exploration in the situation?', 'Is this a situation in which you might try to avoid other people or avoid having to talk to them?'. Avoidance responses were scored from 1 (minimal tendency to avoid/escape from the setting)

to 7 (maximal tendency to avoid/escape). Foxall found, as expected, *approach* and *avoidance* to be separate dimensions, which are negatively related to each other (Pearson correlation coefficient = -0.64). Proposing that emotions of pleasure, arousal and dominance would each exert independent influences on approach and avoidance responses, Foxall (1997) concludes: “*The separate conceptualisation and measurement of approach and avoidance has led to the finding that these behaviours are uniquely related to emotional response patterns*” (Foxall, 1997, p520). In the following chapter we will focus more specifically on the emotional determinants of approach and avoidance behaviours.

Coroborative of these findings by Foxall (1997) on a small sample are the results from a subsequent empirical study on 561 consumers by Foxall and Greenley (2000). As in the previous study by Foxall (1997), the respondents rated eight consumer situations, carefully chosen according to the behavioural perspective model, providing data on emotional responses and approach and avoidance intentions for 4.488 consumer situations. Besides a score for approach and one for avoidance, in this study also a composite measure termed ‘*aminusa*’ was calculated (i.e. approach minus avoidance, defined as the mean difference between approach and avoidance scores). This was done for the purpose of comparison with Mehrabian and Russell’s approach-avoidance measure. However, Foxall and Greenley (2000) found that ‘*aminusa*’ (comparable to the M-R bipolar approach/avoidance measure) appeared to follow a similar pattern as their simple approach measure, indicating that respondents’ approach-avoidance, measured as a single bipolar variable, tends towards the approach pole. They propose that the equivalence of their results for approach and those for *aminusa* suggests that the continued employment of the ‘*aminusa*’ variable is redundant. They conclude: “*Aminusa, essentially Mehrabian and Russell’s bipolar approach-avoidance variable, adds nothing to the explanation that is not provided by approach. However, the approach/avoidance distinction appears useful since the avoidance variable does add information to the analysis and should be retained (Foxall and Greenley, 1999)*” (Foxall and Greenley, 2000, p55).

In fact, the idea that behaviour consists fundamentally of two sorts of motivations or action tendencies: appetitive or approach and aversive or avoidance (withdrawal), which are managed by two separate self-regulatory systems, is commonly tied to the work of Miller and Dollard (Miller and Dollard, 1941; Miller, 1944; see also Lewin, 1935, p62) and has reemerged over the past two decades (Carver, Sutton and Schreier, 2000). Approach and

avoidance tendencies are presumed to be managed by different structures in the nervous system (e.g. Konorski, 1948; Miller, 1944; Schneirla, 1959).

2.6.2. APPROACH-AVOIDANCE BEHAVIOURS IN A RETAIL SETTING

In their literature review, Turley and Milliman (2000) note that over the last thirty years of research, atmospheric effects have been measured on a wide variety of different dependent variables. The most widely examined dependent variables in experimental studies of the retail atmosphere are sales, time in the environment and approach-avoidance behaviour (Turley and Milliman, 2000). Some studies have used multiple dependent variables.

Donovan and Rossiter (1982) adapted Mehrabian and Russell's (1974) approach/avoidance scale to measure respondents' intentions to behave in the store. Transposed to a retail environment, Donovan and Rossiter (1982) distinguish four aspects of approach/avoidance behaviours:

- 1- a desire to stay in (*approach*) or to get out of the store (*avoidance*)
- 2- a desire to explore or look around in (*approach*) the store environment or to avoid moving through or interacting with the environment (*avoidance*)
- 3- a desire to communicate with others in the store (sales personnel, floor staff, other clients) (*approach*) or to avoid this and to ignore communication attempts from other people (*avoidance*)
- 4- the degree of enhancement (*approach*) or hindrance (*avoidance*) of shopping performance (e.g. spending money, repeat-purchasing) and satisfaction with shopping performances

The 8 resulting approach-avoidance items (see table 2-6) were expected to indicate four underlying dimensions: time spent (items 1 and 2), affiliation (items 3 and 4), affect (items 5, 6 and 7) and money spent (item 8).

Affect:

- (1) Do you like this store environment?
- (2) Would you enjoy shopping in this store?
- (3) Would you avoid ever having to return to this store? (*)

Time dimension:

- (4) How much time would you spend browsing in this store?
- (5) Would you want to avoid looking around or exploring this environment? (*)

Affiliation:

- (6) Is this a place where you might try to avoid other people, and avoid to talk with them? (*)
- (7) Is this a place in which you would feel friendly and talkative to a stranger who happens to be near you?

Spending Behaviour:

- (8) Is this the sort of place where I might end up spending more money than you originally set out to spend?
-

Table 2-6: Donovan and Rossiter's (1982) approach/avoidance scale

An exploratory principle component factor analysis yielded only one factor, which appeared to capture approach-avoidance. The authors note that this uni-dimensional approach factor should be interpreted more in the Fishbein and Ajzen (1975) sense of "attitude towards the act" than of intentions per se, because the factor seems highly loaded with affect. In accordance with Russell and Mehrabian's findings that affiliation seems to constitute a separate factor, not only this one factor, but the first three factors of the solution were explored (note that the two additional factors had eigenvalues < 1; these three factors accounted together for 78.8% of the variance). It was found that the affiliation items and the time and money items were in fact somewhat different from the other approach-avoidance items. The authors justify focusing on the various subscales (see table 2-7 for more details), by noting that the uni-dimensionality of approach-avoidance seems to be due to its higher-order factorial position relative to several sub-factors. For example, while their spending intentions measure is significantly related to Mehrabian and Russell's approach-avoidance responses (individual correlations with spend ranged from .35 to .48, all $p < .01$), the shared variance is quite low.

Based on the Donovan and Rossiter 1982 study, Van Kenhove and Desrumaux (1997) expected the 8 approach-avoidance items to indicate four underlying dimensions: time spent,

affiliation, affect and money spent. Note that they did not include the item 'I would avoid ever having to return to this store' in the 'affect' sub-dimension, as Donovan and Rossiter did, but rather in the 'money spent' dimension (see table 2-7 for more details). Exploratory factor analysis revealed however only two dimensions, with two of the reversed-scored items loading on the second dimension, which could be supportive of the existence of a separate avoidance dimension. Yet, this has not been contemplated by the authors. Conducting a maximum likelihood confirmatory factor analysis using LISREL 8, Van Kenhove and Desrumaux (1997), found the fit for the presumed four-factor solution to be unacceptable. Actually, some items had to be dropped because of very low factor-loadings. After dropping several items, eventually a satisfactory three factor-solution was achieved, indicative of the 'time', 'affiliation' and 'affect' sub-dimensions. Note that for the affiliation dimension only one item was retained.

Bateson and Hui (1991) considered in their study only the 'desire to stay' and the 'desire to affiliate' dimensions, based on Mehrabian and Russell (1974) and treated these together as one global approach/avoidance construct.

Also capturing approach/avoidance intentions by means of the 8 items proposed by Donovan and Rossiter (1982), Bellizzi and Hite (1992) discussed effects for each of the items separately. They considered the fact that in their study no effects could be discerned for both 'affiliation' items as indicative of the existence of a separate 'affiliation' factor. Yet, an average composite score was calculated afterwards, treating approach/avoidance as a uni-dimensional construct ($\alpha = .86$).

Mattilla and Wirtz (2001) also treated the 8 approach-avoidance items proposed by Donovan and Rossiter, as a bipolar uni-dimensional scale ($\alpha = .78$).

Thus, in a retailing context, traditional approach–avoidance studies have always considered approach and avoidance to be the opposite poles in a general approach-avoidance construct with several correlated underlying dimensions, such as exploration (time spending), affect and affiliation (Mehrabian and Russell, 1974; Russell and Mehrabian, 1976, 1978; Donovan and Rossiter, 1982; Bellizzi and Hite, 1992; Van Kenhove and Desrumaux, 1997, Matilla and Wirtz, 2001).

In accordance with Donovan and Rossiter (1982), but focusing on actual behaviour, rather than intentions, Sherman and Smith (1986) and Sherman et al. (1997) included the following items in their study:

- (1) number of items purchased
- (2) amount of time spent in the store
- (3) actual amount of money spent in the store
- (4) whether the shopper liked the store environment

In an extension of their 1982 study, Donovan et al. (1994) also measure actual shopping behaviour, rather than intentions. In this study pre-measures of estimated spending and time in the store are compared to post-measures of actual spending and actual time spent in the store. It is argued that post-only measurement of these behavioural dependent variables may be subject to memory error and post-hoc attributions.

Babin and Darden (1995) investigated the *'level of resources expended while shopping'* and the *'perceived shopping value'*. 'Perceived shopping value' was operationalized by means of two dimensions capturing *"an assessment of the total worth of shopping activity in terms of utilitarian and hedonic shopping value"*, where 'utilitarian value' refers to task related worth and 'hedonic value' implies worth found in the shopping experience itself, aside from any task-related motives. Thus, 15 items were used to assess perceived utilitarian and hedonic shopping value (Babin et al., 1994).

Babin and Attaway (2000) introduce another measure of behavioural consequences of variations in store atmospherics, namely *'customer share'*, which is a multi-item scale that captures the extent of temporal and economic resources devoted by a customer to a given store, in proportion to those resources devoted to the category as a whole. Moreover, they hypothesize shopping value (which in itself can serve as a reward) to mediate the relationship between affect and purchase behaviour.

Table 2-7: Studies measuring approach/avoidance behaviour

Authors	Items used to measure approach/avoidance	Findings
<p>Mehrabian and Russell (1974, chapter 8)</p> <p><u>Experiment 1:</u> 103 University under-graduates' reactions to 8 (of 40) verbally described situations (i.e. 824 sets of situations)</p>	<p>Experiment 1:</p> <p><u>Preference for the situation:</u></p> <ul style="list-style-type: none"> - How much do you like this situation? - How much do you prefer this situation? - How much would you seek out or try to find this situation? - Once in the situation, how much would you explore it? - Once in the situation, how much would you like to leave, or get out of it? (*) <p><u>Desire to solve problems in the situation:</u></p> <ul style="list-style-type: none"> - To what extent is this situation a good opportunity to think out some difficult problem you have been assigned in class? - If the problem is an easy one, would you use this situation as an opportunity to solve the problem. <p><u>Desire to affiliate in the situation:</u></p> <ul style="list-style-type: none"> - To what extent is this a situation in which you would be friendly and talkative to a stranger who happens to be near you? - In this situation, would you initiate a conversation just to be friendly? <p><i>8-point scales, scored from 0 'not at all' to 7 'extremely so'.</i></p>	<p><i>A generic concept of approach-avoidance behaviour as response to a situation was hypothesized, composed of intercorrelated factors of preference, exploration, work performance and affiliation.</i></p> <p>Experiment 1: Exploratory principle component factor analysis with oblique rotation on eight approach-avoidance items revealed three factors as indicated: a 'general preference' factor, a 'problem solving' factor and an 'affiliation' factor. The former factors were significantly correlated ($r=0.36, p<0.05$). 'Affiliation' appeared to be significantly correlated with 'preference' ($r=0.22, p<0.05$), but not with 'problem solving' ($r=0.17, p>0.05$).</p>

**Mehrabian and Russell
(1974, chapter 8)**

Experiment 2:

163 subjects' responses to 20 (of 65) verbally described situations (i.e. 3260 sets of situations)

Experiment 3:

214 subjects' reactions to 6 (of 55) verbally described situations (i.e. 1284 sets of situations)

Experiment 2 and 3:

Approach-avoidance items were redesigned to include equal numbers of positively and negatively worded items.

Desire to stay in the situation: ('Preference')

- How much time would you like to spend in this situation?
- How much would you try to leave or get out of this situation? (*)

Desire to explore the situation: ('Preference')

- Once in this situation, how much would you enjoy exploring around?
- How much would you like to avoid any looking around or exploration of this situation? (*)

Desire to work in the situation: ('Preference')

- To what extent is this situation a good opportunity to think out some difficult task you have been working on?
- How much would you dislike having to work in this situation? (*)

Desire to affiliate: ('Affiliation')

- To what extent is this a situation in which you would feel friendly and talkative to a stranger who happens to be near you?
- Is this a situation in which you might try to avoid other people, avoid having to talk to them? (*)

8-point scales, scored from 0 'not at all' to 7 'extremely so'.

The first item, involving time, could be rated as follows: 0 'none', 1 'a few minutes', 2 'half an hour', 3 'one hour', 4 'a few hours', 5 'a day', 7 'many, many days'.

Experiment 2:

Exploratory principle component factor analysis actually revealed two factors with eigenvalues exceeding unity, accounting for 61% of the total variance: the first three categories of approach-avoidance were found to be highly intercorrelated and define a single factor called "preference", which has a low but significant correlation with the "desire to affiliate factor" ($r=0.16$, $p<0.05$).

Experiment 3:

Similar to the previous findings from experiment 2 an exploratory principle component factor analysis with oblique rotation revealed again two factors with eigenvalue exceeding unity, accounting for 61% of the total variance, with similar factor loadings.

The composite "preference" factor was however also significantly correlated with the "affiliation" factor ($r=0.23$, $p<0.01$)

Conclusion:

All the behaviours that were assumed to be part of a generic approach-avoidance reaction to situations were as expected significantly intercorrelated. The desire to affiliate however, was identified as a separate factor in all three experiments. In experiment 1 "problem solving" also popped up as a separate factor.

Therefore it was suggested that ***"the four approach-avoidance indexes (as used in experiments 2 and 3) should be analyzed separately when the object of a study is to obtain detailed answers for the particular environmental influences on each of these"*** (Mehrabian and Russell, 1974, p144). This was also the approach taken by the authors in subsequent analyses. Therefore composite scores were calculated for each index, after reversing signs where appropriate.

**Russell and Mehrabian
(1976)**

44 undergraduate students' responses to settings represented by a sample of 60 photographic slides of environments, selected according to a 2x3x2 factorial design, with 2 levels of pleasantness, three levels of arousing quality and two levels of dominance-eliciting quality, as rated by another group of subjects

Desire to stay:

- How much time would you like to spend, once you are back in these settings?
- How much do you like the way you are feeling at this time?
- How hard would you try to avoid ever having to return? (*)

Desire to explore:

- How much would you enjoy going back to these settings and exploring around?
- How much would you try to avoid going back to look around or to explore these settings? (*)

Desire to affiliate:

- To what extent is this a time you would feel friendly and talkative to a stranger who happens to be near you?
- Is this a time when you might try to avoid other people, avoid having to talk to them? (*)

Desire to smoke:

- At this time, would you feel like smoking a cigarette?
- Would you refuse an offer of a cigarette to smoke? (*)

Desire to drink:

- Would you feel like having a drink (something alcoholic)?
- Do you think that "It's just *not* the right time to have an alcoholic drink"? (*)

measured on nine-point scales ranging from "not at all" to "extremely so", except for the desire to stay item, concerning amount of time, which was measured on a nine-point scale, ranging from none, a few minutes, half an hour, an hour, a few hours, a day, a few days, many days, many months.

In this discussion we disregard the desire to smoke and the desire to drink items.

Desire to stay consisted of three measures. The negatively worded item correlated -.59 with each of the two positively worded items. The positively worded items correlated .72. The two desire to explore items intercorrelated -.71. The two desire to affiliate items intercorrelated -.54. Responses to items within the measures were thus simply summed, after reversing signs where appropriate.

Desire-to-stay and desire-to-explore appeared to be a single approach-avoidance factor, with a correlation coefficient of .88. As anticipated desire-for-affiliation was positively, but only moderately, related to exploration (correlation coeff.=.36) and staying (correlation coeff.=.37).

Based on their empirical findings Russell and Mehrabian (1976) conclude that "***approach toward the setting itself***" is a separate factor from "***interpersonal approach***", or the desire to affiliate.

**Russell and Mehrabian
(1978)**

Study 1

200 university students' reactions to 18 photographic slides of different physical settings, selected according to a completely crossed factorial design with pleasantness, arousing quality and dominance-eliciting quality of the setting (rated by other subjects) as orthogonal factors: 3Px3Ax2D (90 of 320 settings were selected (5 slides per cell) for the 18 cells); (i.e. 3600 observations)

Study 2

310 university undergraduates' reaction to 9 photographic slides of different physical settings, selected according to an equally spaced grid with pleasantness and arousing quality of the setting as orthogonal dimensions (rated by other subjects), dominance was held average : Px A (90 of 320 settings were selected); (i.e. 2790 observations)

Approach-avoidance

- How much time would you like to spend in this place?
- How much do you like this place?
- How much would you want to explore around in this place?
- How much would you want to avoid looking around or exploring this setting? (*)
- How hard would you try to avoid ever having to return to this place? (*)

Desire to affiliate

- To what extent is this a time you would feel friendly and talkative to a stranger who happens to be near you?
- Is this a time when you might try to avoid other people, avoid having to talk to them? (*)

Scored on an eight-point scale from "not at all" to "extremely so", except for the 'time' item, which was rated on a 9-point scale: none, a few minutes, half an hour, one hour, a few hours, a day, a few days, many days, many months.

Study 1:

Among the 5 approach-avoidance items, inter-correlations ranged from .60 to .79. Since the standard deviations were similar (ranging from 2.0 to 2.3), these items were simply summed to form a composite 'approach-avoidance' score.

The two 'desire to affiliate' items correlated -.57. (standard deviations of 1.9 and 2.2) were also summed to form a composite 'desire-to-affiliate' score.

These composite measures 'approach-avoidance' and 'desire to affiliate' were in turn found to correlate .50.

Study 2:

Among the 5 approach-avoidance items, the obtained inter-correlations ranged from .56 to .75. The two desire to affiliate items correlated -.58. Composite scores were used for each factor. The composite 'approach-avoidance' factor correlated .43 with the composite 'desire to affiliate' factor.

**Donovan and Rossiter
(1982)**

30 graduate students' responses to 2 to 3 different actual retail environments (i.e. 66 observations)

Items to measure approach-avoidance intentions were adapted from Mehrabian and Russell to fit retail shopping intentions

Affect:

- (1) Do you like this store environment?
- (2) Would you enjoy shopping in this store?
- (3) Would you avoid ever having to return to this store? (*)

Time dimension:

- (4) How much time would you spend browsing in this store?
- (5) Would you want to avoid looking around or exploring this environment? (*)

Affiliation:

- (6) Is this a place where you might try to avoid other people, and avoid to talk with them? (*)
- (7) Is this a place in which you would feel friendly and talkative to a stranger who happens to be near you?

Spending Behaviour: (single item)

- (8) Is this the sort of place where I might end up spending more money than you originally set out to spend?

An exploratory principle component factor analysis with varimax rotation on the eight approach-avoidance and spending items yielded only one factor with an eigenvalue greater than one, which appears to capture approach-avoidance. The authors note that this uni-dimensional approach factor should be interpreted more in the Fishbein and Ajzen (1975) sense of "attitude towards the act" than of intentions per se, because the factor seems highly loaded with affect.

In accordance with Russell and Mehrabian's findings that affiliation seems to constitute a separate factor, the first three factors of this solution were explored (these accounted for 78.8% of the variance): it was found that the affiliation items and the time and money items were in fact somewhat different from the other approach-avoidance items.

The following dependent approach-avoidance measures were calculated for further analyses:

- APR-AVD: average approach items (1-7) excluding the spend item ($\alpha=.88$)
- Spend: single spend item (8)
- Affect: average of the three highest loading items on the first factor (like, enjoy, return) ($\alpha=.90$)
- Time: average of items (4) and (5) ($\alpha=.67$)
- Affiliation: average of items (6) and (7) ($\alpha=.72$)

The authors justify focusing on the various subscales, by noting that the uni-dimensionality of approach-avoidance seems to be due to its higher-order factorial position relative to several subfactors. For example, while their spending intentions measure is significantly related to Mehrabian and Russell's approach-avoidance responses (individual correlations with spend ranged from .35 to .48, all $p<.01$), the shared variance is quite low.

**Hui and Bateson
(1991)**

115 adult's reactions to a hypothetical person in more and less crowded bank and bar settings

- Desire to stay
- Desire to affiliate

(based on Mehrabian and Russell, 1974)

Desire to stay and desire to affiliate were treated as one global approach/avoidance construct.

**Bellizzi and Hite
(1992)**

experiment 2:

107 graduate students' reactions to projected furniture store interior drawings with manipulated background colours.

8 approach-avoidance items
cfr. Donovan and Rossiter (1982)

Effects were discussed separately on each of the 8 approach-avoidance items. Five of the eight items generated significant effects. Both affiliation items were among those that did not generate a significant effect, which may be indicative of a separate 'affiliation' factor

Afterwards, an average composite score was calculated ($\alpha=.86$) for approach-avoidance, treating it as a unidimensional bipolar construct.

**Babin and Darden
(1995)**

130 shoppers intercepted while shopping at one of 10 stores (including a variety of stores) in a major regional mall

Resource expenditures: (i.e. approach-avoidance behaviour)

the resource expenditure scale was adapted from approach-avoidance scales commonly used in environmental psychology (Donovan and Rossiter, 1982; Mehrabian and Russel, 1974) and included Likert items assessing

- time expenditure
- resource expenditure
- social interactions

+ two behavioural items (normalized to a common metric) assessing

- amount of money spent
- actual time spent shopping

Babin an Darden (1995) investigated the level of resources expended while shopping (based on approach-avoidance scales).

Confirmatory factor analysis demonstrated the unidimensionality of the resource expenditures scale, with construct reliability of .73 and 36 % of variance extracted, item reliabilities ranging from .19 to .59 and standardized factor loadings ranging from 0.44 to 0.77.

**Van Kenhove
and Desrumaux
(1997)**

364 first-time-visitors' in-store reactions to one of seven large retail outlets in Belgium (two clothing stores, three furniture stores and three garden centers)

Time dimension:

- (1) I like to spend much time browsing in this store
- (2) I want to avoid looking around or exploring this store (*)

Affiliation:

- (3) This is a place where I try to avoid other people, and avoid to talk with them (*)
- (4) This is a place in which I feel friendly and talkative to store personnel who happens to be near me

Affect:

- (5) I like this store environment
- (6) I enjoy shopping in this store

Spend:

- (7) I would avoid ever having to return to this store (*)
- (8) This is the sort of place where I might end up spending more money than I originally set out to spend

8 approach-avoidance items

cfr. Donovan and Rossiter (1982)

Measured on 5-point Likert scales

Van Kenhove and Desrumaux note that according to the Donovan & Rossiter (1982) study, the approach-avoidance items were expected to indicate four underlying dimensions: time spent, affiliation, affect and money spent.

An exploratory factor analysis resulted in a two factor solution with all items, except (3), (7), and (8) loading on the first factor. The loadings were relatively low for items (3) and (8) (below .40 on the second factor).

A maximum likelihood confirmatory factor analysis (LISREL 8) revealed that the fit for the four-factor solution, as presented by Donovan and Rossiter (1982) was not tenable, even after deleting items (3) and (8) with very low factor loadings (below .25). ($\chi^2=11.44$, $df=5$, $p=0.043$). Careful examination of the standardized residuals exceeding 2.58 resulted in dropping item 7. This resulted in a three-factor solution: time (items 1 and 2), affiliation (item 3) and affect (items 5 and 6). With a good fit ($\chi^2=2.48$, $df=3$, $p=0.48$, $RMR=0.0083$, $AGFI=0.99$).

Reliability for the time dimension = .87, for the affect dimension = .97, for the affiliation dimension only one item was retained, with regard to spending all items were dropped.

**Foxall
(1997)**

Exploratory study involving 27 students' responses to 8 verbally described consumer environments, selected by the systematic application of the behavioural perspective model (BPM) (i.e. 216 consumer situations)

Approach:

- How much time would you like to spend in this situation?
- Once in this situation, how much time would you enjoy exploring around?
- To what extent is this a situation in which you would feel friendly and talkative to a stranger who happens to be near you?

Avoidance:

- How much would you try to leave or get out of this situation?
- How much would you try to avoid any looking around or exploration in the situation?
- Is this a situation in which you might try to avoid other people or avoid having to talk to them?

Approach responses were scored from 1 (minimal approach tendency) to 7 (maximal approach tendency); Avoidance responses were scored from 1 (minimal tendency to avoid/escape from the setting) to 7 (maximal tendency to avoid/escape).

Foxall (1990, 1997, 2000) suggests that approach and avoidance do not constitute a single dimension of consumer behaviour.

As expected *approach* and *avoidance* were negatively related to each other (Pearson correlation coefficient = -0.64). However, ***“the separate conceptualisation and measurement of approach and avoidance has led to the finding that these behaviours are uniquely related to emotional response patterns”*** (Foxall, 1997, p520).

**Foxall and Greenley
(2000)**

561 consumers' reactions to 8 verbally described consumer situations, carefully chosen according to the behavioural perspective model (BPM), (i.e. 4.488 consumer situations)

Approach:

- How much time would you like to spend in this situation?
- Once in this situation, how much time would you enjoy exploring around?
- To what extent is this a situation in which you would feel friendly and talkative to a stranger who happens to be near you?

Avoidance:

- How much would you try to leave or get out of this situation?
- How much would you try to avoid any looking around or exploration in the situation?
- Is this a situation in which you might try to avoid other people or avoid having to talk to them?
-

Approach responses were scored from 1 (minimal approach tendency) to 7 (maximal approach tendency); Avoidance responses were scored from 1 (minimal tendency to avoid/escape from the setting) to 7 (maximal tendency to avoid/escape).

Besides a score for approach and one for avoidance, in this study also a composite measure termed '*aminusa*' was calculated (i.e. approach minus avoidance, defined as the mean difference between approach and avoidance scores). This was done for the purpose of comparison with Mehrabian and Russell's approach-avoidance measure.

However, '*aminusa*' appeared to follow a similar pattern as approach, indicating that respondents' approach-avoidance, measured as a single variable, tends towards the approach pole. They propose that the equivalence of their results for approach and those for '*aminusa*' suggests that the continued employment of both variables is redundant. They state: "***Aminusa, essentially Mehrabian and Russell's bipolar approach-avoidance variable, adds nothing to the explanation that is not provided by approach. However, the approach/avoidance distinction appears useful since the avoidance variable does add information to the analysis and should be retained (Foxall and Greenley, 1999)***" (Foxall and Greenley, 2000, p55).

**Matilla and Wirtz
(2001)**

270 customers' responses to an actual store setting (a gift-store) in which music and odor were manipulated

8 approach-avoidance items adapted from Donovan and Rossiter (1982)

Approach-avoidance was treated as a bipolar uni-dimensional scale (cronbach $\alpha = 0.78$)

*"Emotions are fuels for drives,
for all motion, every performance,
and any behavioural act"*

FONBERG

1986, p302

APPROACH-AVOIDANCE RESPONSES TO SHOPPING ENVIRONMENTS

Mehrabian and Russell (1974) posited that the emotional states (pleasure, arousal and dominance) engendered by the environment, mediate approach or avoidance behaviours, such as the desire to affiliate with others in the setting, the desire to stay in or escape from the setting, and the willingness to spend money and consume (Mehrabian, 1979; Mehrabian and Riccioni, 1986; Mehrabian and de Wetter, 1987; Mehrabian and Russell, 1975; Russell and Mehrabian, 1976, 1978). More specifically, they hypothesized that pleasure would be significantly related to approach-avoidance measures overall, and that arousal would have an interactive (multiplicative drive-like) effect with pleasantness such that arousal would be positively related to approach behaviours in pleasant environments, but negatively related to approach behaviours in unpleasant environments. They also hypothesized that dominance would be positively related to approach behaviours.

The earliest research in the consumer field by Lutz and Kakkar (1975a,b) could however not confirm the hypotheses that pleasure, arousal and dominance relate predictably to consumer behaviour. They conclude (p148) that: “Despite the increase in explanatory power resulting from the use of pleasure, arousal and dominance variables, it is evident that *the situation in and of itself is not a powerful predictor of consumer behaviour*” (emphasis in original). Foxall and Greenley (1999) argue that the small and apparently arbitrarily selected scope of the consumer settings tested (i.e. verbal descriptions of one general and one snack situation), is responsible for their poor results.

Nevertheless, in a retail context, Donovan and Rossiter (1982) did find support for the contention that *pleasure* and *arousal* are related to respondents’ intentions to remain in the setting and to spend money, but not for *dominance*. Over the various approach-avoidance measures, the proportion of variance accounted for by the PAD ratings ranged from a high of 50% for affect measures (liking, enjoyment, willingness to return) to a low for their single item ‘spend’ measure.

Based on the Behavioural Perspective Model, Foxall (1997) found pleasure, arousal and dominance to exert independent influences upon approach and avoidance behaviours, which were conceptualized not to be opposites in a uni-dimensional approach construct, but actually

two separate related constructs. For approach significant main effects could be found with regard to the three emotional states, pleasure, arousal and dominance, however for avoidance only a significant main effect could be revealed for pleasure. There was also no significant interaction. Based on these findings Foxall (1997) concludes that avoidance is explained by the lack of pleasantness in a consumer setting. The implication being that an inherently unpleasant consumer environment cannot be made more attractive by increasing dominance or arousal reactions. *“The separate conceptualisation and measurement of approach and avoidance has led to the finding that these behaviours are uniquely related to emotional response patterns”* (Foxall, 1997, p520). Nevertheless, these different effects have never been examined in a retailing context, as approach and avoidance have always been assumed to be the opposite poles in a uni-dimensional approach construct.

Next some empirical evidence will be reviewed on the specific roles of pleasure, arousal and dominance as antecedents of approach-avoidance intentions and behaviours.

2.7.1. THE EFFECTS OF PLEASURE ON APPROACH OR AVOIDANCE BEHAVIOURS

It has been generally acknowledged that consumers show a greater tendency for approach behaviours in the occurrence of positive emotions, aiming to share, maintain or increase the positive experience (see Bagozzi, Gopinath and Nyer, 1999). Likewise, positive emotions have been shown to increase customer satisfaction, whereas negative emotions tend to decrease satisfaction (Oliver, 1997).

In the past, valence has always been considered as the primary determinant of approach and avoidance behaviour (e.g. Campbell, 1963; Lewin, 1935; Osgood, 1953). Osgood (Osgood, 1953; Osgood et al., 1957) claimed that the ‘evaluation’ component of the semantic meaning of an object is of major importance as it serves as a guide for behaviour towards the object. According to the emotion-motivation model of Lang, Bradley and Cuthbert (1992), the mere presence of a stimulus object immediately activates, depending on its valence, either a positive approach or a negative avoidance motivational system.

A review of the effects of pleasure on various behaviours, indicates that pleasure induced by a setting increases the approach towards the setting (increased preference, liking, evaluation,

exploration, motivation at tasks and desire to affiliate and cooperate), even though the pleasure is not contingent of the approach (Russell and Mehrabian, 1976; e.g. Griffitt, 1970; Griffitt and Veitch, 1971; Janis, Kaye and Kirschner, 1965; Maslow and Mintz, 1956, Mehrabian and Russell, 1974, chapter 8; Razran, 1938, 1940). In Mehrabian and Russell's (1974) model, approach was therefore hypothesized to be a direct correlate of the situation's pleasure-eliciting quality.

In a retailing context, pleasant affective states have indeed been found to prolong shopping time (e.g. Donovan and Rossiter, 1982) and encourage spending (e.g., Baker, Levy and Grewal, 1992; Sherman, Mathur and Smith, 1997).

According to a study by Obermiller and Bitner (1984), respondents who viewed retail products in an emotionally pleasing environment evaluated the products more positively than subjects who viewed the same products in an unpleasing environment.

Moreover, it has been demonstrated that pleasurable shopping experiences induced by the store environment encourage consumers to spend more time in stores and to spend more money than intended (Donovan et al. 1994).

In the context of environmental crowding, Hui and Bateson (1991) found less perceived crowding and increased perceptions of personal control to be positively related to experienced pleasure, which in turn was found to exert a positive effect on approach/avoidance.

Sherman et al. (1997) found pleasure to have a positive influence on money spent in the store and store liking. On the other hand, pleasure was not found to affect the number of items purchased, nor the time spent in the store.

In their study regarding waiting attribution, Chebat, Gelinas-Chebat, Vaninski and Filiatrault (1995) found pleasure to have the strongest influence on approach-avoidance behaviour.

In contrast, Van Kenhove and Desrumaux (1997) could not conclude that pleasure is the major predictor of approach-avoidance intentions. They found arousal to play a more important role. Nevertheless, pleasure was found significantly related to a composite approach variable and to the time, affiliation and affect sub-dimensions.

Babin and Attaway (2000) find that “customer share” is directly influenced by a store’s ability to create hedonic and utilitarian values (Babin, Darden and Griffin, 1994), which in turn, are both sensitive to the customer’s positive and negative (i.e. evaluative) responses to the store environment.

2.7.2. THE EFFECTS OF AROUSAL ON APPROACH OR AVOIDANCE BEHAVIOURS

Arousal has for a long time been proposed to affect approach-avoidance behaviour (Berlyne, 1960, 1967; Dember and Earl, 1957; Fiske and Maddi, 1961, and Hebb, 1955). Actually, an inverted-U shaped relationship has been proposed, suggesting that extremes of arousal, whether high or low, produce avoidance, whereas moderate degrees of arousal generate approach. Likewise, in Mehrabian and Russell’s 1974 model, approach to a situation was hypothesized to be an inverted-U-shaped function of the arousing quality of the situation.

Mehrabian and Russell (1974, ch 8) explored the independent and interactive effects of pleasure, arousal and dominance on approach-avoidance. Their findings were only partially supportive for the hypothesized inverted-U function. The inverted-U was found in the relationship between arousal and desire to explore. It was also found for desire to work, but only in pleasant situations. For desire to affiliate, the inverted-U relation was found only in one study and again only in pleasant settings. Arousal failed to relate to desire to stay. Additional results helped clarify the inconsistent findings bearing on the inverted-U. These results showed an interaction between pleasure and arousal in determining approach: in pleasant settings, approach tended to vary directly with arousal, whereas in unpleasant settings approach tended to vary inversely with arousal. Based on this interaction effect and a reexamination of the previous literature Russell and Mehrabian (1976) suggested a modification of the inverted-U hypothesis. Figure 2-4 summarizes this new pleasure-arousal hypothesis, which incorporates three separate relationships: (1) pleasure is positively correlated with approach; (2) the relationship between arousal and approach describes an inverted-U function and (3) an interaction effect in which approach is generally positively related to arousal when pleasure is experienced, but generally negatively related with arousal when displeasure is experienced.

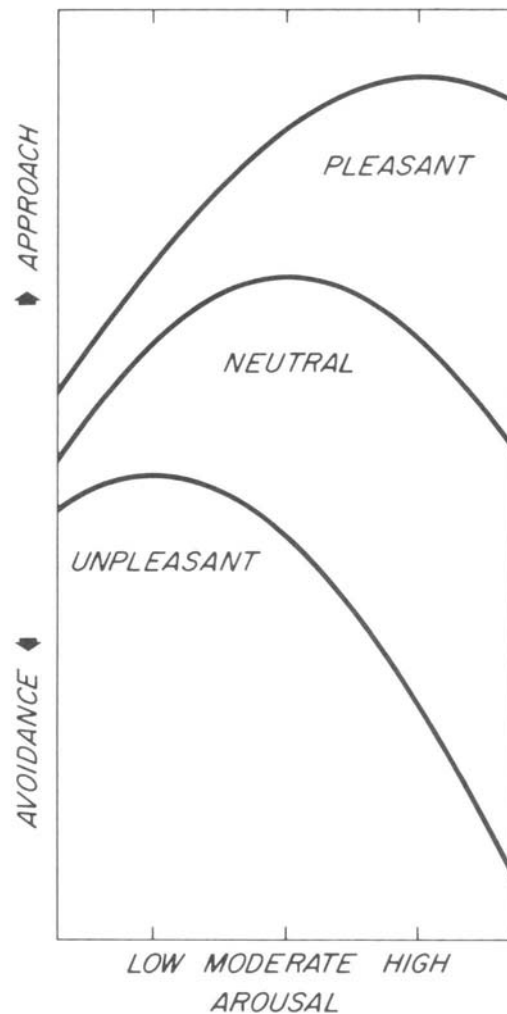


Figure 2-4: Russell and Mehrabian's pleasure-arousal hypothesis, in which pleasure determines the optimum level of arousal

Source: Russell and Mehrabian, 1976

Figure 2-4 , adopted from Russell and Mehrabian (1976) shows the combined effect of these three hypothesized relationships: The inverted U-function between approach-avoidance is represented by a parabolic curve. Increasing degrees of pleasure are represented by shifts of the same curve upwards and to the right. According to Russell and Mehrabian (1976) this set of curves indicates that pleasure determines the optimum level of arousal, in that the level of arousal producing maximum approach is a direct linear function of pleasure. In extremely pleasant settings, approach would be a monotonically increasing function of arousal, whereas in extremely unpleasant settings approach would be a monotonically decreasing function of arousal. The pleasure-arousal hypothesis proposed by Russell and Mehrabian (1976) thus

predicts that the inverted U only occurs in situations of intermediate pleasantness and thus explains Mehrabian and Russell's (1974) failure to find the inverted-U in most settings.

Situations labelled extremely high or low in arousal are typically more unpleasant than the moderately arousing situations (Mehrabian and Russell, 1974; Russell and Mehrabian, 1976). Therefore, the effects of pleasure should be controlled for when investigating the effects of arousal (Russell and Mehrabian, 1976). Results, provided by Russell and Mehrabian (1976) demonstrate that pleasure determines the desired level of arousal, a result not predicted by the simple inverted-U relation of arousal with approach.

Russell and Mehrabian (1976) speculate that approach behaviours as the desire to purchase increase with the pleasantness of the setting, and since arousal has a curvilinear relationship with approach behaviour, that desire is maximized in settings, which evoke an intermediate level of arousal. Thus, the model actually specifies a conditional interaction between pleasure and arousal in determining approach-avoidance: in pleasant environments, arousal should be positively correlated with approach behaviour (H1), whereas in unpleasant environments high arousal is expected to be negatively correlated with approach behaviour (H2).

In a retailing context, Donovan and Rossiter (1982) found arousal to be a significant predictor only of affiliation measures. They conclude (p50): "Arousal is not significantly related to approach-avoidance with the particular exception of affiliation". Nevertheless, when considering a pleasure-arousal interaction, Donovan and Rossiter (1982) found support for the first hypothesis, that for pleasant environments there is a positive correlation of arousal with approach intentions. As they were unable to collect information from enough customers who experienced the environment as unpleasant, they could not verify the second hypothesis.

In an extension of this original study, Donovan et al. (1994), were able to verify part of the second hypothesis, but failed to find support for the first one. They found arousal to account for spending less than intended in unpleasant store settings. In this study approach-avoidance was not measured by approach intentions, but by means of actual behaviour variables: 'extra time spent in the store' and 'unplanned spending'. Emotions experienced in the store were related to a comparison of pre-measures of estimated spending and time to be spent in the store and post-measures of actual spending and actual time spent in the store.

In a study focussing on music, Holbrook and Gardner (1993) found clear evidence for the interaction effect.

Flicker and Speer (1990) could not reveal a significant relation between arousal and the response variables (avoidance - attraction; intended - actual behaviour), neither for the experimental renovated store, nor for the control store (i.e. the same store before renovations).

Sherman et al. (1997) on the other hand, found arousal to have a positive influence on money spent in the store, number of items purchased and time spent in the store. According to their study, arousal did not appear to have a significant impact on store liking.

Results from a maximum likelihood regression analysis (LISREL 8) by Van Kenhove and Desrumaux (1997) also clearly show the importance of the arousal scale. According to their results, arousal is significantly related to the three dependent approach-avoidance sub-constructs (i.e. time, affect and affiliation). Because the sample by Van Kenhove and Desrumaux (1997) was composed of first-time visitors only, a substantial number of people included in the sample (41%) rated the store environment as unpleasant, in contrast to the Donovan and Rossiter (1982) study that included mainly pleasant scores. As pleasure and arousal appeared to be highly correlated ($r = .78$), the authors propose that both pleasure and arousal are necessary conditions for general approach behaviour intentions. In accordance with this hypothesis, in pleasant retail environments with high arousal, the approach intentions were found to be most positive. In unpleasant retail environments with low arousal, the approach intentions were found to be most negative. These results are, however, not in line with the bi-directional influence of pleasure and arousal in the M-R model. Reducing arousal in an unpleasant store environment is not found to increase approach, in this study. Therefore, support was found for the first, but not for the second hypothesis of the M-R interaction effect.

As findings regarding the role of arousal as an antecedent of approach-avoidance behaviour are ambiguous, even with regard to the hypothesized interaction effect, clearly more research is needed on this subject.

2.7.3. THE EFFECTS OF DOMINANCE ON APPROACH OR AVOIDANCE BEHAVIOURS

According to Donovan and Rossiter (1982) the dominance-submissiveness elicited by a store refers to the degree to which a person feels in control and feels free to act in the store. Control is widely accepted as a human driving force (White, 1959; Averill, 1973). Environmental psychologists, Proshansky, Ittelson and Rivlin (1974) have suggested that people tend to feel and behave more positively when they perceive to have more control in the environment. Schutz (1966) also suggested that a feeling of control is essential to having satisfactory interactions with other people. Although Mehrabian and Russell (1974) originally suggested a positive effect of feelings of dominance on approach behaviours, Russell and Mehrabian (1976) refrained from suggesting how feelings of dominance elicited by environments might affect consumer behaviour. In fact, conceptualising affective responses to the environment, Russell and Pratt (1980) deleted the dominance dimension altogether, arguing that dominance requires a cognitive interpretation by the individual and is therefore not purely applicable in environments calling for affective response.

In a retail setting, Donovan and Rossiter (1982) demonstrated that the dominance dimension failed to predict approach-avoidance behaviours. They found that dominance does not strongly affect in-store behaviour. Greenland and McGoldrick (1994) also report associations between *pleasure* and *arousal* and customers' ratings of traditional and modern bank designs, but not for *dominance*.

Hui and Bateson (1991) who operationalized perceived control combining the Mehrabian and Russell (1974) dominance scale and a helplessness scale, could not reveal a direct relationship from perceived control to approach-avoidance. Perceived control was found to be a positive determinant of pleasure, which in turn appeared to exert a positive effect on approach-avoidance.

Thus, for theoretical reasons (Russell & Pratt's, 1980 conceptualization) as well as for a lack of empirical support (e.g. Donovan & Rossiter, 1982; Greenland and McGoldrick, 1994), several researchers investigating atmospheric effects of the store environment using the Mehrabian-Russell model, have disregarded the dominance dimension and simply researched the pleasure and arousal dimensions (e.g. Donovan et al., 1994; Van Kenhove and Desrumaux, 1997). Therefore dominance has received little attention in atmospheric research.

Nevertheless, according to Foxall (1997) and Foxall and Greenley (1999) the failure to find a role for *dominance* might have been predictable given the ad hoc manner in which consumer settings have been selected for test and the single type of consumer setting used in each of these studies. Turley and Milliman (2000) agree that the findings with regard to dominance may be context specific and depending on the independent store environmental variables investigated.

With regard to music, for example, Yalch and Spangenberg (1988) found that environmental music conditions did not significantly affect pleasure nor dominance. Only arousal was significantly affected by store music. In contrast, with regard to retail crowding, the findings of Bateson and Hui (1987) suggest that dominance is positively correlated with pleasure and personal control and negatively correlated with crowding. In a subsequent crowding study by Hui and Bateson (1991), similar results were obtained.

Babin and Darden (1995) suggest that the lack of findings associated with dominance in previous studies involving retail store environments may also be due to the moderating impact of personality (Bitner, 1992) that has all too often been ignored. Indeed, consistent with previous research, Babin and Darden (1995) also find that feelings of dominance appear unimportant when considering their entire sample. However, integrating the moderating role of self-regulation tendency, they find that only state-oriented shoppers² appear to be negatively influenced by feelings of domination (with a path coefficient of -.49 as compared to a path coefficient of .02 for action-oriented shoppers). Based on these findings, Babin and Darden (1995, p61) emphasize that “*rather than dismissing dominance, as some studies have done, future theory development should include dominance as an important emotion influencing shopping behaviour*”.

Investigating a variety of consumption contexts, selected according to the Behavioural Perspective Model, Foxall (1997) succeeded to demonstrate for the first time how all three independent variables – pleasure, arousal and dominance – impact consumers’ approach

² Based on consumers’ self-regulation tendency (Kuhl, 1986), Babin and Darden (1995) make a distinction between shoppers who are “action” oriented (who strongly hold on to original intentions) and people who are “state” oriented (who are more susceptible to social and emotional influences and therefore to competing, contextually derived action tendencies).

behaviour. In view of the failure of previous research to establish the role of dominance, the role of this factor was especially underscored.

Also Gröppel-Klein (1998) calls for the possible importance of the dominance factor with regard to its effect on price acceptability.

2.8. ATMOSPHERIC EFFECTS ON SHOPPING BEHAVIOUR: A REVIEW OF EMPIRICAL EVIDENCE

Turley and Milliman (2000) give an extensive overview of the empirical findings with regard to atmospheric effects on shopping behaviour. The accumulated empirical evidence, clearly shows that shoppers can be induced to behave in certain ways, based on the atmosphere created by retail management. Out of 28 articles examining the effect of the atmosphere on sales, cited in their review, 25 found some significant relationship between the environment and customer purchasing behaviour. The review presented by Turley and Milliman indicates that atmospheric variables influence a wide variety of consumer evaluations and behaviours. Turley and Milliman (2000, p209) conclude: *“Although there may be some debate about whether the atmosphere can influence time spent in an environment, there is enough evidence to be able to clearly state that the atmosphere has an effect on consumer spending and that variations of atmospheric variables affect the amount of money people spend and the number of items they purchase”*.

In this regard, Chebat and Dubé (2000) point to the need for managers in the retailing industry to develop a better understanding of the interface between the resources they manipulate in atmospherics and the experience they want to create for the customer. Van Kenhove and Desrumaux (1997) also called for further research to determine what stimulus factors constitute pleasant and/or arousing environments. In this study, the specific effects of colour in the store environment will be further investigated, based on the environmental psychology model just presented. Before formulating the actual research objectives and the proposed hypotheses, a review on the literature concerning the effects of colour in general will be provided in the next chapter.

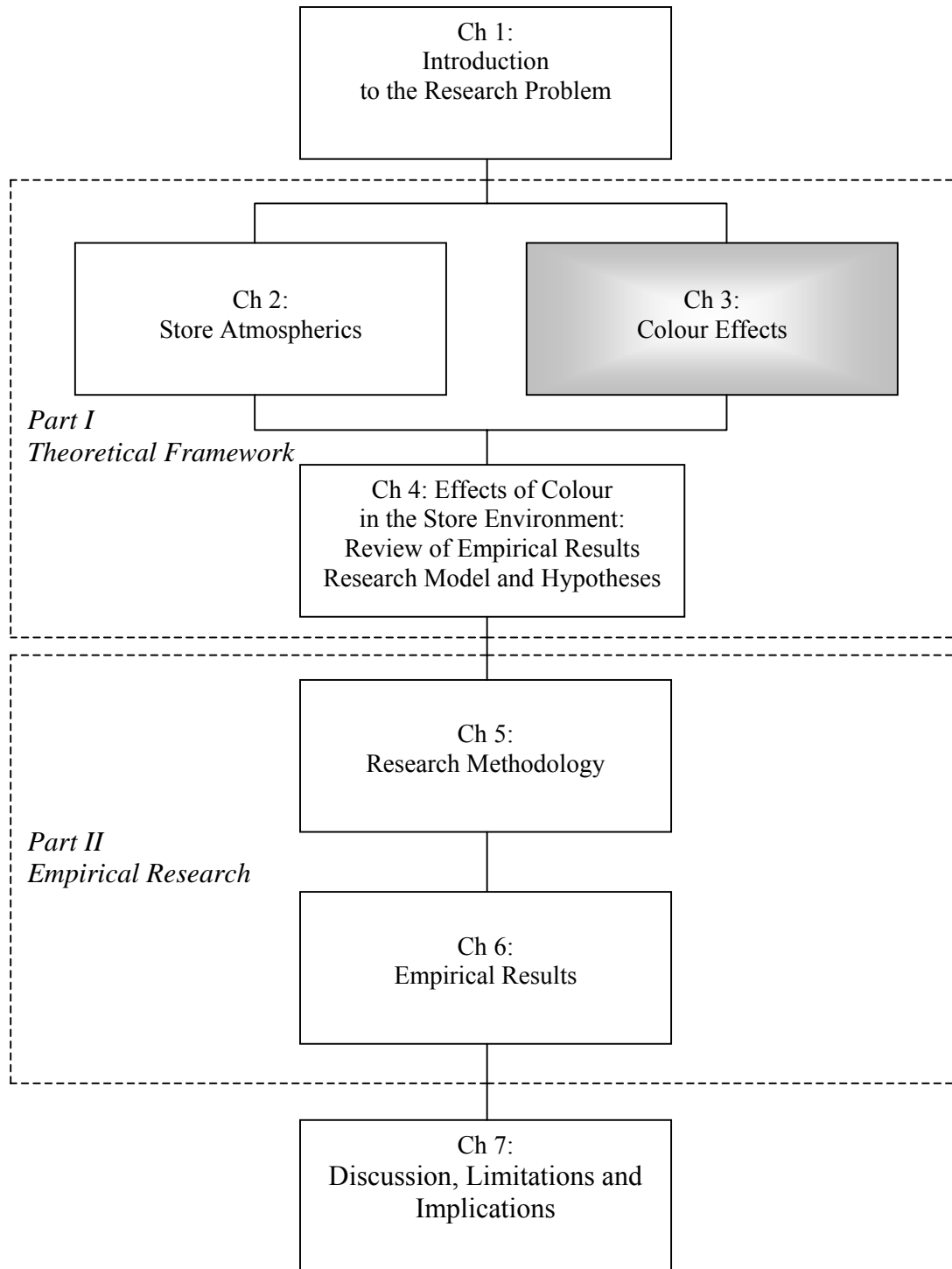
*Complex decisions
on the design and management
of retail atmospherics
are frequently made
on the basis of a dearth of information
that in other domains would be unimaginable.*

CHEBAT & DUBÉ

2000

Chapter 3

Colour Effects



CHAPTER STRUCTURE

Chapter 3: Colour Effects

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"The keenest of all our senses is the sense of sight"

CICERO

3.1. INTRODUCTION

Touching, tasting, smelling, hearing and seeing are the senses through which we perceive the environment surrounding us. However, our sight prevails, with 90 percent of what we know of the world coming to us through our vision (Swirnoff, 1989). An extremely important factor in visual perception is colour. Research suggests in fact that colour determines whether we see stimuli (Lindsay and Norman, 1973). According to Nassau (1983), colour is perceived by the eye and interpreted by the brain. What we see is the light that reflects off objects which enters the eye and registers these objects in our brains. Thus, the eye's retina absorbs the light and sends a signal, or sensation, to the brain, which makes us aware of a characteristic of light, namely colour (Herman Miller, 2001). In this respect, the phenomenon of colour is only a subjective visual sensation, produced by light and not a property of a given object (Wineman, 1979; Porter and Mikellides, 1976a).

Theories of colour have been devised for centuries. Nassau (1983) traces the historical roots of colour *“from the philosophy of Plato where colour belonged unaccessibly in the realm of divine Nature, to the calculations of Newton, who discovered the spectrum and arbitrarily assigned to it seven fundamental colours, analogous to the seven notes of the musical scale”* (cited in Beach et al., 1988, p3).

The use of colours as decoration in living (and working) environments has also received a good deal of attention (Beach et al., 1988; Birren, 1983; Wineman, 1979; Porter and Mikellides, 1976a, 1976b). In a critical review on the human factors of colour in environmental design, Beach et al. (1988) affirm that it was not until the late 1800's, with the advent of introspection, that colour was systematically investigated in a behavioural context. Nevertheless, the succeeding years have seen a plethora of research generated on the topic (Berlin and Kay, 1969; Kuller, 1981; Plack and Shick, 1974; Sucov, 1973; Hayward, 1972). We refer to Beach et al. (1988) for an extensive overview on this subject.

In this chapter we will focus more specifically on how colour is perceived and on the three distinct attributes of colour (hue, saturation and brightness). Moreover, we will give a detailed overview on human affective, cognitive and behavioural responses to colour. In the mean time, we will review the methodological concerns regarding colour research.

3.2. COLOUR PERCEPTION

Colour is our perceptual response to a very narrow span (less than 1%) of the total electromagnetic radiation emitted by the sun (Handprint Media, 2001). The wavelengths of the visible spectrum (light) range from about 380 to 750 nanometers. The invisible radiation at wavelengths shorter than 380 nanometers (higher energy) is called ultraviolet and includes x-rays and gamma rays; lower energy radiation at wavelengths longer than 750 nanometers is referred to as infrared, including heat, microwaves, television and radiowaves (Handprint Media, 2001). The electromagnetic spectrum is illustrated in figure 3-1.

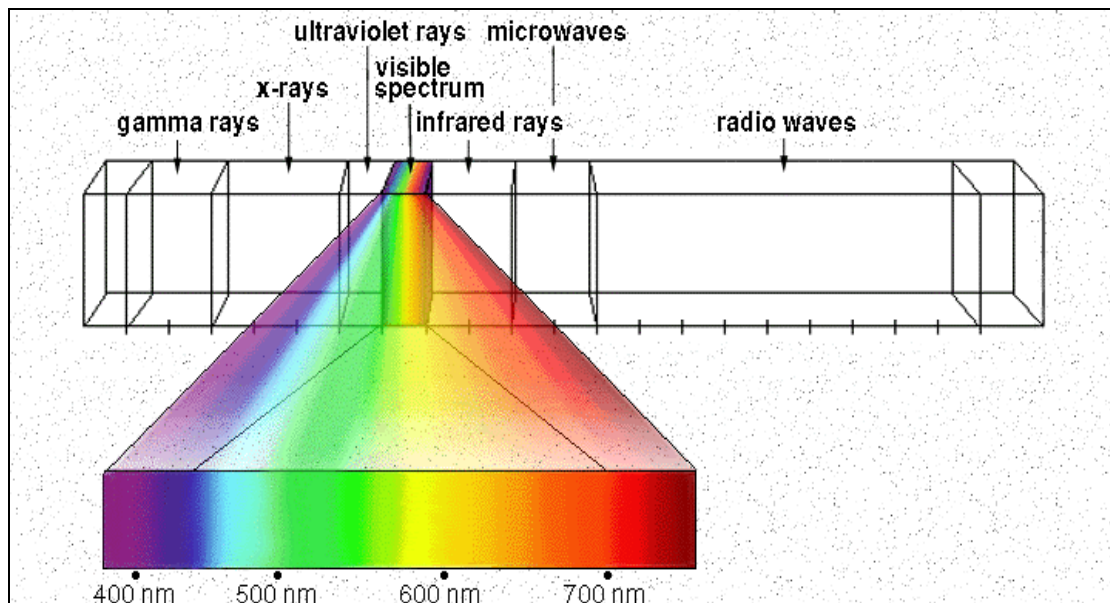


Figure 3-1: The electromagnetic spectrum

Source: Laura Funderburk, 2/03/2001

3.2.1. THE TRICHROMATIC THEORY OF COLOUR VISION

The National Bureau of Standards estimates that the human eye can distinguish over 10 million different colours (Herman Miller, 2001). However, according to the *trichromatic theory of colour vision*, our perception of these millions of colours depends on just three distinct colour receptors in the eye. This theory presents a framework universally used, both to specify colour stimuli and to define how the eye interprets colour from light (Handprint Media, 2001).

Without any knowledge of the nature and number of human photoreceptor cells, but based solely on his observation that all colours could be matched by a suitable mixture of three primary colours, Young proposed already in 1807 that there must be three fiber types in the human eye. Von Helmholtz (reprinted 1924) later formalized Young's "*trichromatic theory*" proposing hypothetical excitation curves for each of the three fiber types in order to make quantitative predictions of the ability to make discriminations on the basis of wavelength. The general idea of *trichromacy*, which thus was totally based on the results of psychophysical colour matching experiments, soon became accepted doctrine (Levine, 2000).

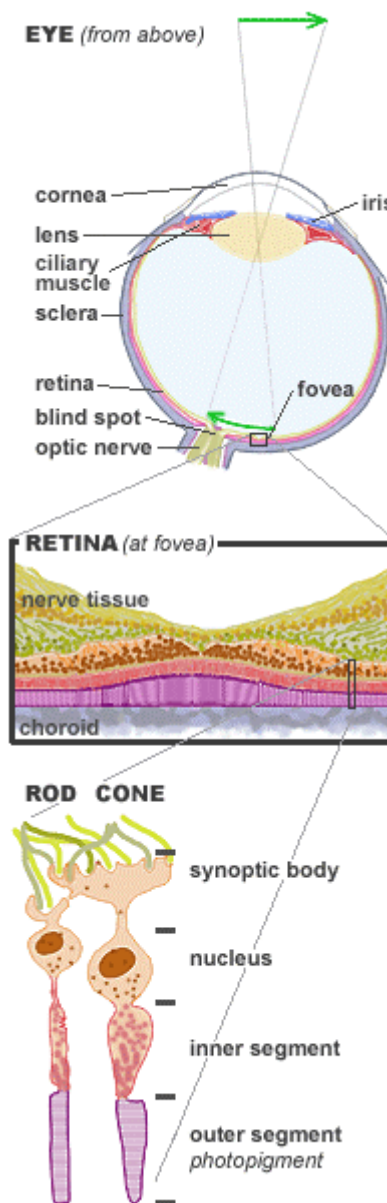


Figure 3-2: Three levels of structure in the eye

Source: Handprint Media, 2001
<http://www.handprint.com/HP/WCL/color1.html>

Later on, a firm physiological foundation was uncovered for the *trichromacy* of human vision. In fact, the eye appears to contain, between the retina and the sclera, two kinds of receptors: rods and cones, as illustrated in figure 3-2. While the rods convey shades of gray, the cones allow the brain to perceive colour hues. In fact there are three types of colour receptor cones, which are more sensitive to different wavelengths of light (according to the type of photopigment they contain): long wavelength or “red” (R) cones (which are actually most sensitive to “greenish yellow” wavelengths around 565 nm), middle wavelength or “green” (G) cones (most sensitive to ‘green’ wavelengths at 530 nm), and short wavelength or “blue” (B) cones (most sensitive to ‘blue’ wavelengths at 435 nm) (Brown and Wald, 1964; Marks et al., 1964, Merbs & Nathans, 1992; Neitz et al., 1995). The graphs in figure 3-3 below, demonstrate how each cone presents a curve of relative sensitivity across the entire spectrum.

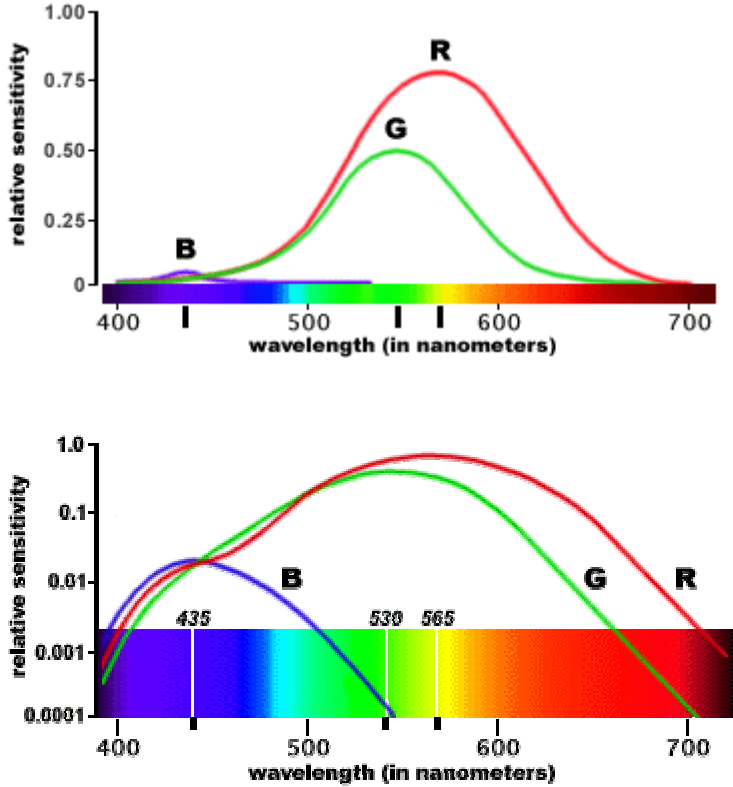


Figure 3-3: Cone spectral sensitivity curves (above: normal vertical scale, below: log vertical scale)³

Source: Smith and Pokorny, 1972, adopted from Handprint Media, 2001 (<http://www.handprint.com/HP/WCL/color1.html>)

³ Note that the cone spectral sensitivity curves in the graph above are displayed on a normal vertical scale, demonstrating clearly the low sensitivity at the extremes, making it obvious that each type of cone responds primarily to light with wavelengths close to their maximum sensitivity. In order to expand the detail of the graph at very low sensitivity, in the graph below the same curves are represented using a logarithmic or exponential scale on the vertical axis with each interval ten times larger than the previous one.

This peak response around the cone's most sensitive wavelength is the reason why colour vision can be modelled as a mixture of three "primary" colours of light, as discovered earlier from psychophysical colour matching experiments (Smith, Pokorny & Starr, 1976; Levine, 2000).

The large differences in the height and spread of the curves (the probability that a cone of each type will respond) arise in part because of the unequal proportions of R, G and B cones in the retina of the eye. About 64% of the colour receptor cells are long wavelength R cones, 32% are mid wavelength G cones and 4% short wavelength B cones (Handprint Media, 2001).

If a cone is sufficiently stimulated by light, anywhere within its range of sensitivity, it generates an invariable nerve impulse. Because this way information about the specific light wavelengths that stimulated the individual cones is lost, which is referred to as "*the principle of univariance*"⁴, the responses from all three types of cones must be combined to "triangulate" to the dominant wavelengths in the light (Abramov & Gordon, 1994; Levine, 2000).

3.2.2. OPPONENT COLOUR PROCESSING

While trichromatic theory accounts for many characteristics of human colour vision, there are a number of visual phenomena, which are not easily explained by this model (Abramov & Gordon, 1994; Levine, 2000). Data accumulated from experiments on colour afterimages, complementary colours and colour naming have given rise to an alternative model for the perception of colour, referred to as "*opponent process theory*", introduced by Ewald Hering in 1878.

Hering proposed that colour vision is mediated by three complex 'substances', also referred to as 'opponent processes', which account for the distinction between respectively red/green, blue/yellow and white/black. These 'substances' or 'processes' were postulated to be

⁴ The "*principle of univariance*" refers to the fact that "*each visual pigment can only signal the rate at which it is effectively catching quanta; it cannot also signal the wavelength associated with the quanta caught*" (Naka & Rushton, 1966, p538).

‘opponent’, which means that, for instance, the red/green ‘substance’ responds in opposite directions to red and green lights (i.e. it may be excited by red light and inhibited by green light).

Thus opponent processing induces four chromatic channels (four unique hues: red, green, yellow and blue) as well as two separate channels of luminosity information (white and black). These six fundamental colour sensations can combine to produce any colour giving way to a “natural colour system” (Hering, 1878, 1920).

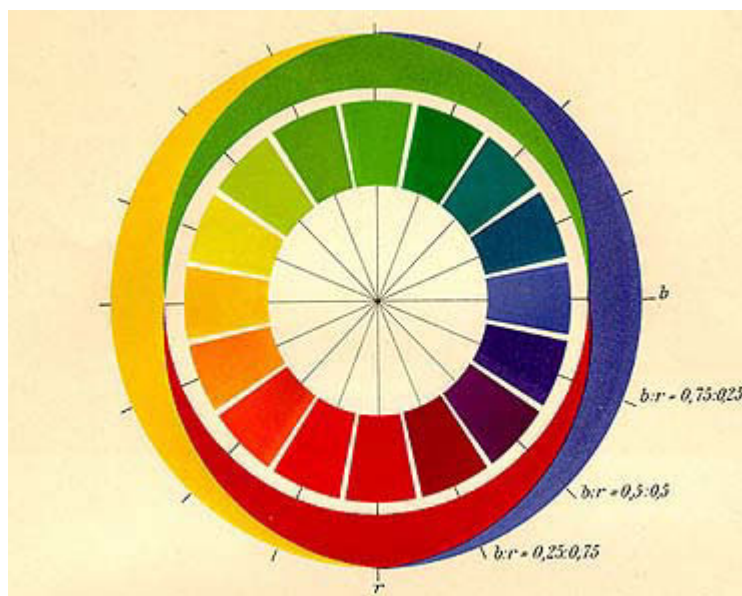


Figure 3-4: A colour circle derived from opponent colour processing
Source: From the original illustrations by Ewald Hering (1920)

Figure 3-4 (Hering, 1920) illustrates how the four unique hues create a colour circle. The two opponent colour pairs (red opposed to green and yellow opposed to blue) are placed opposite each other on the outer circle. These pairs define two opponent colour contrasts that never mix. A line through any part of this mixing ring indicates the relative proportions of two unique colours necessary to create the hue samples shown in the inner colour circle. Experimental evidence however demonstrates that the mixing of opponent colours is neither as symmetrical nor evenly spaced across the visible spectrum as the schematic representation by Hering implies (Handprint Media, 2001).

Although opponent process theory can explain a large variety of visual phenomena that cannot be explained by trichromatic theory (e.g. Hurvich & Jameson, 1957), it was criticized for many years due to a lack of physiological evidence (Levine, 2000). The basis of this criticism disappeared with the discovery of +R-G and -R+G (red-green opponency) and +B-Y and -B+Y (blue-yellow opponency) cells, which actually appear to be some sort of opponent processing cells (DeValois et al., 1966 and 1974; Wiesel and Hubel, 1966; Gouras, 1968; DeMonasterio et al., 1975; Dacey, 1996; Calkins et al., 1998).

3.2.3. THE TWO-STAGE PROCESS OF COLOUR VISION

Throughout the first half of the 20th century, the trichromatic theory (based on outputs from three types of cones) and Hering's opponent processing theory (including the four unique hues) were seen as competing explanations of colour vision. It was only after the middle of the century that scientists recognized that both were necessary to explain colour. In fact, the "opponent processing theory" does not contradict the "trichromatic theory", but actually extends it (Levine, 2000). This is referred to as the "two-stage model" of colour vision.

The trichromatic model describes how the combined outputs from three types of receptors can code any combination of light wavelengths. The opponent processing model explains then how those receptor codes are translated into two colour dimensions (with a luminosity dimension) that are the foundation of conscious colour perceptions, a process which also has been referred to as 'remapping' (Hurlbert, 1991). Thus, colour vision begins in a trio of receptor cells that respond preferentially to different wavelengths of light. These three types of cells are interconnected with other processing cells in the retina to produce at least six types of visual information, interpreted as colour by the mind. The translation from receptor responses to opponent codings happens in the retina of the eye: therefore the brain never "sees" the trichromatic outputs (Hurlbert, 1991, 1997; Levine, 2000; Handprint Media, 2001).

In the retina of the eye, colour information is actually synthesized before it is sent to the brain. Other cells in the retina transform the cone outputs into separate channels of colour information. Figure 3-5 shows the basic neural programming used to transform the raw R, G, and B cone responses through "opponent processing" (comparing responses of one cone against the others) into four new channels of chromatic 'colour' signals, and a channel of

achromatic (colourless) brightness or luminosity signal (Hurvich & Jameson, 1957; Hurlbert, 1991, 1997; Handprint media, 2001).

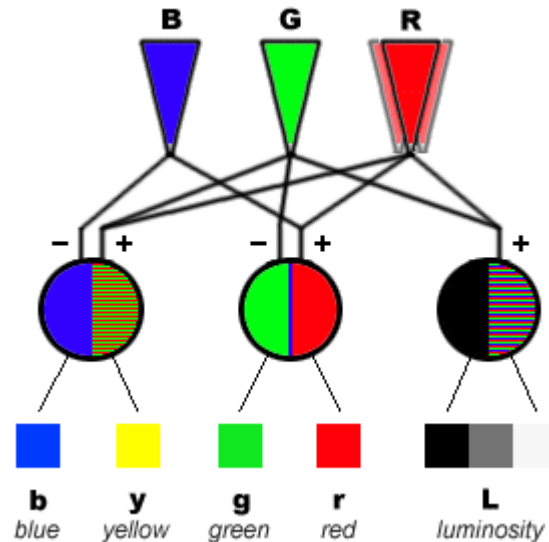


Figure 3-5: Opponent processing of cone outputs
 Source: Handprint Media, 2001
 (<http://www.handprint.com/HP/WCL/color1.html>)

This neural colour circuitry can be summarized as a few basic rules of colour vision (Handprint Media, 2001):

- “The combined stimulation of the R and G cones (right circle in figure...) is interpreted as the brightness or *lightness* of a colour.” Luminosity (light/dark) is the dominant visual information recorded by the eye.
- “The relative proportion of stimulation received by the R cones in contrast to the G cones (central circle in figure...) creates the perception of *red* or *green*.”
 (The B cones contribute slightly to clarify warm colour saturation)
- “If the R and G cones are stimulated approximately equally (and much more than the B cones), we see the colour *yellow*.”
- “The relative proportion of stimulation received by the B cones, in contrast to the R and G cones combined (left circle in figure ...), creates the perception of *blue*.”
- “If all three types of cones are stimulated approximately equally, we see no specific hue, but *white*, *grey* or *black*.”

Thus, the opponent processes are formed by subtractive interactions among the three cone-types. This processing occurs in the retina, rather than in the brain, because these ‘processed’ colour impulses can be sent through the optic nerve with much less “noise” or error than the raw cone outputs. Finally, the optic nerves from both eyes lead to an area in each side of the brain, called the lateral geniculate nucleus (LGN). In that part of the brain colour, edge and spatial (depth) information from both eyes are processed once again. From the LGN, visual data travel to the visual cortex and from there radiate to many other areas of the brain involving language, body movement and long term memory.

‘Optics’ is the branch of science that analyses the mechanisms we use to perceive colour – the rods and cones of the eye’s retina (Herman Miller, 2001). In this context, numerous experiments have been conducted with regard to colour perception and discrimination. It is, however, beyond the scope of this research project to expand on this issue. We intended to give an initial introduction with respect to colour vision in order to clarify some important colour related concepts that we will be referring to in the following paragraphs. For the interested reader, some critical assessments with regard to visual processing mechanisms are provided by Wright (1984), Hurvich (1981), Boynton (1979), Abramov & Gordon (1994), Hurlbert (1997) and Levine (2000).

Not everyone has the same colour discriminating abilities. In the next paragraph we will present a detailed discussion on colour blindness, a visual defect leading to the confusion of colours.

3.2.4. COLOUR BLINDNESS

Colour blindness is a visual defect resulting in the inability to distinguish colours (Medical Post, 1997; Neitz, 1998). There are many different kinds of colour defects (see Levine, 2000, p317-319). Completely colour-blind individuals can recognize only black, white, and shades of grey. This congenital condition of total colour blindness, in which all hues are perceived as variations of grey is called “*monochromatism*” or “*achromatopsia*”⁵ and is extremely rare

⁵ For a discussion on the difference between “achromatopsia” and “monochromacy”, we refer to Levine, 2000, p319.

(Sewell, 1983). Most “monochromats” lack all three cone types (discussed earlier in paragraph 3.2.1.), leaving only the rod photoreceptors to mediate the visual process.

A much more common colour defect is “partial colour blindness” or “*dichromatism*”. Indeed, most “colour-deficient” persons can see colours, but not in the same way as those with full colour vision (Rosenthal & Phillips, 1997; Wilson, 1998; Kaufman-Scarborough, 2000). In fact, one can be blind to one or more primary colours, leading to “colour confusion”, which would be a more accurate term for this condition (Sewell, 1983). Most of those with defective colour vision are only partially colour-blind to red and green, i.e., they have a limited ability to distinguish reddish and greenish shades (illustrated in figure 3-6).

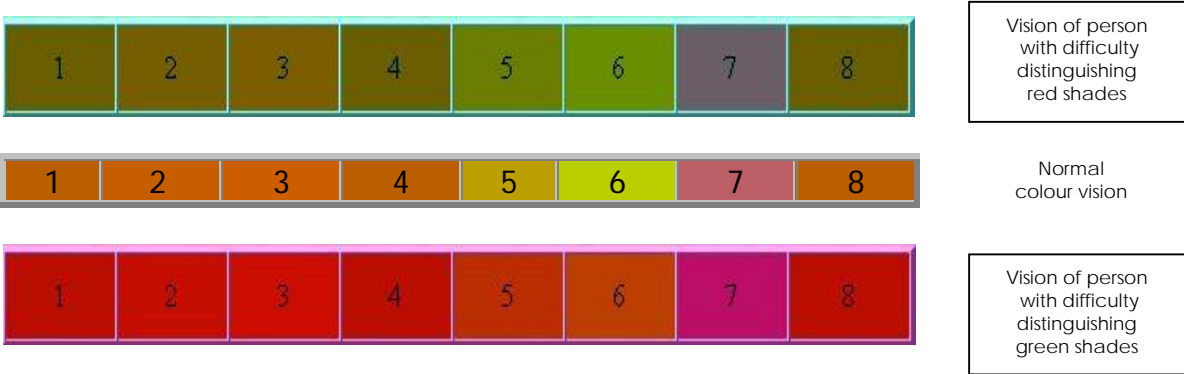


Figure 3-6: Illustration of deficient colour vision
 Source: Holland s., 2001

In fact they are missing one of the three cone pigments: “*protanopes*” lack the long-wavelength-sensitive pigment, and have therefore a difficulty distinguishing red shades, while “*deutanopes*” lack the medium-wavelength-sensitive pigment and have a difficulty distinguishing green shades (Nathans et al., 1986 a, b; Neitz et al., 1996). Those who are completely colour-blind to red and green, miss both cones and see both colours as a shade of yellow.

Colour vision deficiency, which depends on the light-sensitive pigment contained in the cone cells of the eye, is usually an inherited sex-linked characteristic (transmitted through, but recessive in, females) (Nathans et al., 1986 a, b; Neitz et al., 1996). Colour blindness can also be acquired as a result from certain degenerative diseases of the eyes. The colour vision of perfectly colour-normal persons can be affected over time by age, progressive illness (such as multiple sclerosis, leukemia, glaucoma, diabetes or Alzheimer’s) or the use of certain

medications and can change subtly, either temporary or permanent (Braus, 1995; Wilson, 1998). Thus an individual who has had normal colour vision, may not realize a gradual decline in perceptual ability for some time.

The estimates concerning the actual number of persons suffering from colour vision deficiencies vary slightly. Buehler (1996) reports that 1 in 12 men (i.e. 8%) and 1 in 65 women (i.e. 2%) have a colour deficiency. Others suggest that 8 to 12 % of men and 0.4 to 0.5 % of women experience some difficulty in colour perception (Piantanida, 1988; Henthorne, 2000; Medical Post, 1997; Nash, 1994). Within the United States, estimates range from 19 million persons with congenital colour deficiencies (Corsino, 1985; Sewell, 1983) to approximately 41 million, including acquired colour deficiencies (Castleman, personal communication, cited in Kaufman-Scarborough, 2000). In contrast to partial colour blindness, which is obviously sex-linked, complete colour blindness, or *monochromatism*, affects men and women almost equally (Sewell, 1983).

Colour blindness is usually not related to visual acuity; and therefore, only significant when persons who suffer from it seek employment in occupations where colour recognition is important, such as airline pilots or railroad engineers, who must recognize red and green traffic signals (Wald, 1997) or in industries using colour coding such as for electrical components, chemicals and pharmaceuticals (Voke, 1998). Nevertheless, examining the impact of colour-deficient vision upon consumer emotions, enjoyment, efficiency and safety-related aspects of shopping, Kaufman-Scarborough (2000) reveal some prevalent problems and needs of colour deficient consumers that are infrequently addressed. Colour cues may not be processed and interpreted as intended and some information may be obscured, which may result in packaging design becoming illegible, or signing becoming indistinguishable. Kaufman-Scarborough (2000, p462) note that colour deficiencies are not typically addressed in marketing: “Studies of consumer reactions to retail, advertising, packaging and other informational cues traditionally assume that typical consumers have a relatively standard range of colour abilities (Edell & Staelin, 1983; Lee & Barnes, 1990; Meyers-Levy & Peracchio, 1995)”. In order to accommodate for the colour blind, Kaufman-Scarborough (2000) recommends to test alternative colour combinations on packaging, store displays, store signs, advertising copy and websites by means of specific software programs developed to simulate how graphics are actually perceived by colour deficient consumers (Beard, 1995; Nakahara, 2000; Rigden, 2000; Vischeck, 2000; Wolfmaier, 1999).

3.3. THE THREE DIMENSIONS OF COLOUR

Precise colour terminology is an invention of the 20th century, resulting from the scientific study of colour. By the mid 19th century, colour scientists concluded that three colour-making attributes serve extremely well to describe and predict conscious colour judgements. Although there are many slightly different colour description systems, most are based on these three colour-making attributes (Handprint Media, 2001). These colour systems posit that a given colour can be described according to the three dimensions: hue, saturation and lightness (Munsell, 1966; Thompson et al., 1992; Valdez and Mehrabian, 1994; Hoyer and MacInnis, 2001, p92-93). Because colour can be totally determined by these three attributes, these properties can be used to measure the stimulus intensity of colours (Hoyer and MacInnis, 2001, p96). ‘Colorimetry’, is the branch of science which measures the colour systems developed to precisely communicate colour.

3.3.1. HUE

Hue is the most familiar colour attribute (figure 3-7). It refers to the pigment contained in the colour, such as red, blue, green, yellow, ... Traditionally, statisticians (e.g., Armore, 1973) and many colour researchers alike have assumed that colour represents a nominal variable with no natural ordering (e.g., Jacobs and Suess, 1975; Bjerstedt, 1960; Sallis and Buckalew, 1984).



Figure 3-7: Differences in hue, with saturation and value held constant

Source: Handprint Media, 2001
(<http://www.handprint.com/HP/WCL/color2.html>)

However, by using wavelength and the visible spectrum to map colours, the colour spectrum can be viewed as a continuum or ratio scale (Stevens, 1946; Crowley, 1993; Valdez and Mehrabian, 1994). Indeed, light (i.e. electromagnetic radiation emitted by the sun that

stimulates the eye), can be described as oscillations or waves. The distance required for one cycle in such a wave (from peak to peak) is referred to as “wavelength” (illustrated in figure 3-8). The wavelengths of light (the visible spectrum) range from about 380 to 750 nanometers. Waves increase in frequency (decrease in wavelength) as the radiation increases in energy.

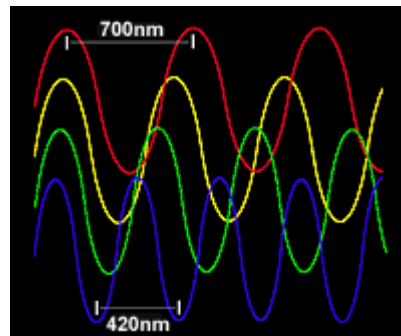


Figure 3-8: Wavelengths of light

Source: Handprint Media, 2001
(<http://www.handprint.com/HP/WCL/color1.html>)

Within the spectrum, the spectral hues do not have clear boundaries, but appear to shade continuously from one hue to the next across colour bands of unequal width. Figure 3-9 shows the visible spectrum roughly as it appears in a brilliant rainbow, fading at either end into invisible ultraviolet (UV) or infrared (IR) radiation (Handprint Media, 2001).

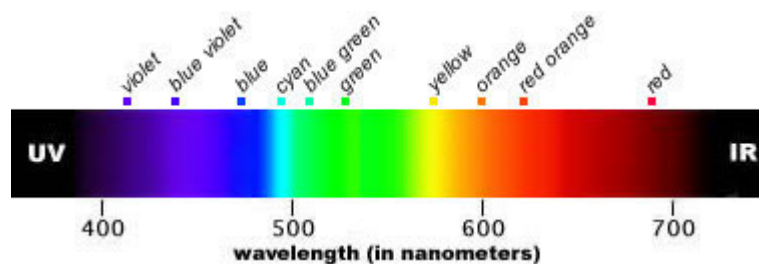


Figure 3-9: The visible electromagnetic spectrum

Source: Handprint Media, 2001
(<http://www.handprint.com/HP/WCL/color1.html>)

Hue, the term most often used to describe colours, actually refers to the dominant wavelength of the colour. Indeed, as illustrated in figure 3-10, our perception of hue is usually determined by the average or dominant wavelengths in the light we see, regardless of the total range of wavelengths present in the stimulus (Handprint Media, 2001).

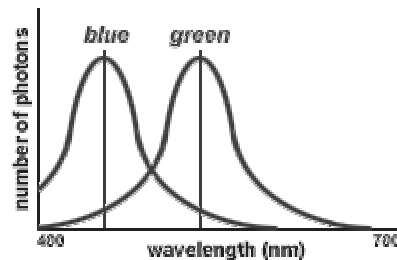


Figure 3-10: Hue denotes the dominant or “average” wavelength of light
Source: Handprint Media, 2001
(<http://www.handprint.com/HP/WCL/color2.html>)

When viewed as wavelengths of visible light, colours can be ordered from short to long wavelengths as follows: violet, blue, green, yellow, orange, red. Researchers have tended to classify colours into two broad categories or colour hues: warm, long-wavelength colours, such as red, orange and yellow, and cool, short-wavelength colours, such as green, blue and violet.

Wavelength, however, is but one of three aspects of colour. Colour stimuli can be characterized completely in terms of hue (i.e., wavelength), saturation or chroma (i.e., purity or vividness) and lightness or value (i.e., black-to-white quality).

3.3.2. SATURATION

Saturation or “chroma” refers to the intensity, richness or purity of the colour. Regardless of how light or dark, saturated (high chroma) colours are deep and rich, almost glowing, with a greater proportion of pigment in them, whereas unsaturated (low chroma) colours are dull, containing more grey. A saturated colour looks very luminous or concentrated, just as if it came through a prism, while an unsaturated colour looks dull, gray, faded or diluted. The following definition, presented by Agoston (1979, p87), may be helpful for a better

understanding of chroma or saturation: “*The Munsell chroma of a colour sample is defined as the difference from a grey of the same lightness*”. The example below (figure 3-11, adopted from Handprint Media, 2001) shows variations in saturation in a scarlet red of constant hue and lightness.



Figure 3-11: Differences in saturation, with hue and value held constant

Source: Handprint Media, 2001
(<http://www.handprint.com/HP/WCL/color2.html>)

In technical terms, saturation is the chromatic intensity of a colour, judged in relation to its own brightness. As illustrated in figure 3-12, saturation represents the spectral purity of a colour. The less the variety of different wavelengths that make up the colour, the more saturated the colour.

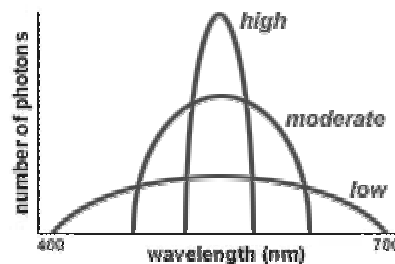


Figure 3-12: Saturation denotes the spectral purity of light

Source: Handprint Media, 2001
(<http://www.handprint.com/HP/WCL/color2.html>)

Single wavelength or mono-spectral lights are always maximally saturated. Unsaturated colours, on the other hand, are mixtures of many different wavelengths of light and do not have a narrow, precise location within the visible spectrum (i.e. they have a flat reflectance profile, comparable to the reflectance profile of grey).

As mentioned earlier, colour stimuli can be characterized completely in terms of hue (i.e., wavelength), saturation or chroma (i.e., purity or vividness) and lightness or value (i.e., black-to-white quality). This last, more familiar, colour-making attribute, which is independent of saturation, will be dealt with next.

3.3.3. LIGHTNESS

The third colour-making attribute, lightness or value, is a more familiar one and refers to the depth of tone of a colour or its black-to-white quality, i.e. the degree to which a colour varies along the white-black continuum (Farrell and Booth, 1984). More specifically, value reflects the degree of darkness or lightness of the colour, relative to a neutral scale, that extends from pure black to pure white. Low value colours have a “blackish” quality to them, as if the colour black was mixed in the pigment. High value colours have a “whitish” quality to them, as if the colour white was mixed into them. This makes high value colours pastel-like in appearance. The example below (adopted from Handprint Media, 2001) illustrates variations in tonal value for a constant dull (unsaturated) middle blue hue.



Figure 3-13: Differences in value, with hue and saturation held constant

Source: Handprint Media, 2001
(<http://www.handprint.com/HP/WCL/color2.html>)

Value is determined by the total quantity of light reaching the eye from all parts of the spectrum: The diagram below (adopted from Handprint Media, 2001) clearly illustrates this: the greater the light, the higher the value (and thus the lighter the perceived colour).

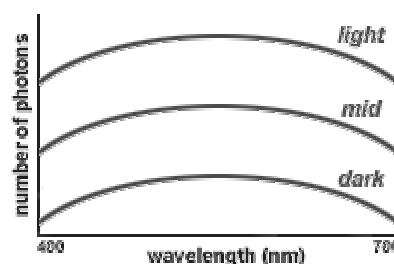


Figure 3-14: Lightness or value denotes the total quantity of light

Source: Handprint Media, 2001
(<http://www.handprint.com/HP/WCL/color2.html>)

In fact, value dominates our visual experience (Levine and Shefner, 2000). The mind relies on lightness and contrast information to infer the physical structure and surface qualities of the entire visual environment. That is why luminosity is handled as a separate channel of visual information from chromatic (colour) sensations (Handprint Media, 2001), as discussed earlier. To perform this critical function across the widest possible range of illumination, the eye and mind are continuously adjusting apparent values to accommodate the total visual context and to draw the maximum amount of contrast from available light. Our “objective” judgment of value suffers as a result.

Note that the lightness and the saturation of a colour are not related. For instance, a saturated pink could have a lot of lightness (a fluorescent pink) or a lot of darkness (a mauve). Although it is easy to confuse saturation (or chroma) and value (Melara et al., 1993; Melgosa et al., 2000), they really are distinct dimensions of colour, just as hue is. To eliminate any confusion, the Munsell Colour System will be elaborated on in the next paragraph, in order to give a more comprehensive view (both visually and conceptually) of how these three dimensions can be used to accurately describe colours.

3.3.4. THE MUNSELL COLOUR SYSTEM

When conducting colour research, one needs to employ a system by which colours can be quantified on the dimensions of hue, saturation (chroma) and lightness (value) (see Kelly and Judd, 1976). Available colour systems can precisely specify a colour through visual matching on these three dimensions. There are several colour calibration systems that scale colour along hue, chroma and value. The most widely used system in psychological research on colour is the Munsell System (Munsell, 1966) (Smets, 1982; Beach et al., 1988; Valdez and Mehrabian, 1994; Gorn et al., 1997).

“The Munsell colour-order system is a way of precisely specifying colours and showing the relationships among colours” (Munsell.com, 2002). The system was developed by the American painter Albert Henry Munsell between 1905 and 1916 and is based on the principle of ‘perceived equidistance’. The concept of ‘equality of differences’ means that ‘equal degrees of colour differences’ have been envisioned with regard to each of the colour attributes: “equal hue steps, equal value steps and equal chroma steps” (Kuehni, 2002, p25). Using spinning colour-tops and a self-developed photometer, Munsell established numerical scales with visually uniform steps for each of these attributes. The interested reader is referred to Kuehni (2002) for a historical perspective on the early development of this colour system. In 1943, a subcommittee of the Colorimetric Committee of the Optical Society of America performed the first systematic investigation of the psychophysical properties of the Munsell System and formulated what has come to be known as the ‘Munsell Renotation’ (Indow, 1988). The Munsell System’s ease of use and familiarity have given it near universal acceptance, making it one of the most widespread and most utilized and cited colour systems in the literature (Billmeyer, 1987). The Munsell Colour-Order System has been widely used in many fields of colour science, most notably as a model of uniformity for colorimetric spaces and has been recognized as a standard system of colour specification in standard Z138.2 of the American National Standards Institute, the JIS Z 8721 Japanese Industrial Standard for Colour, the German Standard Colour system DIN 6164 and several British national standards (Munsell.com, 2002).

Influenced by Rood’s “Modern Chromatics” (1879), Munsell first introduced his colour-sphere (A Colour Notation, 1905), placing five principle hues (red, yellow, green, blue and purple) at equal intervals around a circle and inserting – based on the principle of ‘differential

thresholds' or 'just noticeable differences' – five intermediate hues between them. This way hue can be classified into 10 equally spaced major hues: red, yellow-red, yellow, green-yellow, green, blue-green, blue, purple-blue, purple and purple-red (as illustrated in figure 3-15). The hues are arranged in such a way that opposing pairs are complementary or compensatory, which means that mixing them would result in an achromatic colour (Munsell.com, 2002; Colorsystem.com, 2002).



Figure 3-15: 10 hues represented in the Munsell Colour Circle
Source: The Munsell System of Colour Notation
(<http://www.munsell.com/munsell1.htm>)

The hue circle was then arbitrarily divided into 100 steps of equal visual change in hue, with the zero point at the beginning of the red sector (as illustrated in figure 3-16). This way hue may be identified by a number from 0 to 100, as shown in the outer circle. It is, however, more meaningful to identify hue by the hue-sector and a ten-scale step within this sector. This method of identification is demonstrated in the inner sector of the circle. The hue in the middle of the red sector is, for instance, called five red (5R). Note that the zero step is never used.

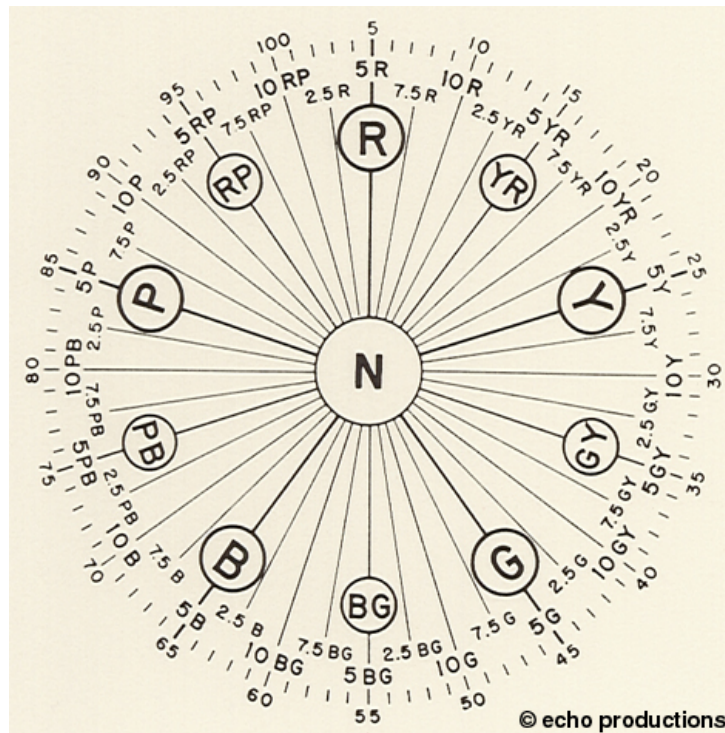


Figure 3-16: Hue designations in the Munsell Colour Circle
 Source: The Munsell System of Colour Notation
<http://www.munsell.com/munsell1.htm>
<http://www.colorsystem.com>

The value scale, which refers to the lightness of the colour, extends from 0 to 10. A value of 0 is used to symbolize pure black and a value of 10 is used for pure white. Black, white and the greytone between them are called neutral (N) or achromatic colours (i.e. they have no hue). In contrast, colours that have a hue are called chromatic colours. The value scale applies to chromatic as well as to neutral colours, with colours with low value being dark and colours with high value being light (Munsell.com, 2002).

The chroma scale, which refers to the saturation or purity of the colour, is actually the degree of departure (or perceptual distance) of a colour from the neutral colour of the same value and extends from 0 up. The scaling of chroma is intended to be visually uniform, with chroma 0 representing pure greytone or neutral colours and there being no arbitrary end to the scale. Colours of low chroma are unsaturated and weak (i.e. they appear to be mixed with grey), while those of high chroma are highly saturated, strong and vivid (Munsell.com, 2002).

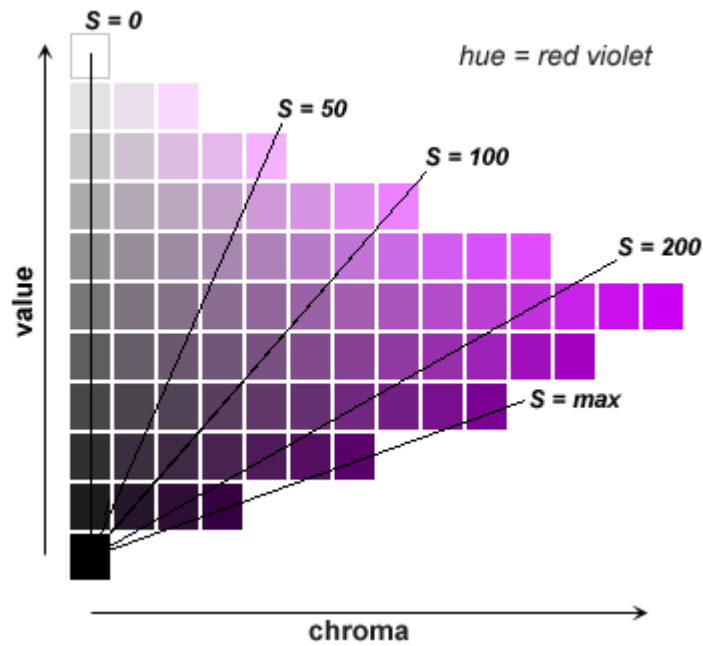


Figure 3-17: Value and chroma for a red violet hue⁶
 Source: Handprint Media, 2001
<http://www.handprint.com/HP/WCL/color2.html>

Figure 3-17 (adopted from Handprint Media, 2001), represents an array of red violet colour samples across the complete range of chroma (saturation) and value. On the vertical axis value increases along equal steps of a gray-scale or value-scale, from black at the bottom to white at the top. On the horizontal axis, chroma changes in equal perceptual steps from achromatic (gray) at the left to maximum chroma at the right. The colour patches in each row of the diagram are of the same lightness, whereas those in each column have the same chroma. The overall shape of this array (bulging in the middle) illustrates that the range of chroma is much larger in the middle values than in the extremely light or dark values. Note that as value decreases, the amount of chroma, required for high saturation, also decreases. So the lines of equal saturation are not vertical, but diagonal.

⁶ To view displays like this of all the different Munsell hues, we refer to the Gretag Macbeth website (<http://standards.gretagmacbeth.com/cmc/index.htm>, last updated March 11, 2002), from which Munsell Conversion Software - V6.13 (Win 95/98/NT/2000/XP) Conversion of Munsell > XYZ > L*a*b* > RGB > CYMK > Color on Screen - can be downloaded for free.

To make matters even more complicated, different hues reach their maximum chroma at different values. For instance, purple-blue has the highest chroma at a very dark value, making its colour array bulge near the bottom, whereas yellow has its highest chroma at a very light value, making its array bulge at the top (Handprint Media, 2001). Indeed, yellow is brighter than red, which, in turn, is brighter than violet and so on...(Colorsystem.com, 2002). For the colours yellow and purple-blue, this contrast is illustrated in figure 3-18. This particularity makes it especially difficult to do colour research. For example, although Gorn et al. (1997) intended to include yellow in their investigations –as it is a primary colour– they excluded the hue, because unlike for blue and red, for which the pattern of chromas and values is quite similar, for yellow it differs radically.

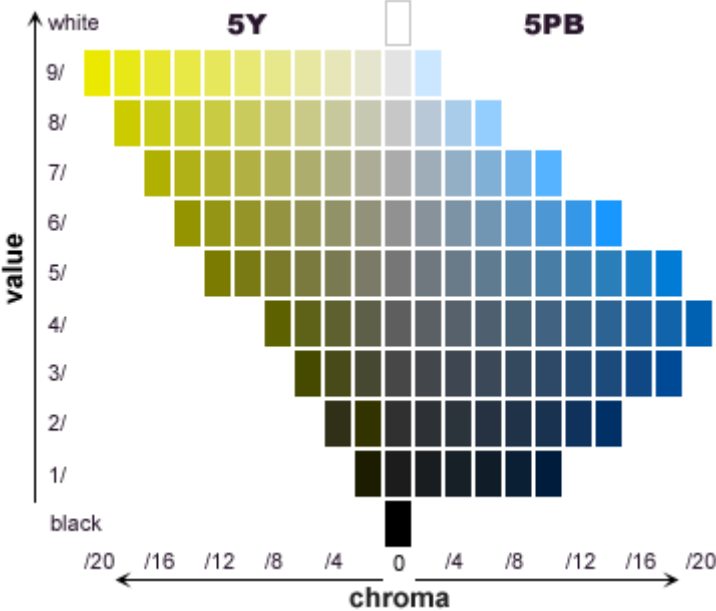


Figure 3-18: value and chroma ranges for yellow and purple-blue demonstrate that the natural colour space is highly irregular.

Source: Handprint Media, 2001
<http://www.handprint.com/HP/WCL/color6.html>

According to the Munsell System (Munsell, 1966), any specific colour can be identified accurately by quoting the levels of hue, chroma and value. The Munsell Book of Colours (1929) displays a collection of coloured chips arranged according to these scales (as illustrated in figure 3-19). Each chip is identified numerically by its hue, value and chroma, and can be represented by means of the symbols H V/C (Hue, Value, Chroma), which is referred to as the Munsell notation (Munsell.com, 2002). The notation for a neutral colour is N V/. (with chroma being zero and therefore omitted).



Figure 3-19: The Munsell System of Colour Notation
Source: <http://www.colorsystem.com>, 2002

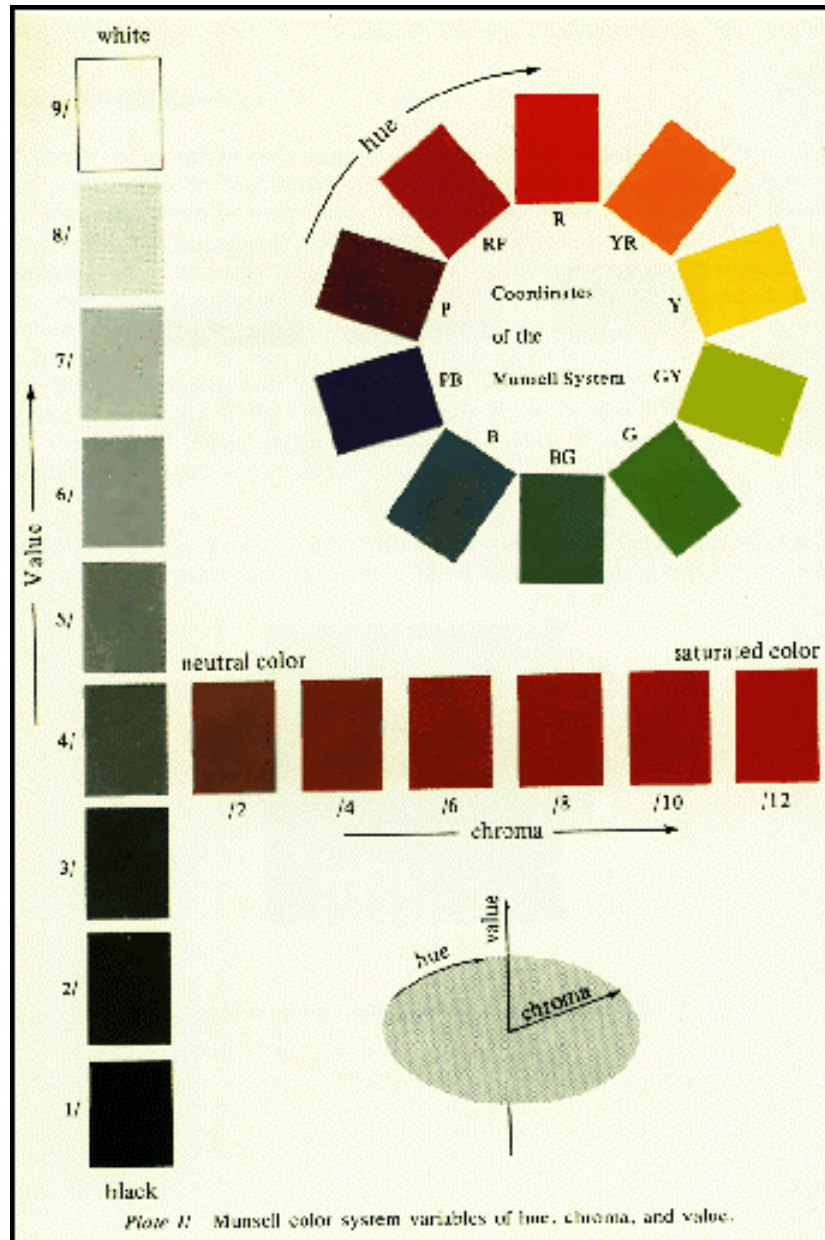


Figure 3-20: Schematic diagram of the three axes of the Munsell colour system

Source: Hall, 1979

(http://kiptron.psyc.virginia.edu/steve_boker/ColorVision2/node16.html)

Munsell hue, value and chroma can be varied independently, so all colours can be arranged according to these three attributes in a three-dimensional space (as illustrated in figure 3-20). However, because the variation in brightness among pure chromatic colours is too large for them to be arranged in sequence along the equator, a geometrically solid is unable to portray the opposing relationships between the colours, as we perceive them (Colorsystem.com, 2002).

Therefore the three-dimensional colour space can best be portrayed as a ‘colour tree’. The neutral colours are placed along a vertical line, called the neutral axis, with black at the bottom, white at the top and greytone in between. The different hues are displayed at various angles around the neutral axis. The chroma scale is perpendicular to the vertical axis, extending outward from the centre. This three dimensional arrangement of colours is called the Munsell colour space. The relationship of the three scales in three-dimensional space is illustrated in figure3-21 (Munsell.com, 2002).

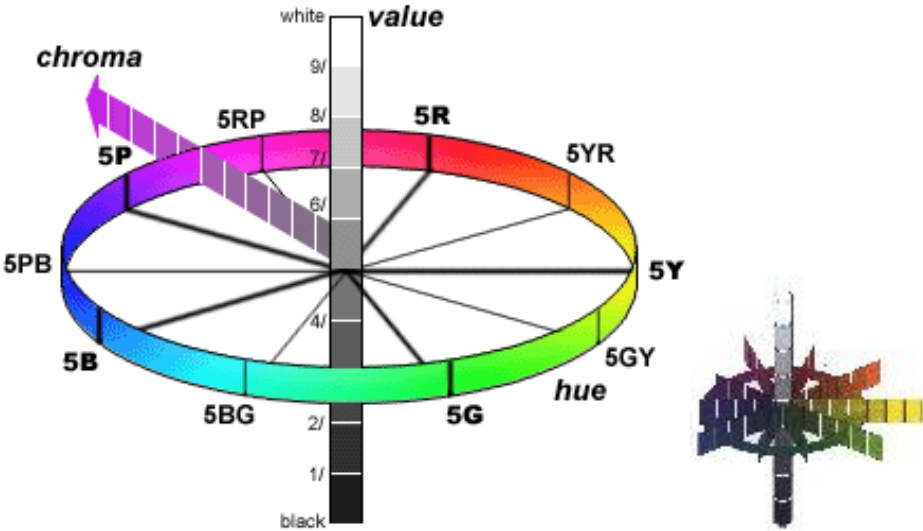


Figure 3-21: The Munsell Colour Space
 Source: Gretag Macbeth, Munsell utilities, 2002
<http://standards.gretagmacbeth.com/cmc/index.htm>
 The Munsell System of Colour Notation
<http://munsell.com/munsell1.htm>

As the highest chroma yellow colours have rather high values, while the highest chroma blue colours have lower values, the Munsell colour solid has an irregular shape, which is illustrated clearly in an early sketch of the colour tree represented in figure 3-22.

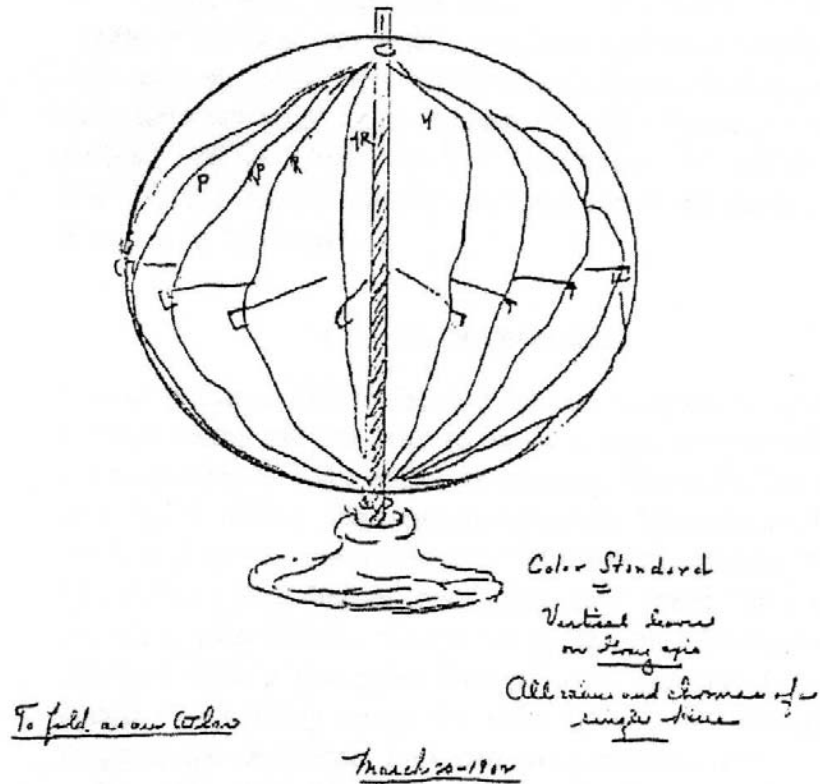


Figure 3-22: Traced sketch by Munsell of his "Colour Tree"
 Source: Volume I of typed diary, March 20, p97, 1902
 (in Kuehni, 2002, p25)

Closely resembling the Munsell Colour System is the Swedish Natural Colour System – NCS – (Hard and Sivik, 1979; Hard, 1975) which has also been used as a descriptive colour model (Sivik 1974a, 1975). The NCS is also based on an individual's perception of colour. According to this colour system, there exist six pure colour perceptions – Yellow, Red, Green, Blue, Black and White. The perception of any colour is based on the degree of its perceptual similarity to these six elementary reference colours, which are assumed to be a component of one's own visual system. Three parameters define a given hue – degree of whiteness, blackness and chromaticness (purity). Schematically, it is almost identical to the Munsell Colour System. It also uses brightness as a central Y-axis and colour purity or saturation as an X-axis. In fact there is evidence to suggest that a single relationship exists between the NCS and Munsell models, which appear both to be describing the same colour space (Judd and Nickerson, 1975).

3.3.5. CONCLUSION

From what was treated in this chapter, it should be clear that three colour-making attributes completely define any colour sensation: lightness or value identifies the proportion of the total illumination that is reflected by a surface; saturation or chroma indicates what proportion of the reflected wavelengths comes from a narrow span of the spectrum and hue refers to the location of these wavelengths within the total span of the colour circle.

The next chapter will reveal that in many colour studies, researchers have simply reported vague verbal descriptions of the colour samples used, hereby failing to provide adequate colour specifications and confusing the effects of specific colour attributes. This is a common, but major methodological caveat in studies on colour effects that we aim to address in the empirical study at hand.

3.4. COGNITIVE RESPONSES TO COLOUR

We have colour categories stored in prior knowledge (Hoyer and MacInnis, 2001, p124). The category of things that are green, for example, includes grass, trees, leaves, and mint as members. These members have associations like refreshing, new, organic, peaceful, and springlike. Because of this category-based knowledge, consumers can make inferences about a stimulus based on its colour (i.e. category-based inferences). They may infer that a brand of green toothpaste that comes in a green package is refreshing, minty, and healthy (example adopted from Hoyer and MacInnis, 2001, p124). It is for this reason that Bio yoghurt by Danone, for example, is offered in green packaging and advertised with a predominantly green background. The fact that a bag of “M&M’s” contains a disproportionate number of brown “M&M’s” compared with the other colours, may also be due to marketers’ finding that the brown colour makes consumers think that “M&M’s” taste more “chocolate-like” (example adopted from Hoyer and MacInnis, 2001, p124). In a study concerning tomato-ketchup, indeed, the darker-red the ketchup, the more spicy it was thought to be, and in contrast, the more orange, the milder the associated taste (Percy, Ketchum, MacLeod and Grove, 1974). Likewise, the colour of bread (white, light or dark) has been found relatively more important in determining consumer perceptions of its nutritional value than were price and nutritional information combined (Peterson, 1977) (for this reason some breads contain colouring, to make them appear darker, and hence more nutritious than they actually are (Consumer Reports, 1976)).

Because consumers can make inferences about an offer based on its colour or the colour of its package (Hoyer and MacInnis, 2001, p124), colour can be used as a marketing tool, in order to create, maintain and modify brand images in customers’ minds (see Schmitt and Simonson, 1997). For this reason, the meanings associated with different colours are extremely important to marketers (McCracken, 1988; Schmitt and Simonson, 1997; Madden et al., 2000).

The existence of the Lanhan Act in the United States, which protects product colours as trademarks, demonstrates the significance of colour to convey meaning. Several companies have already taken legal steps to protect the colour of their brand (Lans, 1995). Think for instance of ‘Belgacom’ blue or ‘Kodak’ yellow.

Because category content varies with culture, the meaning associated with colours and hence inferences based on colour will also vary (Crowley, 1993). For example, white is usually associated with purity and cleanliness in Western Societies, but in Asian countries it signifies death. Green is a popular colour in Muslim countries, but is negatively perceived in Southwest Asia. Black has negative overtones in Japan, India and Europe, but is perceived positively in the Middle East.... Madden, Hewett and Roth (2000) explored the meanings associated with colours and colour combinations in eight countries and cross-cultural patterns in both similarity and dissimilarity in colour meaning associations.

The cognitive schemas and symbolic meanings, associated with specific colours, will not be discussed here in further detail, because they are not the main focus of the present empirical study, in which a 'classic' (i.e. affective) environmental psychology approach is pursued. Instead, we shall focus more specifically on the emotions elicited by colours, which will be elaborated in more detail in the next chapter.

Still, for more information on symbolic colour meaning associations, the interested reader is referred to Déribéré (1969); Sharpe (1974); Birren (1983), Madden, Hewett and Roth (2000), Funderburk (2001), ...

*"Colour does more
than just give us objective information about
our world:
It affects how we feel."*

HERMAN MILLER

2001

3.5. AFFECTIVE RESPONSES TO COLOUR

3.5.1. INTRODUCTION

Our language, whether it be English, Dutch or French, is abound with expressions pointing to connections between colours and emotions (Terwogt and Hoeksema, 1995): in English, it is for instance possible to be purple with rage, or green with envy and when we are down, we are feeling blue... In het Nederlands kunnen we groen lachen,...mais en Français on rit jaune,....

Not only language, but also a large number of studies point to the associations between colours and emotions (e.g. Wexner, 1954; Schaie, 1961, 1962; Kreitler & Kreitler, 1972; Adams and Osgood, 1973; Byrnes, 1983; Valdez and Mehrabian, 1994; Terwogt and Hoeksma, 1995; Hemphill, 1996).

Evidence that relates colour to psychological affective states is also revealed by the studies on colour preference and mood tones. Undoubtedly one of the most intensive areas of colour research is that of colour preference. This field is characterised by more than a hundred years of investigations – the first empirical study having been conducted by Cohn in 1894 (Eysenck, 1941). Since that initial effort, numerous attempts have been made to determine the relationship between feelings/emotions and colours. Sharpe (1981), Ball (1965); Norman and Scott (1952) and Beach et al. (1988) provide excellent overviews of this research. Nevertheless, much of the research on colour and affect is weak due to a number of methodological shortcomings, which will first be examined in more detail.

3.5.2. METHODOLOGICAL CAVEATS

Introducing the subject, incorrectly, Hemphill (1996) asserts that: “*few studies have focused on colour-emotion associations*”. Clearly, this is not exactly true. Valdez and Mehrabian (1994, p394) assess the situation more accurately by pointing out that: “*despite the substantial body of experimental work in this area, results have failed to provide a thorough and general characterisation of relationships between colour and affect*”.

Indeed, despite considerable interest and work in the field, several authors note that much of the research on colour and affect is weak due to several methodological caveats (Gelineau, 1981; Beach et al., 1988; Valdez, 1993).

According to Valdez (1993), the methodological shortcomings in this regard can be grouped into two major categories. A first major area of caveats concerns the failure of many colour-studies to provide adequate “*specifications or controls of colour stimuli*” (e.g., absence of controls for saturation and brightness, while investigating effects of hue). A second area of concern involves the failure to use sufficiently reliable, valid or comprehensive “*measures of emotional responses*” to colour stimuli. In the following paragraphs these two methodological shortcomings will be discussed more deeply.

3.5.2.1. Colour Stimuli Specifications

With respect to the first area of methodological problems related to colour stimuli, it can be noted that many studies have simply reported vague verbal descriptions of the colour samples used. A common criticism of much work on colour-responses lies in not providing adequate operational definitions for stimulus conditions and being vague about measures taken to equate brightness and saturation when investigating hue effects (Norman and Scott, 1952; Beach et al., 1988; Valdez and Mehrabian, 1994). Early studies with regard to colour-emotion associations focused almost solely on the dimension of hue. Many researchers, selected colour stimuli that they felt best represented particular hues, such as red, green, yellow or blue.

A number of studies did not even use actual colour stimuli, but instead elicited subjects' responses to verbal labels of colours (words as "red" or "black") (e.g. Aaronson, 1970; Adams and Osgood, 1973).

Also many studies have failed to relate the colour samples used, to a standardized system of colour notation, such as the Munsell Colour System or the Swedish Natural Colour System – NCS (Hard and Sivik, 1979; Hard, 1975), which have been discussed earlier (in paragraph 3.3.4.). Some researchers specified one aspect (usually hue), but failed to specify the two additional characteristics of colour - saturation and brightness - necessary for a complete description of the colour samples used (see section 3.3.). This way, researchers have been testing differences in reactions to colour samples, confounding hue, saturation and brightness effects (Beach et al., 1988; Valdez, 1993; Valdez and Mehrabian, 1994). In studies where Munsell notations were provided for standardization and comparison purposes, the actual colours chosen were often highly saturated (Nakshain, 1964; Goodfellow and Smith, 1973; Jacobs and Hustmyer, 1974).

The illumination level has also often not been adequately controlled for (Nakashima, 1909; Washburn and Grose, 1921).

When coloured lights were used as stimuli, there appears to be an inherent problem arising from attempts to control for brightness (Beach et al., 1988; Valdez and Mehrabian, 1994). Equating red and blue light for luminance does not necessarily equate them for brightness (Neri et al., 1986). In the studies reviewed, various means were used to equate or control brightness –the method of limits (Hammes and Wiggins, 1962), the method of average error (Caldwell and Jones, 1985), simply asking subjects which of two colours was the lighter one (Wilson, 1966). Some researchers only mentioned that colours were matched for brightness without indicating which method was used (Stark et al., 1982; Nourse and Welch, 1971). Other authors made no mention of brightness at all (Erwin et al., 1961; Goldstein, 1942). Gerard (1958) and Neri et al. (1986) equated luminance, which does not necessarily equate for brightness. Also few studies gave the spectral distribution (saturation) of the coloured lights used as stimuli (Beach et al., 1988). Different means by which to control brightness and saturation or the failure to control for them at all, could certainly be a factor in the inconsistent findings noted among various studies (Beach et al., 1988).

A final methodological problem relating to the colour stimuli used, concerns the presentation order of colour samples, which has often not been counterbalanced (Nakashima, 1909; Washburn, McLean and Dodge, 1934). Yet, presentation and/or order effects were noted in a number of studies (Wilson, 1966; Smets, 1969; Nourse and Welch, 1971; Caldwell and Jones, 1985) (see Beach et al., 1988, p24, for a discussion).

3.5.2.2. Colour Responses and their Assessment

A second group of methodological problems relates to responses to colour (i.e. the dependent measure). As noted by Beach et al. (1988) and Valdez and Mehrabian (1994) it is difficult to abstract general patterns of findings from the colour-emotion literature, because experimenters have used highly limited assessments of reactions to colour. Response measures were often couched in introspective reports (Bullough, 1908; Nakashima, 1909) and almost uniformly, affective responses to colour have been conceptualised as a single effect rather than a multi-dimensional response (Crowley, 1993).

Some studies have used extremely rudimentary measurement techniques, such as simply requesting that subjects rank the colour samples in terms of a single evaluative dimension “perceived pleasantness” (e.g. Eysenck, 1941; Granger, 1955; Silver & McCulley, 1988; Madden et al., 2000), which is apt to elicit a different set of associations in different subjects. Indeed, some people may associate pleasantness with comfort and relaxation (i.e. pleasure plus low arousal), whereas others may associate pleasantness with excitement and elation (i.e. pleasure plus high arousal). The use of single terms to assess emotional reactions is therefore likely to have doubtful reliability and validity (Beach et al., 1988; Valdez and Mehrabian, 1994).

Other studies involved having subjects match verbal emotion labels to different colour samples (e.g. Wexner, 1954; Hemphill, 1996).

Still other studies have used adjective checklists with dubious reliability and validity to assess emotional reactions to colour. With this respect Valdez and Mehrabian (1994) caution again that single-emotion terms that refer vaguely to discrete emotional states (e.g. “exciting” or “comfortable”) have doubtful reliability for assessing emotional reactions. Furthermore, they

argue that, in the absence of a theoretical system that interrelates these discrete emotional states, it is hard to compare the emotional reactions to various colours in terms of these different single emotion terms. The instrument most often used to “tap” into connotative associations of objects/events is the semantic differential, introduced in 1957 by Osgood, Suci and Tannenbaum. Instead of looking for a single relationship between colour and pleasantness, with the advent of the semantic differential, colours were rated on a series of bipolar adjective scales (semantic differentials). These scales are usually divided into seven equal points, where the middle point is seen as neutral (0) while the end points represent opposite extremes (-3, +3). By means of a series of such bipolar scales, subjects had to judge/rate a number of colours, which provided another way to look at colours in terms of affective connotative qualities. The data gathered this way are usually summarized across subjects, yielding a matrix of scale x colour averages and computing correlations between colours and scales. With a large number of scales being employed, it is often necessary to subject the data to factor analysis in order to reduce the dimensionality and seek “common factors”. These factors, in turn, represent a communality among the various scaled connotations of the colours. However, the particular meanings assigned to colours through the use of semantic differentials, rely on the specific descriptor scales an author chooses in any particular study. Although factor analysis is often used to identify the underlying dimensions of colour connotations, considerable inconsistencies have been found between researchers with regard to the number and names of identified factors (Beach et al., 1988). There is also considerable evidence to suggest that the stability of colour-meaning associations is dependent on the scale’s relevance to a given colour (Sivik, 1974d). For example, one would predict much more consistent ratings across subjects to colours on the adjective pair “hot ----- cold”, than on the adjective pair “smooth ----- adequate” (a pair reported in one of the studies). Another concern of the semantic differential is the assumed bipolar nature of the adjectives. The works of Sivik (1974c) and Green and Goldfried (1965) show that the degree of perceived opposition between the two adjectives may vary from subject to subject. Thus, wherever researchers did measure multi-dimensional emotional reactions to colour, they have used a variety of affect inventories and semantic measures, with different and non-overlapping dimensions, which makes it hard to compare them (Beach et al., 1988).

One prevalent dimension revealed systematically in semantic differential scales is the ‘evaluative’ dimension (good versus bad), which is closely related to preference and pleasure ratings (see Osgood, Suci and Tannenbaum, 1957; Mehrabian & Russell, 1974).

Another frequently discovered dimension is the 'activation' dimension. From the results of early studies, various authors cite support for the premise that certain colours have the capacity to excite and arouse an individual (stimulating brainwave activity, skin conductance, etc), while others have a calming and relaxing effect. Crowley (1993) points out that colours that enhance consumers' liking of a stimulus are not necessarily those colours that consumers find activating (or deactivating). These two dimensions of consumer response are shown to have different patterns across the visible spectrum (Crowley, 1993). This conceptualisation is consistent with Mehrabian and Russell's (1974; see also Russell and Pratt, 1980) contention that dimensions of "pleasure" and "arousal" are useful in describing emotional reactions to physical environments. Crowley (1993) found support for the existence of these two distinct dimensions in the impact of colour on shopping. In a similar vein, although expressed differently, Walters et al. (1982) and Gorn et al. (1997) use a two-dimensional view of arousal (Smith and Apter, 1975; Apter, 1976, 1981, 1982), to express the fact that arousal does not always need to be pleasurable or unpleasurable. According to Gorn et al. (1997) both feelings of excitement and relaxation can be pleasant and are likely to lead to favourable attitudes. On the other extreme, feelings of boredom and tension are unpleasant and likely to generate unfavourable attitudes. In the effects obtained for value and chroma on relaxation and excitement respectively, Gorn et al. (1997) found support for the existence of these two distinct dimensions in the effects of colour as an executional cue in advertising. In an attempt to better understand the effect of colour on human behaviour, prior research has examined both arousal perception (i.e., how active a stimulus is perceived to be), as well as the actual physiological arousal engendered by exposure to various colours. Investigators have often focused their attention on the latter, i.e. the physiological responses to colour (Kaiser, 1984; Beach et al., 1988). Two common physiological measures of arousal are changes in electrical activity in the brain (EEG) and changes in skin conductance or resistance (GSR). There are numerous ways to report EEG responses: e.g. amplitude of alpha waves, duration of alpha wave suppression, amount of EEG, etc... (Kaiser, 1984, presents an excellent discussion on this issue). The same can be said about GSR data. Different authors operationally define change scores in terms of responses during different time intervals after stimulus onset. Therefore much variability can exist in what is often thought of as a rigorous response measure. When one tries to compare findings from one study to another, different types of responses might be reported under the same general response name, making such comparisons virtually impossible (Kaiser, 1984; Beach et al., 1988).

Examining emotional reactions as a function of the dimensions of colour hue, saturation and brightness, Valdez and Mehrabian (1994) found support for the Pleasure-Arousal-Dominance model (Russell and Mehrabian, 1977), which argues that these three dimensions provide a general description of emotions and represent lowest common denominators of cognition. Although dominance is a dimension of emotional response that has almost completely been ignored by colour researchers, some of them previously found colour to elicit emotional responses that cannot be captured by pleasure or arousal dimensions, but seem to infer a dimension of dominance or potency (e.g. Osgood et al., 1957; Adams and Osgood, 1973; Sivik, 1974a).

Russell and Mehrabian (1977) provide evidence that the three independent bipolar PAD dimensions (Pleasure, Arousal and Dominance) are both necessary and sufficient to adequately define emotional states (see also Mehrabian, 1996 and Mehrabian, 1998). According to Valdez and Mehrabian (1994), this PAD Emotion Model can therefore be used to compare and contrast the findings from studies that have used non-overlapping dependent measures.

In an extensive study of colour meanings of isolated colours, Wright and Rainwater (1962) had subjects rate colours on 24 semantic differential scales. Originally six factors were extracted, but intercorrelations among them led the authors to propose a final four-dimensional connotative framework of happiness, forcefulness, warmth and elegance. Note that forcefulness also seems to relate to Russell and Mehrabian's dominance dimension.

Sivik's (1974a, 1975) work provides some of the most comprehensive insights into the field of colour meaning (Beach et al., 1988). Sivik uses the Swedish Natural Colour System – NCS – (Hard and Sivik, 1979; Hard, 1975) as his descriptive colour model, instead of the Munsell colour solid, but schematically, the two are almost identical. Sivik's (1974a, 1975) initial studies investigated colours in isolation: seventy-one colours (chosen to represent the NCS colour space) were judged on 26 semantic differential scales by a stratified sample of Swedish adults. Factor analysis yielded four factors: excitement, evaluation, potency and temperature. Emerging from Sivik's (1974a, 1975) initial studies is the complexity of the interaction process between stimulus colour properties and connotative associations. The use of isosemantic mapping graphically represents that interactive process.

Instead of summarizing his data in terms of scale-colour correlations, Sivik chose to present results in the form of isosemantic maps⁷. An isosemantic map is drawn on a colour triangle, which is a full section of the NCS solid axis for a given hue value. Isosemantic maps are constructed on each colour triangle for a given connotative factor. The isosemantic lines on a colour triangle are constructed by connecting the points of equal value.

From this review of the measures used to capture emotional responses to colour stimuli, it becomes obvious that in the absence of a theoretical system, it is hard to compare the emotional reactions to various colours. The next section on colour-emotion associations includes and discusses many empirical studies in detail for the purpose of placing the accomplishments and questions of this research into proper perspective. In order to be able to compare and contrast findings from these previous studies, a comprehensive system for the description of emotions is needed. Therefore, in accordance with Valdez and Mehrabian (1994), we will use the PAD (Pleasure-Arousal-Dominance) Emotion Model as a framework to describe and interrelate the findings from studies that have used a variety of verbal-report, physiological and behavioural measures bearing on emotions.

⁷ Guilford and Smith (1959) used a similar method which they termed isohedonic charts, where colour parameters were mapped on only one scale, pleasantness. Sivik has taken this concept and expanded it to incorporate factor scores abstracted from a number of scales representing a number of different connotative dimensions.

3.5.3. COLOUR-EVOKED PLEASURE

One colour effect deals with the evaluative or affective (“liking”) response to colour. Several studies have examined affective or evaluative reactions to various colours, whether it be as a single response, a uni-dimensional pleasantness construct or a pleasantness dimension in a multidimensional emotion scale. Nevertheless, much of the earlier and even of the more recent work, dealing with colour preferences, has failed to control for the three dimensions of colour – hue, saturation and brightness – and is thus methodologically flawed (e.g. Dashiell, 1917; Eysenck, 1941; Birren, 1952; Wexner, 1954; Osgood et al., 1957; Jacobs and Suess, 1975; Walters et al., 1982; Boyatzis and Varghese, 1994; Hemphill, 1996; Etnier and Hardy, 1997; Madden et al., 2000). In the next paragraphs, these studies will be more carefully reviewed. More specifically, we will first present the effects of colour hue on pleasure responses, followed by the effects of colour saturation and brightness. Finally, we will summarise the conclusions of these previous studies in a concise manner.

3.5.3.1. Effects of Hue

Red, blue and green were usually reported as most preferred colours, while orange and yellow were judged to be less preferred (Guilford, 1934; Walton, Guilford and Guilford, 1933).

Attempting to study the contributions of hue, tint and saturation on affective judgements, Guilford (1934) and Guilford and Smith (1959), conducted some of the most systematic work in this area. Using Milton Bradley coloured papers, Guilford (1934) selected 18 hues being equal in tint (value or brightness) and chroma (saturation), 11 hues varying in value and low in saturation and 11 hues high in saturation. Each colour was judged on a nine-point pleasantness scale, from greatest possible unpleasantness (1) to greatest possible pleasantness (9). Thus, controlling for brightness and saturation, his findings revealed that the hues blue, green and red were more preferred, whereas yellow and orange appeared to be less preferred.

The work of Eysenck (1941) advocated a strong argument for a universal scale of preference (Beach et al., 1988). Eysenck calculated the average ranks for six saturated colours (not equated for brightness) from a number of studies encompassing the responses of 21,060

subjects and found the following colour ranking from most to least preferred: blue, red, green, violet, orange and yellow. With this regard he refers to a general factor of “*aesthetic appreciation*”. This empirical study has been cited extensively as it provides evidence for a universal and seemingly invariant preference ordering of colour. However, Beach et al. (1988) note that Eysenck’s comparisons were made only for saturated colours and that there is no evidence that experimental conditions in the various studies sampled were comparable.

Wexner (1954) conducted a study dealing with associations between colour samples and words that describe feelings. She constructed a list of adjectives judged to be best examples of mood tones, displayed eight coloured papers (8,5” x 11”) and asked subjects to select the one colour that best described a given emotional state. From her study she concluded that indeed definite colour-emotion associations exist. She found the colour red to be associated with “exciting” and “stimulating”, both of which imply pleasure and high arousal (Valdez and Mehrabian, 1994). Blue was associated with “secure/comfortable” and “tender/soothing”, which imply pleasure and low arousal (Valdez and Mehrabian, 1994). Orange was associated with “disturbing/distressed/upset”, implying displeasure and high arousal. Although Wexner neither used standard specifications of her colour samples, nor controlled for brightness and saturation, her findings are generally in accord with other empirical findings.

Granger (1955) sought a more rigorous test of Eysenck’s (1941) findings. He constructed sets of stimuli from Munsell colours, where one dimension would vary, while the other two were held constant for each of the attributes of hue, value and saturation. He found wavelength to be the major factor in determining preference (with 5B blue being most preferred and 5Y yellow being least preferred) and found no interaction effect among the different colour attributes.

The findings of two studies by Osgood et al. (1957) suggest that an acceptable colour is defined by the object with which it is associated. Conducting one of the initial studies on the meaning of colours, Osgood et al. (1957) studied selected colours in the context of objects. In a first study one of six colours or an achromatic condition (black-white) was applied to either one of five objects (shirt, ice-cream, rug, car, cake mix) or as background. The object was then rated on 20 semantic differential scales, representing evaluative, activity and potency factors. Although significant differences were found on the non-evaluative scales, no consistent effects were found on the evaluative ones. A significant colour x object interaction

was found on this common “evaluative” dimension. In terms of evaluation, yellow was rated as the “most favourable” colour. This is in contrast with previous studies using colour patches, which have found yellow to be generally disliked. The authors suggested that their unexpected finding may have been an artifact of the objects used in the study. For the other colour conditions no differences were observed. In a second study, colour was studied in relation to abstract sculptures. Again no significant difference was observed for evaluative scales, while for certain non-evaluative scales significant colour differences could be discerned. As in the first study the colour x object interaction was significant. For abstract sculptures, blue was the most preferred hue.

The work of Guilford and Smith (1959) provides a rigorous examination of the roles that hue, value and saturation played in pleasantness. A ten-point pleasantness scale was used to rate 316 stimulus papers; of these 295 were coloured stimulus papers matched on the three Munsell dimensions. Across all hues, the blue-green regions had the highest affective value (pleasantness) ratings, while the lowest were observed in the yellow, yellow-green regions. This pattern existed across all levels of brightness. Their studies yielded the following rank-ordering of hues, from most to least preferred: blue, green, purple, violet, red, orange, yellow.

Lawler and Lawler (1965) found that children “coloured with a yellow crayon after hearing a happy story and with a brown crayon after hearing a sad story”, revealing a close link between colours and emotions.

Hogg (1969) had subjects rate single colours and colour pairs (manipulating degree of colour contrast) on twelve 7-point semantic differential scales. For single colours, the blue-purple region was generally preferred while the yellow-green region showed low preference ratings on the evaluative dimension (pleasant – unpleasant). With regard to colour pairs, the evaluation factor accounted for 21% of the variance. The colour pair is judged as more pleasant when both colours were blue, or when blue was present than if both colours were green or when green was present.

Helson and Lansford (1970) conducted a well-controlled experiment with regard to background colour effects on perceived colour pleasantness. 125 colour chips were presented

against 25 coloured backgrounds, under five different illumination sources, to ten subjects⁸, for a total of 156,250 ratings. Each subject was shown twelve colour chips on a background and made absolute judgements on a nine-point scale. Colour chips represented main regions from each Munsell hue dimension, with low, medium and high value and chroma. Colour hues, which were judged most pleasant (across all backgrounds and light sources), were blue, purple-blue, green and blue-green. Yellow and purple were ranked low, in addition to colours with strong yellow components.

Hopson, Cogan and Batson (1971) used white, black and grey as background colours and also found blue to be preferred most and yellow-red least.

In their (1973) cross-cultural study in which subjects had to rate colour concepts (words) using the semantic differential factors (Osgood et al., 1957), Adams and Osgood found the words “blue” and “green” to be rated as good across 23 cultures, whereas “yellow” was rated as bad. Compared to achromatic colours (greytones), chromatic colours were in general rated as good.

Sivik (1974a, 1975) had a stratified sample of Swedish adults judge seventy-one colours, chosen to represent the Swedish Natural Colour System’s three-dimensional colour-space. Factor analysis, performed on the 26 semantic differential scales, yielded four factors: excitement, evaluation, potency and temperature. Analysing the evaluative factor, Sivik found that across all hues, dislike varied with hue. However, there appeared to be a complex interaction between hue, the degree of whiteness, blackness and chromaticness (purity or saturation), Sivik (1974a) found that across all three parameters (blackness, whiteness, purity), there were more instances of blue being judged positive or pleasant than any other hue. This observation might account for blue often being cited as the most preferred colour.

Mehrabian and Russell (1974) found that maximal pleasure associated with colours was reported in the green to blue region of the visible spectrum.

Contrary to expectations Gotz and Gotz (1974, 1975) found some yellows to be rated highly pleasant, while pinks were seen as most unpleasant.

⁸ The small number of subjects used in this study has often been cited as a concern (Beach et al., 1988)

Jacobs and Suess (1975) investigated the effects of four primary colours (red, yellow, green and blue) on anxiety (involving displeasure and high arousal). The colour hues were projected onto a large screen, however brightness and saturation levels were not controlled for. Scores on Spielberger, Gorsuch and Lushene's (1970) State-Anxiety Inventory served as the dependent variable. From this study higher state-anxiety scores were found to be associated with red and yellow than with blue and green. This finding is consistent with studies of colour preference, demonstrating that red and yellow are less pleasant than blue and green.

Using a two-dimensional view of arousal (Smith and Apter, 1975; Apter, 1976, 1981, 1982), Walters et al. (1982) found a link between red and felt 'excitement', and blue and felt 'relaxation'. Consistent with the generally accepted view that red is an exciting colour, whereas blue is relaxing (e.g., Guilford and Smith, 1959; Tom et al., 1987). Both feelings of excitement and relaxation are pleasant and likely to lead to favourable attitudes (Gorn et al., 1997).

Similarly, Bellizzi et al. (1983) found that subjects rated cool colour store environments as more attractive and more pleasant than warm colour store environments.

Several researchers have also noted discomfort under red illumination (Howett, 1985; Luria and Kobus, 1985).

In a cross-cultural setting, Reddy and Bennett (1985) found Americans to dislike yellow and green.

In a study among 121 undergraduates, focusing on the effects of colour hue on emotions, Valdez and Mehrabian (1994, Study 2) examined the pleasure elicited by 10 hues, using 5 replication sets with equal brightness and saturation levels in order not to confuse the effects (this way a total of 50 colour samples were used). Pleasure was measured according to Mehrabian's (1978) PAD emotion scale. Valdez and Mehrabian (1994) hypothesized short-wavelength hues (e.g. blue, green) to be more pleasant than long wavelength hues (e.g. yellow, orange). Because of previous contradictory findings with regard to the pleasantness of red, they hypothesized red to score neutral on pleasantness. To explore the effects of hue (10 levels) on averaged pleasure reactions (each colour sample was rated by nearly 25 subjects), a univariate analysis of variance (ANOVA) was used. This revealed a significant .01-level main

effect: $F(9,80) = 21.21$. Figure 3-23 depicts a plot of the mean pleasure responses to each of the 10 hues. In this figure the two complementary non-spectral hues, purple and red-purple, are inserted separately at the right-hand side of the graph. From this plot, extreme short wavelength colours seem to elicit more pleasure than extreme long wavelength colours, whereas middle wavelength hues appear to elicit less pleasure than either the extreme short or long wavelength hues.

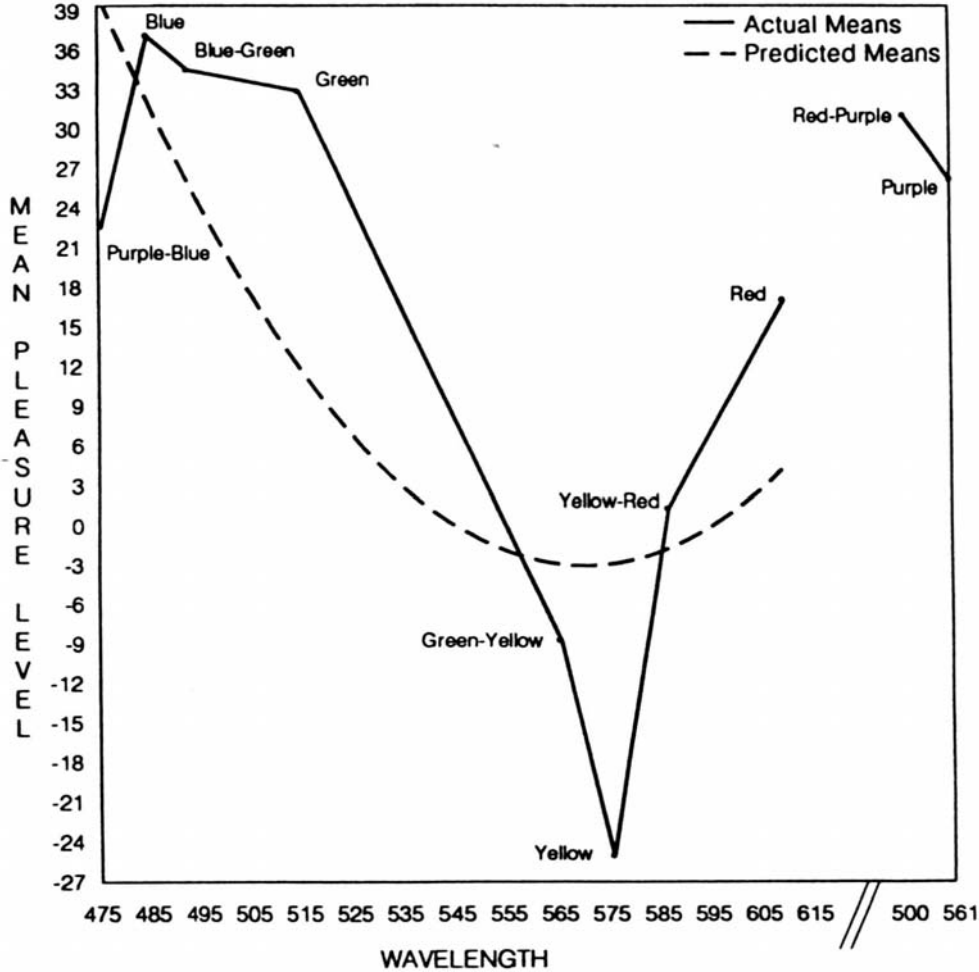


Figure 3-23: Mean pleasure level as a function of colour wavelength
 Source: Valdez and Mehrabian, 1994, Study 2, p402

According to Tukey’s Multiple Comparison Procedure, pleasure levels for blue, blue-green, green, red-purple and purple were significantly greater than those for green-yellow, yellow

and yellow-red. Furthermore, pleasure levels of purple-blue and red were significantly greater than those for green-yellow and yellow. And finally, the pleasure level of yellow-red was significantly greater than that for yellow.

A regression analysis was used to test for a possible significant curvilinear relationship of pleasure (the dependent variable) to wavelength (the independent variable) for the eight spectral colours. (The two complementary colours purple and red-purple could not be included in the regression analysis, because they are not scaled alongside noncomplementary colours with respect to wavelength, as they do not exist within the visible spectrum of light). The regression analysis tested more specifically for effects of wavelength and (wavelength)² on pleasure ratings. The results of this regression analysis can be summarized in the following equation for raw pleasure scores: multiple regression coefficient = .68, with significance of effects assessed at the .05 level.

$$\text{Pleasure} = 1561 - 5.48 (\text{Wavelength}) + .0048 (\text{Wavelength})^2$$

Figure 3-23 also shows predicted pleasure scores, computed from this equation. The plot of predicted pleasure values demonstrates that the preceding equation only provides a rough approximation of the obtained means: Pleasure-displeasure reactions to spectral colours were approximately a U-shaped function of wavelength, with yellows (green-yellow, yellow and red-yellow) at the bottom portion of the U. These findings were generally consistent with the hypotheses derived from a review of the literature. Nevertheless, the findings of Valdez and Mehrabian (1994, Study 2) provided a more concise way of describing the relation between hue and pleasure: Short-wavelength hues were rated as being the most pleasant, whereas intermediate wavelength hues were rated as the least pleasant. For the long wavelength hues yellow-red and red, this trend is reversed as they show increased pleasure ratings. The non-spectral colours red purple and purple elicited high pleasure ratings, comparable to those of the short-wavelength hues.

Testing nine different colours (pink, red, yellow, black, grey, green, blue, purple and brown), presented on 8.5"x11" papers, Boyatzis and Varghese (1994) concluded that children (4-6 years old) tended to associate positive emotions with bright colours. For the analyses, colours were in fact coded as dark or bright, with bright colours being pink, red, yellow, green, purple and blue and dark colours being black, brown and grey. The colour stimuli used, were

however not exactly specified and apparently effects of hue, saturation and brightness were confounded.

Analysing the colour-emotion associations among 40 undergraduate students, Hemphill (1996) found that bright colours (including white, pink, red, yellow, blue, purple and green) elicited mainly positive emotional associations and dark colours (including brown, grey and black) elicited mainly negative emotional associations. Here again the effects of the different colour attributes appear to be confused and colour stimuli were not clearly specified.

Results of a study by Etnier and Hardy (1997) on the influence of environmental colour on task performance found no main effect of colour on affect (as measured by the Zuckerman Inventory of Personal Reactions, Zuckerman, 1977), but indicated that colour and time⁹ did interact to impact positive affect, $F(8, 232) = 10.90, p < .0001$ and desire to cope, $F(2, 58) = 15.07, p < .0001$. The findings lend some support to the idea that colour influences the organism depending on the task type – cognitive versus physical (Jokl, 1982). Positive affect decreased in the warm-coloured room more so than it did in the cool- and neutral-coloured rooms prior to performance of a cognitively demanding task. Thus subjects showed a less positive emotional response towards performing a cognitive task in the warm-coloured room. With regard to the physically demanding task, positive affect decreased less in the warm room prior to task performance than it did in the cool- and neutral-coloured rooms. Thus subjects showed a more positive emotional response towards performing the physical task in the warm-coloured room.

Madden et al. (2000) conducted a study in which respondents from eight countries evaluated ten colour-swatches, presented together with the colour-name. In this study the colour stimuli were not clearly specified according to a colour system, but were probably highly saturated. Brightness and saturation levels were not controlled for. Respondents were undergraduate students from Austria ($n = 29$), Brazil ($n = 26$), Canada ($n = 29$), Colombia ($n = 48$), Hong-Kong ($n = 19$), PRC ($n = 31$), Taiwan ($n = 22$) and the United States ($n = 49$). Colours were evaluated with regard to preference and with regard to colour meaning, using 20 item semantic differential scales. The mean liking ratings for the colours in the different countries are arrayed from most to least liked for each country and presented in table 3-1.

⁹ Affect was measured at several instances: when entering the main laboratory (1), before (2) and after (3) performing a cognitive task and before (4) and after (5) performing a motor task.

Austria		Brazil		Canada		Colombia	
Colour	Mean Liking	Colour	Mean Liking	Colour	Mean Liking	Colour	Mean Liking
Blue	6.59	White	6.34	Black	5.52	Blue	6.23
Green	5.86	Blue	6.12	Blue	5.48	White	5.54
White	5.52	Green	5.35	White	5.41	Green	5.38
Black	5.21	Black	5.23	Red	5.24	Red	5.10
Red	4.34	Red	5.00	Green	5.21	Black	5.02
Orange	4.34	Brown	4.50	Purple	4.03	Purple	3.83
Yellow	3.59	Gold	4.31	Yellow	3.79	Yellow	3.63
Brown	3.97	Purple	4.27	Orange	3.55	Gold	3.52
Purple	3.24	Gold	3.77	Gold	3.55	Brown	3.21
Gold	3.17	Orange	3.58	Brown	3.03	Orange	2.90
Hong Kong		PRC		Taiwan		United States	
Colour	Mean Liking	Colour	Mean Liking	Colour	Mean Liking	Colour	Mean Liking
White	5.84	Blue	5.81	Blue	6.27	Blue	5.90
Blue	5.37	White	5.65	White	6.23	Green	5.63
Black	5.21	Black	5.26	Purple	5.18	Black	5.31
Red	5.21	Red	5.16	Black	4.82	White	5.29
Yellow	5.05	Green	5.13	Green	4.82	Red	5.14
Purple	5.00	Gold	4.55	Yellow	4.64	Gold	3.94
Gold	4.84	Yellow	4.16	Brown	4.59	Purple	3.90
Green	4.58	Orange	4.13	Orange	4.36	Brown	3.80
Brown	4.11	Purple	3.87	Red	4.32	Orange	3.27
Orange	3.89	Brown	3.48	Gold	4.31	Yellow	3.26

Table 3-1: Mean Colour Liking ratings for different countries

Source: Madden, Hewett and Roth, 2000, p95.

With respect to the liking of black, green, red and white, there was no statistically significant difference across countries. Preferences for blue, brown, gold, orange and purple did differ significantly across cultures. Kendall's coefficient of concordance was used to assess similarities in the rankings from most to least preferred colours. The coefficient of agreement ranged from .38 to .78. In three-fourths of the country pairs, there was significant agreement on colour preference rankings. Blue was, overall, the most liked colour with a mean of 6.00

(on a 7-point scale). It was rated as the most preferred colour in five of the eight countries and as the second most liked colour in the three remaining countries. With regard to the semantic differential ratings, colours and semantic items were plotted in two-dimensional perceptual maps for each country. From these plots it is also apparent that blue, green and white are well liked across countries. The results obtained by Madden et al. (2000) indicate that in many parts of the world, consumers exhibit similarities in colour liking and colour meaning associations.

Although it is obvious that a lot of the early studies on the effects of hue on pleasure are methodologically flawed -confounding brightness and saturation effects with the effects of colour hue- there appears to be some consistency in the findings. Studies of colour preference have sometimes dichotomised colours into a warm group (red, orange, yellow) and a cool group (green, blue, violet: see Sharpe 1974 for a review). Cool colours (especially blue) are consistently preferred over warm colours (cf. Silver and McCulley, 1988), although some cross cultural differences have been found (see Wiegiersma and Van Der Elst, 1988). More specifically, extreme short wavelength colours (blue, green) seem to be generally preferred, followed by the extreme long wavelength colour red. Yellow-green, yellow and orange appear to be generally disliked (Walton, Guilford and Guilford, 1933; Guilford, 1934; Eysenck, 1941; Wexner, 1954; Granger, 1955; Guilford and Smith, 1959; Helson and Lansford, 1970; Hopson, Cogan and Batson, 1971; Adams and Osgood, 1973; Sivik, 1974a, 1975; Mehrabian and Russell, 1974; Jacobs and Suess, 1975). Stated more formally, pleasure-displeasure reactions to spectral colours appear to approximate a U-shaped function of wavelength, with yellows (green-yellow, yellow and red-yellow) at the bottom portion of the U. Indeed, the findings of Valdez and Mehrabian (1994, Study 2) confirm that short-wavelength hues are rated as being the most pleasant, whereas intermediate wavelength hues are rated as the least pleasant. For the long wavelength hues yellow-red and red, this trend is reversed as they show increased pleasure ratings. The works of Eysenck (1941) and Madden et al. (2000) advocate a strong argument for a universal scale of preference. Nevertheless, Osgood et al. (1957), suggest that an acceptable colour is defined by the object with which it is associated. Studying selected colours in the context of objects, they found yellow to be rated as the “most favourable” colour, which is in contrast with the general finding, using colour patches, that yellow is mostly disliked.

THE EFFECTS OF COLOUR ON EMOTIONS:
Table 3-2: The Pleasure-eliciting Properties of Colours

EFFECTS OF HUE

Citation	Sample	Design	Stimuli	Dependent variable	Findings
Guilford (1934)		Study designed in order to be able to distinguish the contributions of hue, value and saturation on affective judgements	Milton Bradley coloured papers 18 hues, equated for brightness and saturation	Nine-point pleasantness scale	The hues Blue, Green and Red appeared to be more preferred, whereas Yellow and Orange appeared to be less preferred <u>From most to least preferred:</u> Blue-Green-Purple-Violet-Red-Orange-Yellow
Eysenck (1941)	Meta-analyses encompassing the responses of 21,060 subjects	For a number of studies average ranks of colour preference were calculated	Six saturated colours (not equated for brightness)	Average preference rankings	<u>Universal preference ordering of colour, from most to least preferred:</u> Blue-Red-Green-Violet-Orange-Yellow Eysenck refers to a general factor of “ <i>aesthetic appreciation</i> ”.
Wexner (1954)		Study concerning subjects’ associations between colour samples and words that describe feelings	Eight coloured papers (not specified according to standard specifications & not controlled for brightness or saturation)	Words that describe mood tones	Red was found to be associated with “exciting” and “stimulating” and Blue with “secure/comfortable” and “tender/soothing”, although these emotions vary on the ‘arousal-dimension’, they all do describe pleasant feelings. In contrast, Orange was associated with “disturbing/distressed/upset”, implying displeasure and high arousal.

Granger (1955)			Munsell colours with varied dimensions of hue, saturation and brightness	Preference ranks	<u>Preference varies with the wavelength of the colour</u> With Blue most preferred, Yellow least preferred <i>Wavelength was found to be the major factor determining preference</i>
Osgood et al. (1957)	Studied selected colours in the context of objects	<u>Study 1</u> Colours were applied to either one of five objects (shirt, ice-cream, rug, car, cake mix) <u>Study 2</u> Colours were applied to abstract sculptures	Six colours + black and white	An evaluative (pleasant-unpleasant) dimension identified from a 20 item semantic differential scale	A significant colour x object interaction was found for the evaluative dimension. The authors therefore suggest that an acceptable colour is defined by the object with which it is associated. For the 5 studied objects, yellow was rated as the most favourable colour (which may be due to the selected objects) and no differences were observed for the other colour conditions. With regard to the abstract sculptures, no significant difference was observed for the evaluative scales. Again the colour x object interaction was significant. With abstract sculptures, blue was the most preferred hue.
Guilford and Smith (1959)		Rigorous examination of the roles of hue, value and saturation on pleasantness	316 stimulus papers, 295 of which were matched on the three Munsell dimensions	Ten-point pleasantness scale	Across all hue regions, the Blue-Green regions had the highest pleasantness ratings, while the lowest were observed in the Yellow, Yellow-Green regions. This pattern existed across all levels of brightness
Hogg (1969)			Single colours and colour pairs, manipulating degree of contrast	An evaluative (pleasant-unpleasant) dimension identified from a twelve item 7-point semantic differential scale	The Blue-Purple region was generally preferred, while the Yellow-Green region showed low preference ratings on the evaluative dimension. Colour pairs were judged more pleasant when both colours were Blue or when Blue was present than when both colours were Green, or when Green was present.

Helson and Lansford (1970)	10 subjects provided a total of 156,250 ratings	Studied background colour effects on perceived pleasantness	125 colour chips, representing the main Munsell hue dimension regions, with low medium and high value and chroma, presented against 25 coloured backgrounds	Nine-point scale absolute preference judgements for coloured chips against backgrounds	Coloured chips against various coloured backgrounds judged most pleasant were: Blue, Purple-Blue, Green and Blue-Green. On the other hand Purple, Yellow and colours with strong Yellow components were ranked low.
Hopson, Cogan and Batson (1971)			Colours presented against white, black and grey backgrounds		Against white, black and grey backgrounds, Blue was found to be preferred most and Yellow-Red least.
Adams and Osgood (1973)	Subjects across 23 cultures		Colour names (words)	An evaluative (pleasant-unpleasant) dimension identified from a semantic differential scale	The words "Blue" and "Green" were found to be rated as good across 23 cultures, whereas the word "Yellow" was rated as bad.
Sivik (1974a)	A stratified sample of Swedish adults	Studied colours in isolation	71 colours chosen to represent the NCS colour space (based on the SwedishNatural Colour System)	An evaluative dimension, identified from a 26 item semantic differential scale	Although there appeared to be a complex interaction between hue, the degree of whiteness, blackness and purity, across all parameters, dislike appeared to vary with hue: there were more instances of blue being judged positive or pleasant than for any other hue. This observation might account for blue often being cited as the most preferred colour.
Mehrabian and Russell (1974)					Maximal pleasure associated with colours was found in the Green to Blue region of the visible spectrum.

Gotz and Gotz (1974, 1975)					Contrary to expectations, some Yellows were rated highly pleasant, while Pinks were seen as most unpleasant
Jacobs and Suess (1975)			Red Yellow Green Blue not controlled for brightness or saturation (projected onto a large screen)	Anxiety (involving high arousal and displeasure) (Spielberger, Gorsuch and Lushene's 1970 State-Anxiety Inventory)	Higher "anxiety" scores (involving displeasure) were found to be associated with Red and Yellow than with Blue and Green.
Walters et al. (1982)			(chroma and saturation were not controlled for)		Red was related to "felt excitement" and Blue was related to "felt relaxation".
Bellizzi et al. (1983) Experiment 2	Convenience sample 125 females	<u>Colour as a peripheral cue</u> Laboratory experiment Manipulated background colours of projected furniture store interior	Red Yellow Green Blue & White (full strength hues)	Evaluation dimension of 20 item semantic differential scores	Subjects rated cool colour store environments as more attractive and more pleasant than warm colour store environments.
Howett (1985) Luria and Kobus (1985)					Discomfort appears to be experienced under Red illumination
Reddy and Bennett (1985)					Americans dislike Yellow and Green
Silver and McCulley (1988)				Colour preferences	Cool colours (especially blue) appear to be consistently preferred over warm colours (red, orange, yellow).

Bellizzi and Hite (1992) <u>Experiment 2</u>	Convenience sample 107 graduate marketing students	Laboratory experiment Manipulated background colours of projected furniture store interior	Red Blue (brightness and saturation not controlled)	Pleasure dimension of 18 item PAD scale (Mehrabian and Russell, 1974 as adapted by Donovan and Rossiter, 1982)	The Blue store environment was found to be more pleasurable than the Red store environment.
Crowley (1993)	Convenience sample 100 females	Laboratory experiment Manipulated background colours of projected furniture store interior	Blue Green Yellow Red (fully saturated)	Evaluation dimension of 20 item semantic differential scores	Found support for the hypothesis that consumer evaluations exhibit an increasingly positive linear trend from longer (warmer) to shorter (cooler) wavelengths.
Valdez and Mehrabian (1994) – Study 2	121 undergraduate students	Laboratory experiment Colour patches	50 colour samples: 10 hues, using 5 replication sets with equal brightness and saturation levels.	Pleasure, measured according to Mehrabian's (1978) PAD emotion scale	Pleasure levels for Blue, Blue-Green, Green, Red-Purple and Purple were significantly greater than those for Green-Yellow, Yellow and Yellow-Red. The pleasure level of Yellow-Red was significantly greater than that for Yellow. In fact a curvilinear relation seems to exist between colour wavelength and elicited pleasure-level: pleasure-displeasure reactions to spectral colours were approximately a U-shaped function of wavelength, with Yellows (Green-Yellow, Yellow and Red-Yellow) at the bottom portion of the U. Extreme short wavelength colours seem to elicit more pleasure than extreme long wavelength colours, whereas middle wavelength hues appear to elicit less pleasure than either the extreme short or long wavelength hues.

Etnier and Hardy (1997)	<u>Colour as a peripheral cue</u> Investigated the effect of environmental colour on the performance of cognitive and motor-tasks	Green, white or orange coloured room (not specified)	Positive affect (as measured by the Zuckerman Inventory of Personal Reactions 1977)	No main effect of room-colour on affect could be discerned, however, colour and time did appear to interact to impact positive affect. Positive affect decreased in the warm-coloured room more so than it did in the cool and neutral coloured rooms prior to performance of a cognitively demanding task. Thus subjects showed a less positive emotional response towards performing a cognitive task in the warm room. Positive affect decreased less in the warm room prior to performance of a physically demanding task than it did in the cool and neutral coloured rooms. Thus subjects showed a more positive emotional response towards performing a physical task in the warm room.	
Madden et al. (2000)	Sample of undergraduate students from eight countries: Austria (n = 29), Brazil (n = 26), Canada (n = 29), Colombia (n = 48), Hong-Kong (n = 19), PRC (n = 31), Taiwan (n = 22) and the United States (n = 49).	Colour patches with colour names were evaluated by respondents	Black, blue, brown, gold, green, orange, purple, red, white and yellow. (standard colour shading options in Lotus Almipro word processing software, not clearly specified according to a colour system, probably highly saturated with brightness and saturation levels not controlled)	Colour preference ratings (like-dislike on a 7-point scale) Colour meaning (20 item semantic differential scale)	Blue was, overall, the most liked colour. It was rated as the most preferred colour in five of the eight countries and as the second most liked colour in the three remaining countries. With regard to the semantic differential ratings, colours and semantic items were plotted in two-dimensional perceptual maps for each country. From these plots it is also apparent that blue, green and white are well liked across countries. The obtained results indicate that in many parts of the world, consumers exhibit similarities in colour liking and colour meaning associations. In three-fourths of the country pairs, there was significant agreement on colour preference rankings. With respect to the liking of black, green, red and white, there was no statistically significant difference across countries. Preferences for blue, brown, gold, orange and purple did differ significantly across cultures.

3.5.3.2. Effects of Saturation

Although early colour preference studies focused almost solely on the dimension of hue, Washburn (1911) found that the affective judgements to saturated colours were more positive than those assigned to tints (lighter colours) or shades (darker colours). However, it was not until the work of Guilford (1934) that any systematic attempt was made to study the contributions of hue, tint and saturation on affective judgements.

Attempting to study the contributions of hue, tint and saturation on affective judgements, Guilford (1934) and Guilford and Smith (1959), conducted some of the most systematic work in this area. Using Milton Bradley coloured papers, Guilford (1934) selected 18 hues being equal in tint (value or brightness) and chroma (saturation), 11 hues varying in value and low in saturation and 11 hues high in saturation. Each colour was judged on a nine-point pleasantness scale, from greatest possible unpleasantness (1) to greatest possible pleasantness (9). Saturated colours were found to be preferred over unsaturated ones.

Granger (1955) constructed sets of stimuli from Munsell colours, where one dimension would vary, while the other two were held constant for each of the attributes of hue, value and saturation. He found wavelength to be the major factor in determining preference (with 5B blue being most preferred and 5Y yellow being least preferred) but also noted that as saturation increased, so did preference, up to a point. Colours seen as too vivid were less preferred. Granger did not find an interaction effect among the different colour attributes.

The work of Guilford and Smith (1959) also provides a rigorous examination of the roles that hue, value and saturation play in pleasantness. A ten-point pleasantness scale was used to rate 316 stimulus papers; of these 295 were coloured stimulus papers matched on the three Munsell dimensions. Guilford and Smith found that the greater the saturation within a given hue, the greater its perceived pleasantness appeared to be, with the relationships tending to be curvilinear. Moreover, Guilford and Smith observed that colours at the levels of brightness which can be the most saturated, were most liked. Their data were presented in terms of isohedonic charts¹⁰. Isohedons, or lines of uniform affective value, for a given hue were plotted across varying values of brightness (y-axis) and saturation (x-axis). Representing the

¹⁰ A variation on this technique is isosemantic mapping (Sivik, 1975, 1974a), where colour is plotted in a similar manner in relation to semantic differential values.

data in this manner allowed predicting a likely pleasantness rating for colours defined by Munsell coordinates. With their laboratory experiments, Guilford and Smith (1959) demonstrated the complexity of the relationship between the three dimensions of colour as they relate to pleasantness.

Sampling 24 colours, Smets (1982) examined the contributions of brightness and saturation to pleasantness ratings in greater detail. She found all three attributes contributed to ratings along this dimension, with saturation accounting for 88% of the variance, whereas brightness accounted for only 12% of the variance.

In a comprehensive study of emotional reactions to colour among 250 undergraduates, Valdez and Mehrabian (1994) also found support for the hypothesis that pleasure is a positive correlate of saturation. Stepwise multiple regression analysis was used to explore the contributions of brightness and saturation to pleasure. The pleasure elicited by 76 colour stimuli was measured by means of Mehrabian's (1978) verbal-report PAD (Pleasure, Arousal, Dominance) scales. Averaged pleasure responses (each colour sample was rated by approximately 25 subjects) constituted the dependent variable, and brightness and saturation the independent variables in the regression analysis, yielding the following equation:

$$\text{Pleasure} = .69 \text{ Brightness} + .22 \text{ Saturation}$$

From this study, a colour's brightness and saturation levels appear to explain a substantial portion of the variance in the feelings of pleasure it induces (multiple regression coefficient = .69). As expected more saturated (more vivid and purer) colours induced greater feelings of pleasure in viewers. However, the regression analysis indicates the effect of brightness to be considerably stronger than the effect of saturation in determining pleasure responses to colour. The differential magnitudes of these two effects had not been anticipated based on previous research. Valdez and Mehrabian (1994) found no second-order curvilinear relationship between colour saturation and the elicited pleasure.

In their study involving 156 university undergraduates, Gorn et al. (1997) manipulated the colour of a big "swoosh" in the centre of an ad for a fictitious paint company, "Rainbow Paints", according to a 2 by 2 by 2 factorial design (hue x chroma x value). Using a two-dimensional view on arousal (Smith and Apter, 1975; Apter, 1976, 1981, 1982; Walters et al.,

1982), Gorn et al. (1997) found that respondents exposed to ads containing higher chroma colours reported a greater liking for the ad, and that this effect was mediated by greater feelings of excitement (involving high pleasure and high arousal) experienced. The greater feelings of excitement experienced involve a strong pleasure component, suggesting that increased saturation of colours may increase feelings of pleasure.

THE EFFECTS OF COLOUR ON EMOTIONS:
Table 3-3: The Pleasure-eliciting Properties of Colours

EFFECTS OF SATURATION

Citation	Sample	Design	Stimuli	Dependent variable	Findings
Washburn (1911)					Found that the affective judgements to saturated colours were more positive, than those assigned to tints or shades (which are less saturated).
Guilford (1934)		Study designed in order to be able to distinguish the contributions of hue, value and saturation on affective judgements	Milton Bradley coloured papers 11 hues varying in value and low in saturation and 11 hues high in saturation	Nine-point pleasantness scale	Found saturated colours to be preferred over unsaturated colours
Granger (1955)			Munsell colours with varied dimensions of hue, saturation and brightness	Preference ranks	Although wavelength was found to be the major factor determining preference, Granger also noted that, as saturation increased, so did preference, up to a point. Colours seen as too vivid were less preferred. Granger did not find an interaction effect among the different colour attributes.
Guilford and Smith (1959)		Rigorous examination of the roles of hue, value and saturation on pleasantness	316 stimulus papers, 295 of which were matched on the three Munsell dimensions	Ten-point pleasantness scale	They demonstrated the complexity of the relationship between the three dimensions of colour as they relate to pleasantness. Nevertheless, they found that the greater the saturation within a given hue, the greater its perceived pleasantness appeared to be, with the relationship tending to be curvilinear. They also observed that colours at the levels of brightness which can be the most saturated, were most liked.

Smets (1982)			24 Munsell colours, varying in saturation and brightness		Found saturation to account for 88% of the variance in pleasantness ratings.
Valdez and Mehrabian (1994) – Study 1	250 undergraduate students	Laboratory experiment with colour patches	76 colour samples : 10 hues, using 5 replication sets with equal brightness and saturation levels.	Pleasure, measured according to Mehrabian's (1978) PAD emotion scale	Found support for the hypothesis that pleasure is a positive correlate of saturation. As expected more saturated (more vivid and purer) colours induced greater feelings of pleasure. A colour's saturation level appears to explain a substantial portion of the variance in the feelings of pleasure it induces, however a regression analysis indicates the effect of brightness to be considerably stronger. No support was found for a second-order curvilinear relationship between saturation and the elicited pleasure.
Gorn et al. (1997)	156 university undergraduates	Manipulated the colour of a big "swoosh" in an advertisement	4 blue and 4 red colour samples, chosen according to a 2x2x2 factorial design (hue x chroma x value)	<u>Feelings of excitement</u> (involving high pleasure and high arousal)	Found that respondents exposed to ads containing higher chroma colours reported a greater liking for the ad and that this effect was mediated by greater feelings of excitement (involving high pleasure and high arousal) experienced.

3.5.3.3. Effects of Value

The case of achromatic colours:

With regard to achromatic colours such as white, grey and black (representing brightness variations only), Adams and Osgood (1973) found in their cross-cultural study, in which subjects had to rate colour concepts (words) using the semantic differential factors (Osgood et al., 1957), that the words grey and black were rated as bad, whereas the concept white was rated as good.

Birren (1978) and Sharpe (1974) found the colour black to be associated with anxiety, which implies displeasure and high arousal.

Apparently not controlling for value or chroma, Boyatzis and Varghese (1994) found that children tended to associate negative emotions with dark colours, such as black and grey.

Valdez and Mehrabian (1994, Study 3) used five achromatic colour samples (ranging from white to black) to explore the effect of brightness in achromatic colours on pleasure responses. A regression analyses with average pleasure (25 subjects rated each sample) as the dependent variable and brightness as the independent variable revealed the following equation, expressing the relationship of pleasure to brightness of achromatic colours (standardized variables, multiple regression coefficient = .71):

$$\text{Pleasure} = .71 (\text{Brightness})$$

As hypothesized a positive relation could be revealed between brightness of achromatic colours and pleasure. Pleasure reactions increased as colour samples ranged from black, over greys of increasing brightness on to white. As expected black was rated as least pleasant, greys were assigned intermediate levels of pleasantness and white was perceived to be the most pleasant. The relationship between brightness and pleasantness was very strong (as can be determined by the beta weight of .71 in the preceding equation) and highly significant.

The case of chromatic colours

Although early colour preference studies focused almost solely on the dimension of hue, Washburn (1911) found that the affective value of tints (lighter colours) was preferred to shades (darker ones). However, it was not until the work of Guilford (1934) that any systematic attempt was made to study the contributions of hue, tint and saturation on affective judgements.

Eysenck (1941) calculated the average ranks for six saturated colours (not equated for brightness) from a number of studies encompassing the responses of 21,060 subjects. He noted that there appeared to be a direct relationship between liking of a given colour and its differentiation from white. In contrast to Washburn's (1911) findings, Eysenck's tentative conclusion was that preference of any colour varies inversely with the luminosity factor of that colour. Note however that his study involved only saturated colours.

Attempting to study the contributions of hue, tint and saturation on affective judgements, Guilford (1934) and Guilford and Smith (1959), conducted some of the most systematic work in this area. Using Milton Bradley coloured papers, Guilford (1934) selected 18 hues being equal in tint (value or brightness) and chroma (saturation), 11 hues varying in value and low in saturation and 11 hues high in saturation. Each colour was judged on a nine-point pleasantness scale, from greatest possible unpleasantness (1) to greatest possible pleasantness (9). From this study, Guilford (1934) found lighter colours to be preferred over darker ones.

The work of Guilford and Smith (1959) also provides a rigorous examination of the roles that hue, value and saturation play in pleasantness. A ten-point pleasantness scale was used to rate 316 stimulus papers; of these 295 were coloured stimulus papers matched on the three Munsell dimensions. Guilford and Smith found that as brightness increased, perceived pleasantness also increased, with the relationships tending to be curvilinear. However, a preferred hue pattern appeared to exist across all levels of brightness. Guilford and Smith also observed that colours at the levels of brightness which can be the most saturated, were most liked. Their data was presented in terms of isohedonic charts. With their laboratory experiments, Guilford and Smith (1959) demonstrated the complexity of the relationship between the three dimensions of colour as they relate to pleasantness.

In their (1973) cross-cultural study in which subjects had to rate colour concepts (words) using the semantic differential factors (Osgood et al., 1957), Adams and Osgood found that evaluation correlated in general strongly and positively with brightness.

In Sivik's (1974a, 1975) analysis of the evaluative factor, there appeared to be a complex interaction between hue, the degree of whiteness, blackness and chromaticness (purity or saturation). Generally, as the degree of blackness increased, colours were judged to be of a lower pleasantness or less preferred. Although this is a consistent finding, across all hues, dislike varied with hue. Sivik (1974a) found that across all three parameters (blackness, whiteness, purity), there were more instances of blue being judged positive or pleasant than any other hue. For example, to obtain the same degree of judged dislike between a dark blue and a dark yellow (brown), the blue must be much darker (have more blackness) than the yellow. Emerging from Sivik's (1974a, 1975) initial studies is the complexity of the interaction process between stimulus colour properties and connotative associations. Through the use of isosemantic mapping he graphically represents that interactive process.

Sampling 24 colours, Smets (1982) examined the contributions of brightness and saturation to pleasantness ratings in greater detail. She found all three attributes contributed to ratings along this dimension, with brightness accounting for 12% of the variance, whereas saturation accounted for 88% of the variance.

In a comprehensive study of emotional reactions to colour among 250 undergraduates, Valdez and Mehrabian (1994) also found support for the hypothesis that pleasure is a positive correlate of brightness. Stepwise multiple regression analysis was used to explore the contributions of brightness and saturation to pleasure. The pleasure elicited by 76 colour stimuli was measured by means of Mehrabian's (1978) verbal-report PAD (Pleasure, Arousal, Dominance) scales. Averaged pleasure responses (each colour sample was rated by approximately 25 subjects) constituted the dependent variable, and brightness and saturation the independent variables in the regression analysis, yielding the following equation:

$$\text{Pleasure} = .69 \text{ Brightness} + .22 \text{ Saturation}$$

From this study, a colour's brightness and saturation levels appear to explain a substantial portion of the variance in the feelings of pleasure it induces (multiple regression coefficient =

.69). As expected brighter (less dark) colours induced greater feelings of pleasure in viewers. Moreover, in contrast to Smet's (1982) findings, the regression analysis indicates the effect of brightness to be considerably stronger than the effect of saturation in determining pleasure responses to colour. The differential magnitudes of these two effects had not been anticipated based on previous research. Valdez and Mehrabian (1994) found no second-order curvilinear relationship between colour brightness and the elicited pleasure.

In their study involving 156 university undergraduates, Gorn et al. (1997) manipulated the colour of a big "swoosh" in the centre of an ad for a fictitious paint company "Rainbow Paints" according to a 2 by 2 by 2 factorial design (hue x chroma x value) but found (for red and blue hues) no support for the hypothesis that lower value, darker colours generate more unpleasant feelings (as measured by the items "unhappy", "irritated", "annoyed", loadings=0.74, 0.92, 0.90; Cronbach α =0.82). However, using a two-dimensional view on arousal (Smith and Apter, 1975; Apter, 1976, 1981, 1982; Walters et al., 1982), they did find that those exposed to ads containing higher value colours reported a greater liking for the ad and through this effect also a greater liking of the brand. The former effect appeared to be mediated by greater experienced feelings of relaxation (involving high pleasure and low arousal). The greater feelings of relaxation experienced involve a strong pleasure component, suggesting that increased lightness of colours may nevertheless increase feelings of pleasure.

THE EFFECTS OF COLOUR ON EMOTIONS:
Table 3-4: The Pleasure-eliciting Properties of Colours

EFFECTS OF BRIGHTNESS

Citation	Sample	Design	Stimuli	Dependent variable	Findings
<i>The case of achromatic colours</i>					
Adams and Osgood (1973)	Subjects across 23 cultures		Colour names (words)	An evaluative (pleasant-unpleasant) dimension identified from a semantic differential scale	The words “Grey” and “Black” were found to be rated as bad across 23 cultures, whereas the concept “White” was rated as good
Birren (1978) and Sharpe (1974)					Found the colour black to be associated with anxiety, implying displeasure and high arousal.
Boyatzis and Varghese (1994)			Not controlling for value or chroma		Children tend to associate negative emotions with dark colours, such as black and grey.
Valdez & Mehrabian (1994) – Study 3	125 undergraduate students	Laboratory experiment Colour patches	5 achromatic colour samples (ranging from white to black)	Pleasure, measured according to Mehrabian’s (1978) PAD emotion scale	As hypothesized, a strong positive relation could be revealed between brightness of achromatic colours and pleasure. Pleasure reactions increased as colour samples ranged from black, over greys of increasing brightness on to white, with black receiving the lowest and white receiving the highest pleasantness scores.

The case of chromatic colours

Washburn (1911)					Found that the affective value of tints (lighter colours) was preferred to shades (darker colours).
Guilford (1934)		Study designed in order to be able to distinguish the contributions of hue, value and saturation on affective judgements	Milton Bradley coloured papers 11 hues varying in value and low in saturation and 11 hues high in saturation	Nine-point pleasantness scale	Found lighter colours to be preferred over darker ones.
Eysenck (1941)	Meta-analyses encompassing the responses of 21,060 subjects	For a number of studies average ranks of colour preference were calculated	Six saturated colours (not equated for brightness)	Average preference rankings	Notes that there appears to be a direct relationship between liking of a given colour and its differentiation from white. His tentative conclusion was that preference of any colour varies inversely with the luminosity factor of that colour.
Guilford and Smith (1959)		Rigorous examination of the roles of hue, value and saturation on pleasantness	316 stimulus papers, 295 of which were matched on the three Munsell dimensions	Ten-point pleasantness scale	They demonstrated the complexity of the relationship between the three dimensions of colour as they relate to pleasantness. Nevertheless, they found that as brightness increased, perceived pleasantness also increased, with the relationship tending to be curvilinear
Lawler and Lawler (1965)			Happy versus sad story	Crayons chosen by children for colouring	Found that children coloured with a yellow crayon after hearing a happy story and with a brown crayon after hearing a sad story.
Adams and Osgood (1973)	Subjects across 23 cultures		Colour names (words)	An evaluative (pleasant-unpleasant) dimension identified from a semantic differential scale	Found that evaluation correlated in general strongly and positively with brightness.

Sivik (1974a)	A stratified sample of Swedish adults	Studied colours in isolation	71 colours chosen to represent the NCS colour space (based on the Swedish Natural Colour System)	An evaluative dimension, identified from a 26 item semantic differential scale	In Sivik's analysis of the evaluative factor, there appeared to be a complex interaction between hue, the degree of whiteness, blackness and purity. Generally as the degree of blackness increased, colours were judged to be of a lower pleasantness or less preferred. Although this is a consistent finding across all hues, dislike varied with hue. For example: to obtain the same degree of judged dislike between a dark blue and a dark yellow (brown), the blue must be much darker than the yellow as blue is generally more preferred.
Smets (1982)			24 Munsell colours, varying in saturation and brightness		Found brightness to account for 12% of the variance in pleasantness ratings.
Boyatzis and Varghese (1994)			Not controlling for value or chroma		Children tend to associate positive emotions with light colours, such as blue and yellow.
Valdez and Mehrabian (1994) – Study 1	250 undergraduate students	Laboratory experiment with colour patches	76 colour samples : 10 hues, using 5 replication sets with equal brightness and saturation levels.	Pleasure, measured according to Mehrabian's (1978) PAD emotion scale	Found support for the hypothesis that pleasure is a positive correlate of brightness. As expected brighter (less dark) colours induced greater feelings of pleasure. A colour's brightness level appears to explain a substantial portion of the variance in the feelings of pleasure it induces. A regression analysis indicates the effect of brightness to be considerably stronger than that of saturation No support was found for a second-order curvilinear relationship between brightness and the elicited pleasure.
Hemphill (1996)	40 undergraduate students		Not controlling for value or chroma	Colour-emotion association	Among adults (undergraduate students) bright colours (including white, pink, red, yellow, blue, purple and green) elicited mainly positive emotional associations and dark colours (including brown, grey and black) elicited mainly negative emotional associations.

Gorn et al. (1997)	156 university undergraduates	manipulated the colour of a big “swoosh” in an advertisement	4 blue and 4 red colour samples, chosen according to a 2x2x2 factorial design (hue x chroma x value)	<u>Unpleasant feelings</u> measured by the items: unhappy, irritated and annoyed ($\alpha=.82$) <u>Feelings of relaxation</u> (involving high pleasure and low arousal)	Found no support for the hypothesis that lower value, darker colours generate more unpleasant feelings. However, they did find that those exposed to ads containing higher value colours reported a greater liking of the ad and through this effect also a greater liking of the brand. This effect appeared to be mediated by greater feelings of relaxation (involving high pleasure and low arousal) experienced.
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3.5.3.4. Overview

Although it is obvious that a lot of the early studies on the effects of hue on pleasure are methodologically flawed – confounding brightness and saturation effects with the effects of colour hue – there appears to be some consistency in the findings. Extreme short wavelength colours (blue, green) seem to be generally preferred, followed by the extreme long wavelength colour red. Yellow-green, yellow and orange appear to be generally disliked (Walton, Guilford and Guilford, 1933; Guilford, 1934; Eysenck, 1941; Wexner, 1954; Granger, 1955; Guilford and Smith, 1959; Helson and Lansford, 1970; Hopson, Cogan and Batson, 1971; Adams and Osgood, 1973; Sivik, 1974a, 1975; Mehrabian and Russell, 1974; Jacobs and Suess, 1975). Stated more formally, pleasure-displeasure reactions to spectral colours appear to approximate a U-shaped function of wavelength, with yellows (green-yellow, yellow and red-yellow) at the bottom portion of the U. Indeed, the findings of Valdez and Mehrabian (1994, Study 2) confirm that short-wavelength hues are rated as being the most pleasant, whereas intermediate wavelength hues are rated as the least pleasant. For the long wavelength hues yellow-red and red, this trend is reversed as they show increased pleasure ratings. The works of Eysenck (1941) and Madden et al. (2000) advocate a strong argument for a universal scale of preference. Nevertheless, Osgood et al. (1957), suggest that an acceptable colour is defined by the object with which it is associated. Studying selected colours in the context of objects, they found yellow to be rated as the “most favourable” colour, which is in contrast with the general finding, using colour patches, that yellow is mostly disliked.

Although Washburn (1911) already suggested affective judgements to more saturated colours to be more positive, it was not until the work of Guilford (1934) that any systematic attempt was made to study the contribution of colour saturation to evoked pleasure. In this and subsequent studies, saturated colours were systematically found to be preferred over unsaturated ones. Granger (1955) noted that as saturation increased, so did preference, but only up to a certain point. He found colours seen as too vivid to be less preferred. Guilford and Smith (1959) also found that the greater the saturation within a given hue, the greater its perceived pleasantness appeared to be, with the relationships tending to be curvilinear. Smets (1982) found saturation to account for 88% of the variance in pleasure induced, whereas brightness accounted for only 12% of the variance. Although Valdez and Mehrabian (1994) also found support for the hypothesis that pleasure is a positive correlate of saturation,

contrary to Smets' (1982) findings, they found the effect of brightness to be considerably stronger than the effect of saturation. Moreover, contradicting the findings by Granger (1955) and Guilford and Smith (1959), Valdez and Mehrabian (1994) did not find a second-order curvilinear relationship between colour saturation and the elicited pleasure. Gorn et al. (1997) found that respondents exposed to ads containing higher chroma colours reported a greater liking for the ad, and that this effect was mediated by the experience of greater feelings of excitement, which involve pleasant feelings of high arousal.

With regard to achromatic colours such as white, grey and black (representing brightness variations only), empirical findings also reveal consistent results. Consistent with previous findings (Adams and Osgood, 1973; Sharpe, 1974; Birren, 1978; Boyatzis and Varghese, 1994), Valdez and Mehrabian (1994, Study 3) could confirm the hypothesised positive relation between brightness of achromatic colours and pleasure. Pleasure reactions increased as colour samples ranged from black, over greys of increasing brightness on to white. Black was rated as least pleasant, greys were assigned intermediate levels of pleasantness and white was the most pleasant. The relationship between brightness and pleasantness was very strong and highly significant.

Consistent with the effect of brightness for achromatic colours, lighter chromatic colours also seem to be preferred over darker ones. Although for saturated colours, Eysenck (1941) came to the tentative conclusion that preference of any colour varies inversely with the luminosity factor of that colour, more systematic studies investigating the contribution of brightness found exactly the opposite to be true: that indeed lighter colours are preferred to darker ones (Washburn, 1911; Guilford, 1934; Guilford and Smith, 1959, Adams and Osgood, 1973). Guilford and Smith (1959) found that, as brightness increased, perceived pleasantness also increased, with the relationships tending to be curvilinear. They also demonstrated the complexity of the relationship between the three dimensions of colour as they relate to pleasantness. In Sivik's (1974a, 1975) analysis of the evaluative factor, there also appeared to be a complex interaction between hue, the degree of whiteness, blackness and chromaticness (purity or saturation). However, generally, as the degree of blackness increased, colours were judged to be of a lower pleasantness or less preferred. Although this is a consistent finding, across all hues, dislike varied with hue (e.g. to obtain the same degree of judged dislike between a dark blue and a dark yellow (brown), the blue must be much darker (have more blackness) than the yellow). Examining the contribution of colour brightness to pleasantness

in greater detail, Smets (1982) found brightness to account for only 12% of induced pleasure variance, whereas saturation accounted for 88% of the variance. As expected, Valdez and Mehrabian (1994) also found that brighter (less dark) colours induced greater feelings of pleasure in viewers. However, in contrast with Smets' (1982) findings, Valdez and Mehrabian (1994) found the effect of brightness to be considerably stronger than the effect of saturation in determining pleasure responses to colour. Unlike Guilford and Smith (1959), Valdez and Mehrabian (1994) found no second-order curvilinear relationship between colour brightness and the elicited pleasure. Manipulating the colour of a big "swoosh" in the centre of an ad, Gorn et al. (1997) did not find support for the hypothesis that lower value or darker colours generate more unpleasant feelings (for red and blue hues). However, they did find that those exposed to ads containing higher value colours reported a greater liking of the ad and through this effect also a greater liking of the brand. The former effect appeared to be mediated by greater feelings of relaxation, which besides low arousal, also involve pleasure, thus suggesting that increased lightness of colours may nevertheless increase feelings of pleasure.

3.5.4. COLOUR-EVOKED AROUSAL

It has been widely accepted that people's feelings are affected by colour. In particular, colour is believed to affect the degree of felt arousal (e.g., Walters et al., 1982; Mikellides, 1990). From the results of early studies, various authors cite support for the premise that certain colours have the capacity to excite and arouse an individual, while others have a calming and relaxing effect.

In this regard Crowley (1993), points out that colours that enhance consumers' liking of a stimulus are not necessarily those colours that consumers find activating (or deactivating). These two dimensions of consumer response are shown to have different patterns across the visible spectrum. Referring to the theory of psychological reversals (Smith & Apter, 1975; Apter, 1976, 1981, 1982; Walters et al., 1982), Gorn (1997) also argues that arousal can be experienced as pleasant (i.e. excitement) or unpleasant (i.e. tension) and that a lack of arousal can also be experienced as pleasant (i.e. relaxing) or unpleasant (i.e. boring). In the consumer behaviour literature, colour arousal effects have only recently been addressed (Crowley, 1993; Valdez and Mehrabian, 1994; Gorn, 1997).

In an attempt to better understand the effect of colour on human behaviour, prior research has examined both arousal perception (i.e., how active a stimulus is perceived to be), as well as the actual physiological arousal engendered by exposure to various colours. Investigators have often focused their attention on the latter, i.e. the physiological responses to colour (Kaiser, 1984; Beach et al., 1988).

Two common physiological measures of arousal are changes in electrical activity in the brain (Electro Encephalogram - EEG) and changes in skin conductance or resistance (Galvanic Skin Response - GSR). With increased arousal, skin conductance increases while skin resistance decreases. Alpha waves are patterns of neural activity found during periods of relaxed wakefulness that decrease and become desynchronised during periods of arousal. This process is known as the alpha attenuation response, AAR (Ali, 1972). Thus arousal is often measured by changes in alpha wave frequency and/or amplitude (Kaiser, 1984; Wilson and Wilson, 1959). There are numerous ways to report EEG responses: e.g. amplitude of alpha waves, duration of alpha wave suppression, amount of EEG, etc... (Kaiser, 1984, presents an excellent discussion on this issue). The same can be said about GSR data. Different authors

operationally define change scores in terms of responses during different time intervals after stimulus onset. Therefore much variability can exist in what is often thought of as a rigorous response measure. When one tries to compare findings from one study to another, different types of responses might be reported under the same general response name, making such comparisons virtually impossible (Kaiser, 1984; Beach et al., 1988). Moreover, some of the original laboratory studies have been criticized because of their small and non-representative sample sizes, the failure to operationally define stimulus variables, confounding of stimulus and experimental design variables and extrapolating beyond the evidence provided by the data (Beach et al., 1988; Kaiser, 1984; Sharpe, 1981; Sucov, 1973; Norman and Scott, 1952).

Nevertheless, it has been generally acknowledged that some colours are more arousing and activating (stimulating brainwave activity, skin conductance, etc) while other colours tend to be more calming and deactivating.

These studies regarding the effects of colour on arousal will be reviewed in the next paragraphs. More specifically, we will first present the effects of colour hue on arousal responses, followed by the effects of colour saturation and brightness. Finally, the conclusions of these previous studies will be concisely summarized.

3.5.4.1. Effects of Hue

Physiological responses

Studies involving physiological reactions to colour have been motivated largely by the hypothesis that long-wavelength colours (e.g., red and yellow) are more arousing to short wavelength colours (e.g., blue and green).

According to Beach et al. (1988), Goldstein (1942) is the most cited work in terms of how colour affects behaviour. Based on his observations while conducting experiments on a small number of patients (3-5) suffering from organic diseases of the central nervous system, Dr. Goldstein postulated an affective theory of colour, which he believed applied to all individuals. From his work with brain-damaged patients, he observed that in the presence of green, abnormal behaviours became less deviant, while in the presence of red, these

behaviours became exaggerated. The colour stimuli he used in these experiments were pieces of coloured paper, coloured rooms, coloured lights and coloured clothing. Based on his observations, Dr. Goldstein viewed red as having an “expansive” effect on the senses and of being capable of inducing a state of excitation in both emotional and motor behaviour. Green, on the other hand, had in his opinion a contractive nature and promoted tranquillity (Nakshian, 1964). Based on these premises, Dr. Goldstein (1942) felt that one’s performance on certain motor tasks and judgements could be interfered with or disturbed by the colour red and facilitated by the colour green. However, neither numerical results, nor statistical analyses of his observations were ever presented (Beach et al., 1988; Nakshian, 1964; Norman and Scott, 1952; Goldstein, 1942).

According to Beach et al. (1988), one of the most comprehensive and stringent studies of the effects of coloured illumination on both subjective and physiological measures, was according to Beach et al. (1988) provided by Gerard (1958, 1959). In his often-cited empirical study, 24 male college students were exposed to three different lighting conditions (red, blue and white light, each projected on a screen during ten minutes in counterbalanced order). The hues blue and red were chosen as they represent extreme colours of the visible spectrum. Luminance of the translucent screen in the three light conditions was equated by the method of limits. Statistically significant differences could be revealed between the red and blue conditions for all physiological measures recorded during exposure, except for heartbeat. The blue illumination condition yielded lower blood pressure and palmar conductance, a lower respiration rate, increased alpha wave frequency (EEG) and a reduced eyeblink frequency as compared to the red illumination condition. Moreover, Gerard noted that subjects reported feeling more alert under the red illumination condition and more relaxed in the blue one, lending additional support to the sedative effect of blue. Responses to the white light varied, but were most often similar to those of the red light condition.

Erwin, Lerner, Wilson and Wilson (1961) exposed subjects to four different coloured lights (red, blue, green and yellow), for five minutes each, and found the duration of alpha wave onset to be shortest under the green condition. However, the authors could not reveal any significant difference in arousal (as measured by suppression of alpha waves) between the red, yellow and blue conditions. According to Beach et al. (1988), the authors did not discuss how (if at all) brightness was equated between the four colour stimuli, nor did they give much details regarding the colour stimuli used.

Among those investigators who have examined colour effects on arousal, Wilson (1966) was the first to suggest a possible relationship between arousal reactions and a colour's wavelength. As he found red to be significantly more arousing than green, based both on absolute skin conductance measures and conductance change (galvanic skin response) data, Wilson (1966) posited a U-shaped relationship between colour wavelength and arousal effects. According to Wilson (1966, p949) this relationship may help to explain why the psychological distance between red and violet is less than between either colour and green. This U-shaped hypothesis predicts that the colours with more extreme wavelengths are the most activating. Behind this hypothesis is a Darwinian logic (Wilson, 1966, p949) that more extreme wavelengths are arousing because they are near potentially harmful wavelengths, i.e. infrared (heat) and ultraviolet (sunburn). Wilson's (1966) subjects were exposed to highly saturated red and green slides. Five slides of each colour were shown in alternating order for one minute each. Using mean conductance level and change in conductance level as measures for arousal, he found support for the hypothesis that red is more arousing than green, with the effect being particularly apparent in the GSR data. His results showed both conductance scores and change scores to be higher in the red condition, demonstrating that red is more stimulating and more exciting. This study also revealed some confounding order effects (Beach et al., 1988). It should also be noted that neither colour brightness, nor saturation were controlled for in the study (Valdez and Mehrabian, 1994). When subjects were asked, as a check on brightness after the experiment, which of the two colours (red or green) was lighter, 18 out of the 20 responded green.

Contending that hues at the end of the visible spectrum (blue, purple) are more stimulating than those in the middle (green), as suggested by Wilson (1966), Nourse and Welch (1971) exposed fourteen subjects to green and violet light in alternating order (six one-minute exposures). Arousal was measured by the difference in skin conductance level at the initial exposure of a colour and the highest level reached in the first 12 seconds. A significant difference in GSR amplitude between the two colour conditions could be revealed, with GSR measures being higher in the violet light condition than in the green one. However, another factor may have been confounded with hue effects: instead of using filters, the lights were painted and appeared to differ not only in hue but to have two very different spectral compositions as well. Whereas the green light was a relatively pure spectral composition (high in saturation), the violet light had a spectral composition which covered the entire visible spectrum and was therefore low in saturation. Also the lights were presented in two

different configurations, with the green lights forming a '+'-shaped cross and the violet lights forming an 'x'. There was also a significant colour-order interaction: the response to violet was greatest for those subjects who had been shown green first and responses were only significantly different for the first presentation of a colour, and not for the remaining two, which may be explained by the subjects adaptation (habituation) on subsequent presentations. Nevertheless, this study is often cited as support for differential arousal properties of colour (Beach et al., 1988).

Ali (1972) investigated alpha wave recovery in male subjects being exposed to blue and red lights (equated for brightness) for either 5 or 10 minutes. Greater alpha recovery over time occurred under blue than under red light, which over ten minutes showed relatively little recovery. These findings led Ali to conclude that a higher level of arousal (cortical activity) takes place in red light, which then requires a longer time period before resting alpha activity can resume.

Jacobs and Hustmyer (1974) found GSR to be significantly affected by colour, while heartbeat and respiration measures yielded no difference. Red, yellow, green and blue coloured slides were shown to subjects for one minute each in counterbalanced order, with white slides projected between the different colours for one minute. Saturation was high for each colour, but brightness varied, with yellow being the most bright (8/) and the red being the least bright (3.9/). Arousal, measured in terms of GSR as the greatest change in skin conductance occurring within the first 15 seconds after stimulus onset, appeared to be highest in the red condition, followed by the green, yellow and blue conditions. Jacobs and Hustmyer (1974) found no significant difference between the red versus green condition and the blue versus yellow condition. They note that their findings agree with those reported by Gerard (1958) with regard to GSR and heartbeat, but are contrary to these of Gerard (1958) with regard to respiration data. With regard to GSR their findings disagree with those of Wilson (1966). The authors claim discrepancies between this study and other studies to be due to the colour stimulus difference (lights versus painted surfaces).

Caldwell and Jones (1985) found no systematic effects of red, blue or white coloured lights on subjects' eyeblink frequency, skin conductance, finger pulse volume, heartbeat or EEG measures. However, as the stimulus was only presented for a maximum of 45 seconds, the length of exposure to the coloured light conditions may have been too short to detect subtle

changes. Colour effects appeared to be limited to the first presentation of a given colour. Nevertheless, no difference in percent of alpha activity or peak EEG frequency could be detected under red or blue light conditions.

Kuller (1985) found no evidence to support the notion that red interiors are more stressful than blue interiors. He observed no difference in EEG measures when individuals sat in a red or blue-walled room.

Based on previous research (Gerard, 1958; Lean, 1984), Etnier and Hardy (1997) hypothesized that there would be a statistically significant effect of environmental colour on physiological arousal, with the warm colour increasing arousal in comparison to the cool and neutral colours. In their own study on the influence of environmental colour on task performance Etnier and Hardy (1997) did not find a significant main effect of environmental colour (green, orange or white coloured room) on physiological arousal (heart rate, blood pressure). However the colour x time¹¹ interaction was significant for systolic blood pressure $F(4,116)=275.03$, $p<.0001$, diastolic blood pressure $F(4,116)=18.46$, $p<.0001$, and heart rate $F(4,116)=1170.93$, $p<.0001$.

It is evident that a great deal of inconsistency exists in the literature, arising from incomplete operational definitions of the stimulus conditions and the multifaceted nature of response measures defined as arousal (Beach et al., 1988). Whereas experimental studies involving physiological reactions to arousal (e.g., GSR, EEG) have been motivated largely by the hypothesis that long-wavelength colours are more arousing than short wavelength colours, numerous studies in this field could not confirm this contention (Erwin, Lerner, Wilson and Wilson, 1961; Jacobs and Hustmyer, 1974; Caldwell and Jones, 1985; Kuller, 1985; Etnier and Hardy, 1997). Nevertheless, this hypothesized positive relationship between colour wavelength and arousal is still generally proposed to be true, based on some supporting evidence (Goldstein, 1942; Gerard, 1958, 1959; Ali, 1972). However, researchers have often confined their studies to only two hues, often not even controlling for brightness or saturation, and just extrapolated the results without any further ado... Following a Darwinian logic, on the other hand, Wilson (1966) posited a U-shaped relationship between colour wavelength and arousal effects, predicting that the colours with more extreme wavelengths are the most

¹¹ Measures were taken at several instances: when entering the main laboratory (1), before (2) and after (3) performing a cognitive task and before (4) and after (5) performing a motor task.

activating. This contention has also received some support (Erwin, Lerner, Wilson and Wilson, 1961; Wilson, 1966; Nourse and Welch, 1971).

Arousal perception (i.e. semantic differential ratings)

Wexner (1954) conducted a study dealing with associations between colour samples and words that describe feelings. She constructed a list of adjectives judged to be best examples of mood tones and displayed eight coloured papers (8,5" x 11"). Subjects were asked to select the one colour that best described a given emotional state. From her study she concluded that indeed there exist definite colour-emotion associations. Wexner (1954) found the colour red to be associated with "exciting" and "stimulating", both of which imply pleasure and high arousal (Valdez and Mehrabian, 1994). Blue was associated with "secure/comfortable" and "tender/soothing", which imply pleasure and low arousal (Valdez and Mehrabian, 1994). Orange was associated with "disturbing/distressed/upset", implying displeasure and high arousal. However, Wexner neither used standard specifications of her colour samples, nor controlled for brightness or saturation. Nevertheless, her findings are generally in accord with other research.

Conducting one of the initial studies on the meaning of colours, Osgood et al. (1957) studied selected colours in the context of objects. In a first study one of six colours or an achromatic condition (black-white) was applied to either one of five objects (shirt, ice-cream, rug, car, cake mix) or as background. The object was then rated on 20 semantic differential scales, representing evaluative, activity and potency factors. Activity seemed to be related to the hue dimension – red and yellow were seen as active, while green, violet and blue were passive.

Wright and Rainwater (1962) undertook an extensive study of colour meanings of isolated colours. They had over 1200 subjects rate 50 3" mat surface colours on 24 semantic differential scales. Each subject rated only one colour on all 24 scales. Hue, value and saturation were varied. They found that redness corresponds with greater perceived warmth and less tranquillity and that excitation may be a linear function of hue.

Investigating the emotional stereotypes of colours, Aaronson (1970) had subjects rate colour names to 12 adjectives from the Emotion Profile Index (forced choice adjective checklist

presented as paired comparisons). He interprets his data as supportive of reliable colour-emotion stereotypes; however, he never presents the actual colour-emotion stereotypes other than for the single descriptor “activation”. He cites red as being high in activation and blue being low.

In their cross-cultural study in which subjects had to rate colour concepts (words) using the semantic differential factors (Osgood et al., 1957), Adams and Osgood (1973) found red to be rated as active across 23 cultures.

In a very comprehensive study, Sivik (1974a, 1975) examined seventy-one colours selected to represent the colour space of the Swedish Natural Colour System – NCS (Hard and Sivik, 1979; Hard, 1975). Judgements on 26 semantic differential scales by a stratified sample of Swedish adults revealed four underlying factors: excitement, evaluation, potency and temperature. From his findings, Sivik concluded that, with respect to the excitement factor, no difference was exhibited between hues with equal chromaticness. This finding contradicts the long-held stereotype that warm colours, such as red and yellow, are exciting, while cool colours, such as blue and green, are calming. Perceived colour-temperature ratings did show a strong hue component. Across all three parameters, yellow and yellow-red regions are judged warmest while blues and blue-greens are judged as coldest. However, the degree of perceived warmth and coldness also changed with varying amounts of blackness, whiteness and chromaticness. Sivik hypothesizes that the reason why red and yellow have been labelled as exciting, might be attributed to the fact that pure, saturated reds and yellows are more prevalent than pure and highly saturated greens and blues. This was also noted by Beach et al. (1988). Sivik notes that one can have a dull red, or an exciting green, based on the purity of the colour. Emerging from Sivik’s (1974a, 1975) initial studies is the complexity of the interaction process between stimulus colour properties and connotative associations. Instead of summarizing his data in terms of scale-colour correlations, Sivik graphically represents that interactive process through the use of isosemantic mapping

Measuring arousal by means of a paper and pencil anxiety test (anxiety being an emotional state involving displeasure and high arousal), Jacobs and Suess (1975) obtained support for the hypothesis that red is more arousing than blue. They assigned subjects to one of four colour conditions. Similar to the study reported by Jacobs and Hustmyer (1974), red, yellow, green and blue coloured slides were projected on a large screen. Scores on Spielberger,

Gorsuch and Lushene's (1970) State-Anxiety Inventory served as the dependent variable. Subjects were administered the paper and pencil anxiety test three times. Between each administration, a colour slide was projected during five minutes. Significantly higher anxiety scores were obtained in the red and yellow colour conditions than in the green and blue ones. This finding is consistent with studies of colour arousal, demonstrating that red and yellow are more arousing than blue and green. Still, brightness and saturation levels were not controlled for.

Citing anecdotal stories regarding colour decisions based on assumed behavioural responses, Porter and Mikellides (1976a) describe green as being calm and restful. Birren (1978) and Sharpe (1974) found the colour red to be associated with excitation.

Consistent with the generally accepted view that red is an exciting colour, whereas blue is relaxing (e.g., Guilford and Smith, 1959), Walters et al. (1982), using a two-dimensional view of arousal (Smith and Apter, 1975; Apter, 1976, 1981, 1982), found a link between red and felt 'excitement', and blue and felt 'relaxation'. Chroma and saturation were, nevertheless, not controlled for in this study either.

Profusek and Rainey (1987) investigated the effects of rooms painted in red versus Baker-Miller pink on state anxiety (which implies feelings of low pleasure and high arousal). As hypothesized, pink elicited less anxiety than red. Colour brightness and saturation level were however not controlled for. Actually Baker-Miller pink was much lighter than red, thus hue and value effects were confounded.

Weller and Livingstone (1988) investigated the effects of the colour of paper (blue, pink, white), on which a text about rape and murder incidents was presented, on emotional reactions to these events. Subjects reported being less upset when these incidents were presented on pink paper than when they were described on blue or white paper. Again brightness and saturation were not controlled in this study.

In a study among 121 undergraduates, focussing on the effects of colour hue on emotions, Valdez and Mehrabian (1994, Study 2) examined the arousal elicited by 10 hues, using 5 replication sets with equal brightness and saturation levels in order not to confuse the effects (this way a total of 50 colour samples were used). Arousal was measured according to

Mehrabian's (1978) PAD emotion scale. Long-wavelength hues were hypothesized to be more arousing than short-wavelength hues. A univariate analysis of variance (ANOVA) was used to explore the effects of hue (10 levels) on averaged arousal reactions (each colour sample was rated by nearly 25 subjects), revealing a significant .01-level main effect: $F(9,80) = 3.80$. Figure 3-24 demonstrates a plot of the mean arousal responses to each of the 10 hues. The two non-spectral hues purple and red-purple, are depicted separately at the right of the graph.

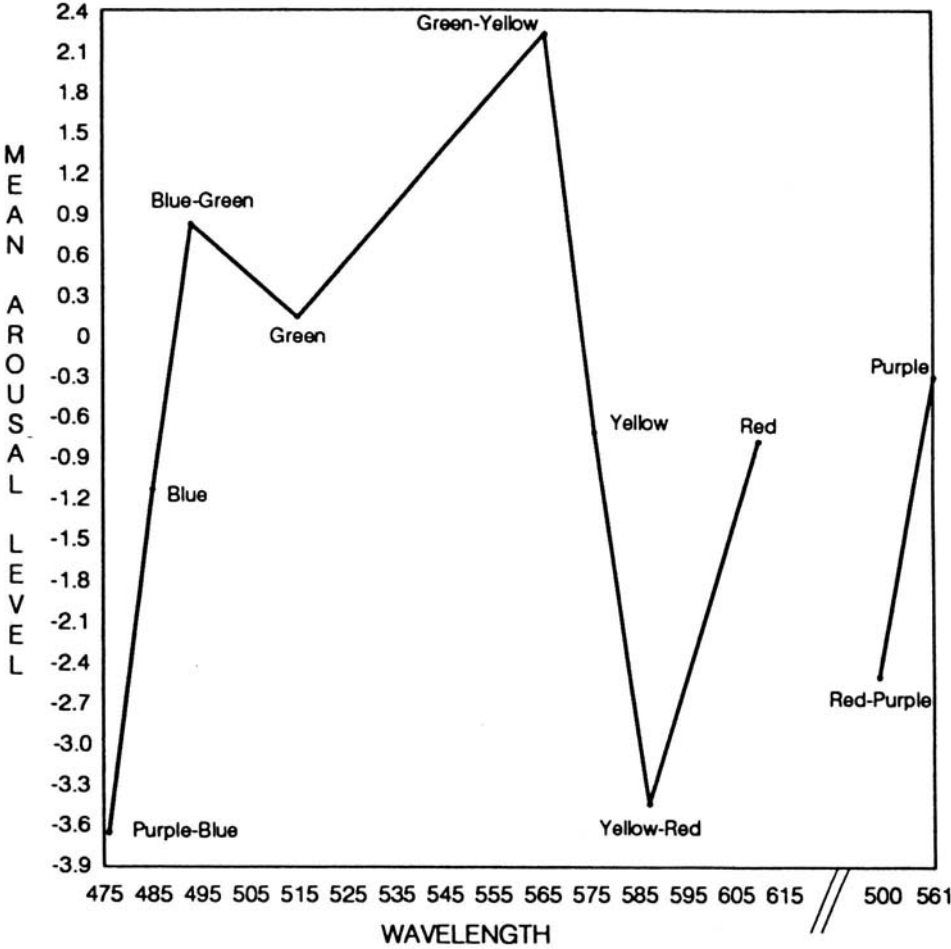


Figure 3-24: Mean arousal level as a function of colour wavelength
 Source: Valdez and Mehrabian, 1994, Study 2, p403

No support was found for the hypothesis that long-wavelength hues are more arousing than short wavelength hues. Tukey's Multiple Comparison Procedure could only reveal that the mean arousal level for green-yellow was significantly higher than the mean arousal levels for

purple-blue, yellow-red and red-purple and that the mean arousal level for blue-green was significantly higher than the mean arousal level for purple-blue.

Furthermore, a regression analysis was used to test for a possible significant parabolic relationship of arousal (the dependent variable) to wavelength (the independent variable). However, also here no significance was obtained. The obtained results relating hue and arousal were generally weak and non-significant. The only noteworthy generalization is that the green hues (green-yellow, blue-green, and green) seem to elicit the highest arousal reactions from subjects.

Gorn et al. (1997) manipulated the colour of a big “swoosh” in the centre of an ad for a fictitious paint company “Rainbow Paints” according to a 2 by 2 by 2 factorial design (hue x chroma x value). Using a two-dimensional view on arousal (Smith and Apter, 1975; Apter, 1976, 1981, 1982; Walters et al., 1982), they found partial support for the hypothesis that respondents exposed to the colour red are more excited than those exposed to the colour blue and that those exposed to the colour blue are more relaxed. Results from a study among 156 university undergraduates revealed that those exposed to the red hue reported stronger feelings of excitement. However only the results for the rating scale measure were statistically significant, not those of the verbal protocol measure¹² (rating scale: $F(1,138)=4.98$, $p<0.05$, omega square=0.026, means 1.97 versus 2.53; verbal protocol: $F(1,137)=3.10$, $p>0.05$). The results also show that those exposed to the blue hue reported experiencing greater feelings of relaxation (rating scale means = 4.31 vs. 4.04), however the effect of hue on feelings of relaxation fails to reach statistical significance on both the rating scale and the verbal protocol measures. Because the effects revealed for hue were small as compared to those for chroma and value, and much of the prior research has reported significant hue effects, Gorn et al. (1997) conducted a follow up study, comparing red and blue at very high saturation (5 Blue at value level 4 and chroma level 10 and 5 Red at value level 4 and chroma level 14). Because by doing so the stimuli varied not only in hue, but also in saturation, the effects of saturation and hue are confound. Submitting respectively 18 and 19 undergraduate business students to each condition, the results revealed that under these new conditions hue did not significantly

¹² The verbal protocol measure consisted of having respondents list all the feelings they had while viewing the ad. Subsequently these feeling responses were coded by two judges into three separate categories: ‘excitement’, ‘relaxation’ and ‘unpleasantness’, in parallel to the three feeling dimensions measured by the rating scales. All responses were classified, scored (+ or -) and summed for each category. Responses obtained from this verbal protocol-measure were significantly correlated with the scores on the rating scale measures ($p<.05$).

affect feelings of relaxation or excitement, nor ad or brand attitudes. They conclude that taken together, the results of both studies suggest that, when used as an executional cue in an ad, the hue (red vs. blue) of a colour at best has modest effects on feelings.

Madden et al. (2000) conducted a study in which respondents from eight countries evaluated ten colour-swatches, presented together with the colour-name. In this study the colour stimuli were not clearly specified according to a colour system. Brightness and saturation levels were not controlled for. The colour patches were probably high in saturation. Respondents were undergraduate students from Austria (n = 29), Brazil (n = 26), Canada (n = 29), Colombia (n = 48), Hong-Kong (n = 19), PRC (n = 31), Taiwan (n = 22) and the United States (n = 49). Colour meanings were captured using 20 item semantic differential scales. Colours and semantic items were plotted in two-dimensional perceptual maps for each country. From these plots it is apparent that “a spectrum of colour meaning” can be identified along an arousal or activation dimension: with red on the one hand, ranging over a gold-orange-yellow cluster, over a black-brown-purple cluster to a blue-green-white cluster on the other hand. The meaning associations along this spectrum run from “active”, “hot” and “vibrant” (associated with red) to “calming”, “gentle” and “peaceful” (associated with a blue-green-white cluster). The results obtained by Madden et al. (2000) indicate that in many parts of the world, consumers exhibit similarities in colour meaning associations.

Thus, studies using semantic differential scales to capture “perceptions of arousal” have more systematically found excitement and activity to be related to the hue dimension, with red and yellow generally seen as active, stimulating and exciting, while green, violet and blue are perceived to be passive, relaxing, soothing and calm (Wexner, 1954; Osgood et al., 1957; Wright and Rainwater, 1962; Aaronson, 1970; Adams and Osgood, 1973; Sharpe, 1974; Jacobs and Suess, 1975; Porter and Mikellides, 1976a; Birren, 1978; Walters et al., 1982; Madden et al., 2000). However, contradicting this long-held stereotype that warm colours are exciting, while cool colours are calming, Sivik (1974a, 1975) concluded on the basis of his comprehensive study, that no difference is exhibited between hues with equal chroma on the excitement factor, thus revealing the complexity of the interaction process between stimulus colour properties and connotative associations. Likewise, Valdez and Mehrabian (1994, Study 2) could not support the hypothesis that long-wavelength hues are more arousing than short wavelength hues either. They found the obtained results, relating hue and arousal, to be generally weak and non-significant. Unexpectedly, they found the green hues (green-yellow,

blue-green, and green) to elicit the highest arousal reactions from subjects. Gorn et al. (1997) conclude from their study with regard to the effects of colour in advertising, that when used as an executional cue in an ad, the hue (red vs. blue) of a colour at best has modest effects on feelings of arousal.

Studies using both approaches (physiological responses and perceptions of arousal) have found that certain colours, are indeed more activating than other colours (e.g. Nakshian, 1964; Clynes and Kohn, 1968; Sallis and Buckalew, 1984; Jacobs and Nordan, 1979, see Crowley, 1993). However there is a lot of inconsistency in the findings as to what colours are more and less arousing and whether there is indeed a relationship between colour wavelength and its arousal eliciting quality.

THE EFFECTS OF COLOUR ON EMOTIONS:
Table 3-5: The Arousal-eliciting Properties of Colours

EFFECTS OF HUE

Citation	Sample	Design	Stimuli	Dependent variable	Findings
Goldstein (1942)	Experiments conducted on a small number of patients (3-5) with brain-damage	Subjects exposed to pieces of coloured paper, coloured rooms, coloured lights and coloured clothing	Red and Green (not equated for brightness or saturation)	Observations of deviant behaviour	In the presence of green, abnormal behaviours became less deviant, while in the presence of red, these behaviours became exaggerated.
Wexner (1954)		Study concerning subjects' associations between colour samples and words that describe feelings	Eight coloured papers (not specified according to standard specifications & not controlled for brightness or saturation)	Words that describe mood tones	Orange was found to be associated with "disturbing/distressed/upset", implying high arousal (and displeasure). Red was found to be associated with "exciting" and "stimulating", (implying high arousal and pleasure) whereas Blue was associated with "secure/comfortable" and "tender/soothing" (implying low arousal and pleasure)
Osgood et al. (1957)	Studied selected colours in the context of objects	<u>Study 1</u> Colours were applied to either one of five objects (shirt, ice-cream, rug, car, cake mix) <u>Study 2</u> Colours were applied to abstract sculptures	Six colours + black and white	An activation dimension identified from a 20 item semantic differential scale	Activity seemed to be related to the hue dimension: red and yellow were seen as active, while green, violet and blue were passive.

Gerard (1958, 1959)	24 male college students	Subjects exposed to three different coloured lighting conditions, each projected on a screen for 10 minutes in counterbalanced order	Red, Blue and White light (with luminance equated by the method of limits)	<u>Physiological measures:</u> - blood pressure - palmar conductance - respiration rate - alpha wave frequency (EEG) - eyeblink frequency - heart beat	Statistically significant differences could be revealed between the red and blue conditions for all physiological measures, except for heart beat. The blue illumination condition yielded lower blood pressure and palmar conductance, a lower respiration rate, increased alpha wave frequency (EEG) and a reduced eyeblink frequency as compared to the red illumination condition. Moreover, Gerard noted that subjects reported feeling more alert under the red illumination condition and more relaxed in the blue one. Responses to the white light varied, but were most often similar to those in the red light condition.
Erwin, Lerner, Wilson & Wilson (1961)		Subjects exposed to four different coloured lights for 5 minutes	Red, Blue, Green and Yellow light (not specified nor equated for luminance)	<u>Physiological measure:</u> - suppression of alpha waves	Found the duration of alpha wave onset to be shortest under the green condition. No significant difference was found between the other conditions.
Wright and Rainwater (1962)	over 1200 subjects	An extensive study of colour meanings of isolated colours	50 3" mat surface colours (with hue, value and saturation varied)	24 semantic differential scales (showiness, calmness, tranquility,...)	Found that redness corresponds with less tranquillity and that excitation may be a linear function of hue.
Wilson (1966)		Subjects were exposed to highly saturated red and green slides. (five slides of each colour were shown in alternating order for one minute each)	highly saturated red and green slides (neither colour brightness, nor saturation were controlled for)	<u>Physiological measures:</u> GSR measure - mean conductance level - change in conductance level	Wilson posited a U-shaped relationship between colour wavelength and arousal, predicting that colours with more extreme wavelengths are the most activating. He found support for the hypothesis that red is more arousing than green, with the effect being particularly apparent in the GSR data. His results showed both conductance scores and change scores to be higher in the red condition, demonstrating that red is more stimulating and more exciting. This study also revealed some confounding order effects.

Aaronson (1970)		Investigated the emotional stereotypes of colours	colour names	12 adjectives from the Emotion Profile Index (forced choice adjective checklist presented as paired comparisons)	He cites red as being high in activation and blue as being low in activation.
Nourse and Welch (1971)	Sample of 14 subjects	Exposed subjects to green and violet light in alternating order (six one-minute exposures).	Green and Violet light (not only differing in hue, but also in spectral composition, i.e. purity)	<u>Physiological measure:</u> (GSR) Arousal was measured by the difference in skin conductance level at the initial exposure of a colour and the highest level reached in the first 12 seconds.	A significant difference in GSR amplitude between the two colour conditions could be revealed, with GSR measures being higher in the violet light condition than in the green one, supposedly offering support for the contention that hues at the end of the visible spectrum (blue, purple) are more stimulating than those in the middle (green), Also a significant colour-order interaction was noted, which may be explained by the subjects adaptation (habituation) on subsequent presentations.
Ali (1972)	Male subjects	Exposed subjects to blue and red lights for either 5 or 10 minutes	Red and Blue lights, equated for brightness	<u>Physiological measure:</u> alpha wave recovery	Greater alpha wave recovery over time occurred under blue than under red light. Thus, a higher level of arousal (cortical activity) appears to take place in the red light
Adams and Osgood (1973)	Subjects across 23 cultures		Colour names (words)	An activation dimension identified from a semantic differential scale	The word "Red" was found to be rated as active across 23 cultures.

Jacobs and Hustmyer (1974)	Subjects were shown different coloured slides for one minute each in counterbalanced order, with white slides projected between the different colours for one minute	Red, yellow, green and blue coloured slides, projected on a large screen (saturation was high for each colour, but brightness varied, with yellow being the most bright (8/) and red being the least bright (3.9/))	<u>Physiological measures:</u> - GSR (the greatest change in skin conductance occurring within the first 15 seconds after stimulus onset) - heart beat - respiration rate	Found GSR to be significantly affected by colour, while heart rate and respiration measures yielded no difference. Arousal, measured in terms of GSR, appeared to be highest in the red condition, followed by the green, yellow and blue conditions. They found no significant difference between the red versus green condition nor between the blue versus yellow condition.	
Sivik (1974a)	A stratified sample of Swedish adults	Studied colours in isolation	71 colours chosen to represent the NCS colour space (based on the Swedish Natural Colour System)	An excitement dimension, identified from a 26 item semantic differential scale	From his findings, Sivik concludes that no difference was exhibited between hues with equal chromaticness on the excitement factor. This finding contradicts the long-held stereotype that warm colours such as red and yellow are exciting, while cool colours, such as blue and green are calming. Sivik hypothesizes that the reason why red and yellow have been labelled as exciting might be attributed to the fact that pure, saturated reds and yellows are more prevalent than pure and highly saturated greens and blues.

Jacobs and Suess (1975)	Subjects were assigned to one of four colour conditions : different coloured slides were projected on a large screen for five minutes	Red, yellow, green and blue coloured slides were projected on a large screen (brightness and saturation levels were not controlled for)	State-Anxiety Inventory (Spielberger, Gorsuch and Lushene, 1970) (anxiety is an emotional state involving displeasure and high arousal)	Obtained support for the hypothesis that red is more arousing than blue. Significant higher anxiety scores were obtained in the red and yellow colour conditions than in the green and blue ones. This finding is consistent with studies of colour arousal, demonstrating that red and yellow are more arousing than blue and green.
Walters et al. (1982)		(chroma and saturation were not controlled for)		Red was related to “felt excitement” and Blue was related to “felt relaxation”.
Caldwell and Jones (1985)	Subjects exposed to three different coloured lighting conditions, each for 45 seconds	Red, Blue and White light	<u>Physiological measures:</u> - finger pulse volume - skin conductance - alpha wave frequency (EEG) - eye-blink frequency - heart beat	Found no systematic effect of red, blue or white coloured lights on subjects’ eye-blink frequency, skin conductance, finger pulse volume, heart rate or EEG measures. However, as the stimulus was only presented for a maximum of 45 seconds, the length of exposure to the coloured light conditions may have been too short to detect subtle changes. Colour effects appeared to be limited to the first presentation of a given colour. Nevertheless, no difference in percent of alpha activity or peak EEG frequency could be detected under red or blue light conditions.
Kuller (1985)	Subjects were assigned to a red or blue walled room	Red or blue-walled room	<u>Physiological measures:</u> EEG measures	Found no evidence to support the notion that red interiors are more stressful than blue interiors. He observed no difference in EEG measures when individuals sat in a red or blue-walled room.
Profusek and Rainey (1987)	Subjects were exposed to rooms painted in red versus Baker-Miller pink	Red or Baker-Miller pink walled room	State anxiety	As hypothesized, pink elicited less anxiety than red.

Weller and Livingstone (1988)		<u>Colour as a peripheral cue</u> Investigated the effects of the colour of paper on which text about rape and murder incidents was presented	Blue, Pink & White coloured paper (brightness and saturation were not controlled)	Emotional reactions to rape and murder incidents.	Subjects reported being less upset when rape and murder incidents were presented on pink paper than when they were described on blue or white paper.
Valdez and Mehrabian (1994) – Study 2	121 undergraduate students	Laboratory experiment Colour patches	50 colour samples: 10 hues, using 5 replication sets with equal brightness and saturation levels.	Arousal, measured according to Mehrabian's (1978) PAD emotion scale	A significant main effect of hue on arousal could be revealed. However no support was found for the hypothesis that long-wavelength hues are more arousing than short wavelength hues. The mean arousal level for green-yellow was significantly greater than the mean arousal levels for purple-blue, yellow-red and red-purple and the mean arousal level for blue-green was significantly greater than the mean arousal level for purple-blue. The obtained results, relating hue and arousal were generally weak and non-significant. The only noteworthy generalization is that the green hues (green-yellow, blue-green and green) seem to elicit the highest arousal reactions from subjects.
Etnier and Hardy (1997)		<u>Colour as a peripheral cue</u> Investigated the effect of environmental colour on the performance of cognitive and motor-tasks	Blue-Green, white or orange coloured room	<u>Physiological arousal:</u> - systolic blood pressure - diastolic blood pressure - heart beat.	Did not find a significant main effect of environmental colour on physiological arousal. However the colour x time interaction was significant for systolic blood pressure, diastolic blood pressure and heart beat.

Gorn et al. (1997)	<p><u>Study 1</u> 156 university undergraduates</p> <p><u>Study 2</u> 18 and 19 undergraduate students</p>	manipulated the colour of a big “swoosh” in an advertisement	<p><u>Study 1</u> 4 blue and 4 red colour samples, chosen according to a 2x2x2 factorial design (hue x chroma x value)</p> <p><u>Study 2</u> Highly saturated blue 5B 4/10 and red 5R 4/14</p>	<p>Using a two-dimensional view on arousal (Smith and Apter, 1975 ; Apter, 1976, 1981, 1982; Walters et al., 1982)</p> <p>(with excitement versus boredom and tension versus relaxation)</p> <p>Both a rating scale measure as a verbal protocol measure were used</p>	<p>Found partial support for the hypothesis that respondents exposed to the colour red are more excited than those exposed to the colour blue and that those exposed to the colour blue are more relaxed.</p> <p>Those exposed to the red hue reported stronger feelings of excitement, however only the results for the rating scale measure were statistically significant, not those of the verbal protocol measure.</p> <p>The results also show that those exposed to the blue hue reported experiencing greater feelings of relaxation, however the effect of hue on feelings of relaxation fails to reach statistical significance on both the rating scale and the verbal protocol measures.</p> <p>Because in study 2, the stimuli varied not only in hue, but also in saturation, the effects of saturation and hue are confound. The results revealed that under these new conditions hue did not significantly affect feelings of relaxation or excitement, nor add or brand attitudes.</p> <p>They conclude that taken together, the results of both studies suggest that, when used as an executional cue in an ad, the hue (red vs. blue) of a colour at best has modest effects on feelings.</p>
Madden et al. (2000)	<p>Sample of undergraduate students from eight countries: Austria (n = 29), Brazil (n = 26), Canada (n = 29), Colombia (n = 48), Hong-Kong (n = 19), PRC (n = 31), Taiwan (n = 22) and the United States (n = 49).</p>	Colour patches with colour names were evaluated by respondents	<p>Black, blue, brown, gold, green, orange, purple, red, white and yellow.</p> <p>(standard colour shading options in Lotus Almipro word processing software, not clearly specified according to a colour system, probably highly saturated with brightness and saturation levels not controlled)</p>	Colour meaning (20 item semantic differential scale)	<p>Colours and semantic items were plotted in two-dimensional perceptual maps for each country. From these plots “a spectrum of colour meaning” can be identified along an arousal or activation dimension: with red on the one hand, ranging over a gold-orange-yellow cluster, over a black-brown-purple cluster to a blue-green-white cluster on the other hand. The meaning associations along this spectrum run from “active”, “hot” and “vibrant” (associated with red) to “calming”, “gentle” and “peaceful” (associated with a blue-green-white cluster).</p> <p>The results obtained by Madden et al. (2000) indicate that in many parts of the world, consumers exhibit similarities in colour meaning associations.</p>

3.5.4.2. Effects of Saturation

Remarkably, none of the studies dealing with physiological reactions to colour have investigated these reactions in relation to colour brightness and saturation levels.

Nevertheless, using semantic differential ratings, Wright and Rainwater (1962) did undertake an extensive study of colour meanings, incorporating the effects of brightness and saturation. They had over 1200 subjects rate 50 3" mat surface colours on 24 semantic differential scales. Each subject rated only one colour on all 24 scales. Hue, value and saturation were varied. Originally six factors were extracted, but intercorrelations among them led the authors to propose a final four-dimensional connotative framework of happiness, forcefulness, warmth and elegance. Across all scales, saturation was found to exert the strongest influence in terms of colour meanings. The relation of activity to colour appeared to be a direct function of saturation. "Showiness", according to Valdez and Mehrabian (1994) assumed to be indicative of the arousing quality of a colour, correlated positively with saturation, suggesting that arousal is a positive correlate of colour saturation.

Hogg (1969) had subjects rate single colours and colour pairs (manipulating the degree of colour contrast) on twelve 7-point semantic differential scales. For single colours, results showed 70.5% of the variance to be attributable to a factor labelled colour obtrusiveness, which was highly correlated with saturation. For colour pairs, sixty-one percent of the variance was accounted for by an activity-potency factor. Saturation was again the most important component of this factor: the more saturated a colour, the more potent/active it was perceived to be.

In their cross-cultural study in which subjects had to rate colour concepts (words) using the semantic differential factors (Osgood et al., 1957), Adams and Osgood (1973) found activity to be associated strongly with colour (versus no colour), which may imply that more saturated colours are perceived as more active than less saturated colours, which seem to contain less colour pigment.

Providing some of the most comprehensive insights into the field of colour meaning (according to Beach et al., 1988), Sivik (1974a, 1975) uses the Swedish Natural Colour System – NCS – (Hard and Sivik, 1979; Hard, 1975) as his descriptive colour model. His

initial studies investigated colours in isolation. Seventy-one colours (chosen to represent the NCS colour space) were judged on 26 semantic differential scales by a stratified sample of Swedish adults. Factor analysis yielded four factors: excitement, evaluation, potency and temperature. Emerging from Sivik's (1974a, 1975) initial studies is the complexity of the interaction process between stimulus colour properties and connotative associations. Sivik hypothesizes that the reason why red and yellow have been labelled as exciting, might be attributed to the fact that pure, saturated reds and yellows are more prevalent than pure and highly saturated greens and blues. Thus he implies that colour saturation is positively correlated to excitement.

In a comprehensive study of emotional reactions to colour among 250 undergraduates, Valdez and Mehrabian (1994, Study 1) also found support for the hypothesis that arousal is a positive correlate of saturation. Stepwise multiple regression analysis was used to explore the contributions of brightness and saturation to arousal. The arousal elicited by 76 colour stimuli was measured by means of Mehrabian's (1978) verbal-report PAD (Pleasure, Arousal, Dominance) scales. Averaged arousal responses (each colour sample was rated by approximately 25 subjects) constituted the dependent variable, and brightness and saturation the independent variables in the regression analysis, yielding the following equation:

$$\text{Arousal} = -.31 \text{ Brightness} + .60 \text{ Saturation}$$

From this study, a colour's brightness and saturation levels appear to explain a substantial portion of the variance in the feelings of arousal it induces (multiple regression coefficient = .73). More specifically, the equation presented above indicates that more saturated colours induce greater feelings of arousal in viewers. Furthermore, the regression analysis indicates the effect of saturation to be considerably stronger than the effect of brightness in determining arousal responses to colour. Indeed, the contribution of saturation to arousal is almost twice the magnitude of the effect of brightness on arousal. Thus the hypothesized positive relationship between saturation and arousal could be confirmed: more saturated (more vivid and purer) colours appear to elicit greater feelings of arousal.

Gorn et al. (1997) manipulated the colour of a big "swoosh" in the centre of an ad for a fictitious paint company "Rainbow Paints" according to a 2 by 2 by 2 factorial design (hue x chroma x value). Using a two-dimensional view on arousal (Smith and Apter, 1975 ; Apter,

1976, 1981, 1982; Walters et al., 1982), Gorn et al. (1997) found support for the hypothesis that ads with higher chroma colours induce greater feelings of excitement, without feelings of relaxation being negatively affected. Their results reveal that when the chromatic strength of the coloured “swoosh” in the ad was high as opposed to low, the message recipient felt more excited (rating scale: $F(1,138)=4.31$, $p<0.05$, $\omega^2=0.021$, means 2.47 versus 2.00; verbal protocol: $F(1,137)=5.96$, $p<0.05$, $\omega^2 = 0.033$, means =0.22 versus 0.03).

THE EFFECTS OF COLOUR ON EMOTIONS:
Table 3-6: The Arousal-eliciting Properties of Colours

EFFECTS OF SATURATION

Citation	Sample	Design	Stimuli	Dependent variable	Findings
Wright and Rainwater (1962)	Over 1200 subjects	An extensive study of colour meanings of isolated colours	50 3" mat surface colours (with hue, value and saturation varied)	24 semantic differential scales (showiness, calmness, tranquillity,...)	Across all scales, saturation was found to exert the strongest influence in terms of colour meanings. The relation of activity to colour appears to be a direct function of saturation. "showiness", assumed to be indicative of the arousing quality of a colour, correlated positively with saturation.
Hogg (1969)			Single colours and colour pairs (manipulating degree of colour contrast)	Twelve 7-point semantic differential scales.	For single colours, results showed 70.5% of the variance to be attributable to a factor labelled colour obtrusiveness, which was highly correlated with saturation. For colour pairs, sixty-one percent of the variance was accounted for by an activity-potency factor. Saturation was again the most important component of this factor – the more saturated a colour, the more potent/active it was perceived to be.
Adams and Osgood (1973)	Subjects across 23 cultures		Colour names (words)	An activation dimension identified from a semantic differential scale	Found activity to be associated strongly with colour (versus no colour).
Sivik (1974a)	A stratified sample of Swedish adults	Studied colours in isolation	71 colours chosen to represent the NCS colour space (based on the Swedish Natural Colour System)	An excitement dimension, identified from a 26 item semantic differential scale	Sivik hypothesizes that the reason why red and yellow have been labelled as exciting might be attributed to the fact that pure, saturated reds and yellows are more prevalent than pure and highly saturated greens and blues.

Valdez and Mehrabian (1994) – Study 1	250 undergraduate students	Laboratory experiment with colour patches	76 colour samples : 10 hues, using 5 replication sets with equal brightness and saturation levels.	Arousal, measured according to Mehrabian’s (1978) PAD emotion scale	<p>Found support for the hypothesis that arousal is a positive correlate of saturation. Stepwise multiple regression analysis was used to explore the contribution of brightness and saturation to arousal, yielding the following equation: Arousal = $-.31$ Brightness + $.60$ Saturation</p> <p>A colour’s brightness and saturation levels appear to explain a substantial portion of the variance in the feelings of arousal induced (multiple regression coefficient = $.73$).</p> <p>More specifically, the equation presented above indicates that more saturated (more vivid and purer) colours induce greater feelings of arousal. Furthermore, the regression analysis indicates the effect of saturation to be considerably stronger than the effect of brightness in determining arousal responses to colour (the contribution of saturation to arousal is almost twice the magnitude of the effect of brightness on arousal).</p>
Gorn et al. (1997)	<u>Study 1</u> 156 university undergraduates	manipulated the colour of a big “swoosh” in an advertisement	<u>Study 1</u> 4 blue and 4 red colour samples, chosen according to a 2x2x2 factorial design (hue x chroma x value)	<p>Using a two-dimensional view on arousal (Smith and Apter, 1975 ; Apter, 1976, 1981, 1982; Walters et al., 1982)</p> <p>(with excitement versus boredom and tension versus relaxation)</p> <p>Both a rating scale measure and a verbal protocol measure were used</p>	Found support for the hypothesis that ads with higher chroma colours induce greater feelings of excitement, but not relaxation. Their results reveal that when the chromatic strength of the coloured “swoosh” in the ad was high, as opposed to low, the message recipient felt more excited, but not more relaxed.

3.5.4.3. Effects of Value

The case of achromatic colours:

The effect of brightness in achromatic colours such as white, grey and black (representing brightness variations only) on arousal responses was originally unclear.

Adams and Osgood (1973) found in their cross-cultural study, in which subjects had to rate colour concepts (words) using the semantic differential factors (Osgood et al., 1957), that the words grey and black were rated as inactive, implying low arousal.

On the contrary, Birren (1978) and Sharpe (1974) found the colour black to be associated with anxiety, implying displeasure and high arousal.

Psychophysiological research suggests that white has a calming effect in that white light seems to produce the least amount of tension in the form of hand tremor (James and Domingos, 1953). More recently, and consistent with the work of James and Domingos (1953), Ott (1976) reports that students in classrooms lit with full-spectrum white light were calmer and less fidgety than those in other lighting conditions.

In a more systematic study, Valdez and Mehrabian (1994, Study 3) used five achromatic colour samples (ranging from white to black) to explore the effect of brightness in achromatic colours on arousal responses. Arousal was in general hypothesized to be a positive correlate of brightness, however, with regard to achromatic colours no explicit hypothesis was given. A nonlinear regression analyses with average arousal (25 subjects rated each sample) as the dependent variable and brightness as the independent variable revealed the following equation, expressing the relationship of arousal (raw values) to brightness of achromatic colours (multiple regression coefficient = .47):

$$\text{Arousal} = 8 - .6915 (\text{Brightness}) + .0073 (\text{Brightness})^2$$

A plot of the actual and predicted mean arousal responses as a function of brightness is given in figure 3-25.

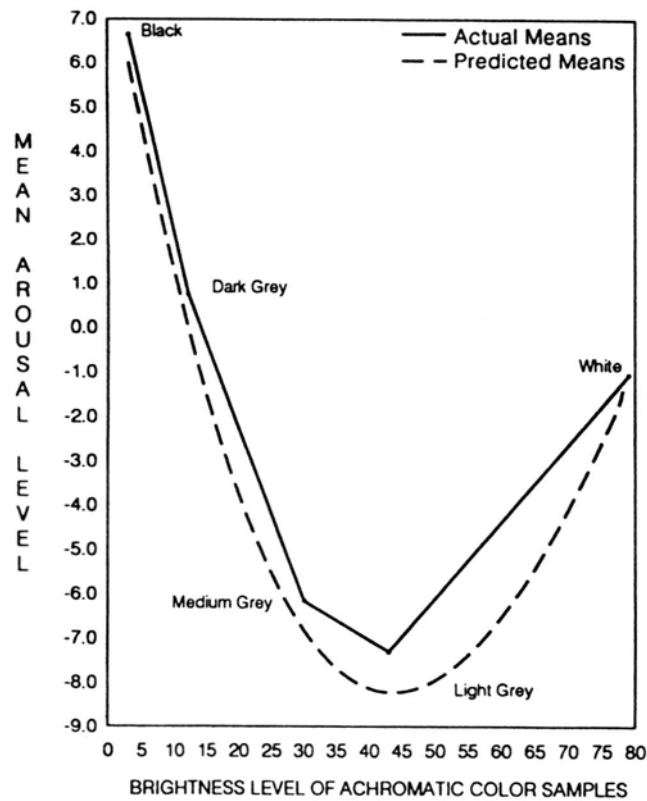


Figure 3-25: Actual and predicted average arousal levels as functions of brightness of achromatic colours

Source: Valdez and Mehrabian, 1994, Study 3, p405

Figure 3-25 demonstrates that arousal reactions to achromatic colours tend to form a U-shaped function of brightness: black elicited the greatest arousal response, which diminished steadily for the three successive greys of increasing brightness, but increased again to an intermediate value for white. Figure 3-25 also shows that the obtained arousal means for all five levels of brightness were predicted extremely well by the proposed equation.

The case of chromatic colours:

As was the case for saturation, none of the studies dealing with physiological reactions to colour have investigated these reactions in relation to colour brightness levels.

Nevertheless, using semantic differential ratings, Wright and Rainwater (1962) did undertake an extensive study of colour meanings, incorporating the effects of brightness and saturation. They had over 1200 subjects rate 50 3" mat surface colours (with varying hue, value and saturation) on 24 semantic differential scales. Each subject rated only one colour on all 24 scales. Originally six factors were extracted, but intercorrelations among them led the authors to propose a final four-dimensional connotative framework of happiness, forcefulness, warmth and elegance. "Showiness", according to Valdez and Mehrabian (1994) assumed to be indicative of the arousing quality of a colour, correlated positively with brightness, whereas "calmness", indicative of the non-arousing quality of a colour, was found to correlate negatively with brightness, suggesting that arousal is a positive correlate of colour brightness.

Profusek and Rainey (1987) found that rooms painted in Baker-Miller pink, a high value colour, namely a "whitish" hue of the red family of colours, had a more relaxing and calming effect than red-painted rooms (see also Schauss, 1985; Bennett et al., 1991).

Contrasting these previous findings, in a comprehensive study of emotional reactions to colour among 250 undergraduates, Valdez and Mehrabian (1994, Study 1) did not find support for the hypothesis that arousal is a positive correlate of brightness. On the contrary, they revealed a negative relationship between colour brightness and induced arousal. In order to explore the contributions of brightness and saturation to arousal, stepwise multiple regression analysis was used. The arousal elicited by 76 colour stimuli was measured by means of Mehrabian's (1978) verbal-report PAD (Pleasure, Arousal, Dominance) scales. Averaged arousal responses (each colour sample was rated by approximately 25 subjects) constituted the dependent variable, and brightness and saturation the independent variables in the regression analysis, yielding the following equation:

$$\text{Arousal} = -.31 \text{ Brightness} + .60 \text{ Saturation}$$

From this study, a colour's brightness and saturation levels appear to explain a substantial portion of the variance in the feelings of arousal it induces (multiple regression coefficient = .73). However, contradicting the hypothesized positive relationship, the equation indicates that less bright (i.e. darker) colours induce greater feelings of arousal in viewers. Nevertheless, the effect of brightness appears to be considerably weaker than the effect of saturation in determining arousal responses to colour. One reason for this contradicting

finding may have been that the latter hypothesis between brightness and arousal was inferred by Valdez and Mehrabian (1994) from reports that used experimental methods that confounded brightness and saturation levels while testing for the effect of brightness. Previous studies tended to select highly saturated bright colours, when sampling for bright colours, assuming that bright colours are also more saturated. This way confounding colour brightness and saturation, earlier researchers may have incorrectly attributed the greater arousal response to highly saturated bright colour samples to brightness, rather than to saturation. This error may have been possible, because the contribution of saturation to arousal is almost twice the magnitude of the effect of brightness on arousal (note the coefficient of +.60 for saturation versus coefficient -.31 for brightness). From the results of the study by Valdez and Mehrabian (1994, Study 1), thus, unexpectedly, darker (less bright) colours seem to induce more arousal.

Furthermore, Valdez and Mehrabian (1994) found a second-order curvilinear relationship between colour brightness and the elicited arousal.

$$\text{Arousal} = 8.724 - .62 (\text{Brightness}) + .007173 (\text{Brightness})^2$$

The multiple regression coefficient for this equation is .52. Actual mean arousal values and those predicted from the equation above were plotted against brightness (for each of the six brightness values sampled) and showed extremely close agreement (see figure 3-26).

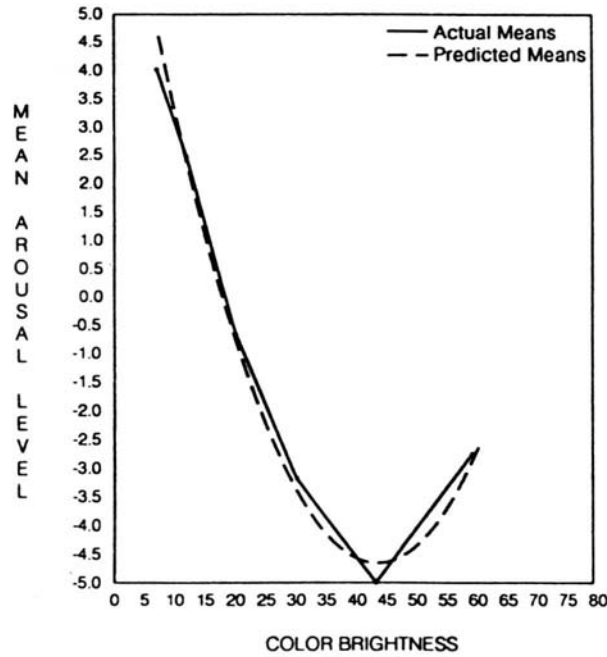


Figure 3-26: Actual and predicted average arousal levels as functions of colour brightness

Source: Valdez and Mehrabian, 1994, study 1.

Both the actual and predicted plots demonstrate that arousal declines steeply and monotonically with increasing brightness up to a brightness value of 43, beyond which arousal reversed and increased slightly for the highest brightness value. In other words, arousal appears to decrease as colours range from dark to light, but this trend is slightly reversed for the lightest colours.

Manipulating the colour of a big “swoosh” in the centre of an ad for a fictitious paint company “Rainbow Paints” according to a 2 by 2 by 2 factorial design (hue x chroma x value), Gorn et al. (1997) used a two-dimensional view on arousal (Smith and Apter, 1975; Apter, 1976, 1981, 1982; Walters et al., 1982). In agreement with the results obtained by Valdez and Mehrabian (1994), they found support for the hypothesis that lighter, higher value colours are more relaxing than lower value, darker colours, without feelings of excitement being affected. In their study involving 156 university undergraduates, Gorn et al. (1997) found that those exposed to ads containing higher value colours (for red and blue hues) reported experiencing greater feelings of relaxation (rating scale: $F(1,138)=9.22$, $p<0.01$, $\omega^2=0.054$, means 3.70 versus 4.67; verbal protocol: $F(1,137)=5.62$, $p<0.05$, $\omega^2=0.04$, means =0.08 versus 0.85), but no difference in the level of felt excitement (rating scale: $F(1,138)=2.95$, $p>0.05$; verbal protocol: $F>1$).

THE EFFECTS OF COLOUR ON EMOTIONS:
Table 3-7: The Arousal-eliciting Properties of Colours

EFFECTS OF BRIGHTNESS

Citation	Sample	Design	Stimuli	Dependent variable	Findings
<i>The case of achromatic colours</i>					
Adams and Osgood (1973)	Subjects across 23 cultures		Colour names (words)	An activation dimension identified from a semantic differential scale	The words "Grey" and "Black" were rated as inactive across 23 cultures.
Birren (1978) and Sharpe (1974)					Found the colour black to be associated with anxiety, implying displeasure and high arousal.
Valdez and Mehrabian (1994) – Study 3	125 undergraduate students	Laboratory experiment Colour patches	5 achromatic colour samples (ranging from white to black)	Arousal, measured according to Mehrabian's (1978) PAD emotion scale	A curvi-linear relationship could be revealed between the brightness of achromatic colours and the arousal evoked. Arousal reactions to achromatic colours tend to form a U-shaped function of brightness: black elicited the greatest arousal response, gradually diminishing for lighter greys, but increasing again for white to an intermediate level of arousal.
<i>The case of chromatic colours</i>					
James and Domingos (1953)				Tension in the form of hand tremor	White seems to have a calming effect in that it appears to produce the least amount of tension in the form of hand-tremor
Wright and Rainwater (1962)	over 1200 subjects	An extensive study of colour meanings of isolated colours	50 3" mat surface colours (with hue, value and saturation varied)	24 semantic differential scales (showiness, calmness, tranquility,...)	Found that the relation of activity to colour appears to be a direct function of brightness: "showiness", indicative of the arousing quality of a colour, correlated positively with brightness. Furthermore, "calmness", indicative of the non-arousing quality of a colour, correlated negatively with brightness.

Ott (1976)	Students	Different coloured light lit classrooms			Students in classrooms lit with full-spectrum white light were calmer and less fidgety than those in other lighting conditions.
Profusek and Rainey (1987)		Subjects were exposed to rooms painted in red versus Baker-Miller pink	Red or Baker-Miller pink walled room	State anxiety	As hypothesized, Baker-Miller pink (a 'whitish' hue of the red family of colours) had a more relaxing and calming effect than red-painted rooms.
Valdez and Mehrabian (1994) – Study 1	250 undergraduate students	Laboratory experiment with colour patches	76 colour samples : 10 hues, using 5 replication sets with equal brightness and saturation levels.	Arousal, measured according to Mehrabian's (1978) PAD emotion scale	<p>Contrary to expectations, arousal appeared to be a negative correlate of brightness. Stepwise multiple regression analysis was used to explore the contribution of brightness and saturation to arousal, yielding the following equation: $Arousal = -.31 \text{ Brightness} + .60 \text{ Saturation}$</p> <p>A colour's brightness and saturation levels appear to explain a substantial portion of the variance in the feelings of arousal induced (multiple regression coefficient = .73).</p> <p>More specifically, the equation presented above indicates that less bright (i.e. darker) colours induce greater feelings of arousal. However, the regression analysis indicates the effect of saturation to be considerably stronger than the effect of brightness in determining arousal responses to colour (the contribution of brightness to arousal is about half the magnitude of the effect of brightness on arousal).</p> <p>Furthermore, a second-order curvilinear relationship was found between colour brightness and the elicited arousal: $Arousal = 8.724 - .62 \text{ (Brightness)} + .007173 \text{ (Brightness)}^2$ (multiple regression coefficient of .52)</p> <p>Thus, arousal appears to decline steeply and monotonically with increasing brightness up to a brightness value of 43, beyond which arousal reversed and increased slightly for the highest brightness value. In other words, arousal appears to decrease as colours range from dark to light, but this trend is slightly reversed for the lightest colours.</p>

Gorn et al. (1997)	<u>Study 1</u> 156 university undergraduates	manipulated the colour of a big “swoosh” in an advertisement	<u>Study 1</u> 4 blue and 4 red colour samples, chosen according to a 2x2x2 factorial design (hue x chroma x value)	Using a two-dimensional view on arousal (Smith and Apter, 1975 ; Apter, 1976, 1981, 1982; Walters et al., 1982) (with excitement versus boredom and tension versus relaxation) Both a rating scale measure and a verbal protocol measure were used	Found support for the hypothesis that lighter, higher value colours are more relaxing than lower value, darker colours, without feelings of excitement being affected. They actually found that those exposed to ads containing higher value colours (for red and blue hues) reported experiencing greater feelings of relaxation, but no difference in the level of felt excitement.

3.5.4.4. Overview

With regard to the effect of colour hue on arousal, a great deal of inconsistency exists in the literature, arising from incomplete operational definitions of the stimulus conditions and the multifaceted nature of response measures defined as arousal (Beach et al., 1988; Valdez and Mehrabian, 1994). Studies involving physiological reactions to arousal have been motivated largely by the hypothesis that long-wavelength colours (e.g. red and yellow) are more arousing than short wavelength colours (e.g. blue and green). Despite the numerous studies in this field that could not confirm this contention (Erwin, Lerner, Wilson and Wilson, 1961; Jacobs and Hustmyer, 1974; Caldwell and Jones, 1985; Kuller, 1985; Etnier and Hardy, 1997), it still is generally accepted, based on some supporting evidence (Goldstein, 1942; Gerard, 1958, 1959; Ali, 1972). However, researchers often have confined their studies to only two hues, often not even controlling for brightness or saturation and just extrapolated the results without any further ado... Following a Darwinian logic, on the other hand, Wilson (1966) posited a U-shaped relationship between colour wavelength and arousal effects, predicting that the colours with more extreme wavelengths are the most activating. This contention has also received some support (Erwin, Lerner, Wilson and Wilson, 1961; Wilson, 1966; Nourse and Welch, 1971). Studies using semantic differential scales to capture “perceptions of arousal”, have more systematically found excitement and activity to be related to the hue dimension, with red and yellow generally seen as active, stimulating and exciting, while green, violet and blue are perceived to be passive, relaxing, soothing and calm (Wexner, 1954; Osgood et al., 1957 Wright and Rainwater, 1962; Aaronson, 1970; Adams and Osgood, 1973; Sharpe, 1974; Jacobs and Suess, 1975; Porter and Mikellides, 1976a; Birren, 1978; Walters et al., 1982; Madden et al., 2000). However, contradicting this long-held stereotype that warm colours are exciting, while cool colours are calming, Sivik (1974a, 1975) concluded on the basis of his comprehensive study, that no difference is exhibited between hues with equal chromaticness on the excitement factor. Sivik hypothesizes that the reason why red and yellow have generally been labelled as exciting, might be attributed to the fact that pure, saturated reds and yellows are more prevalent than pure and highly saturated greens and blues. He notes that one can have a dull red, or an exciting green, based on the purity of the colour. Emerging from Sivik’s (1974a, 1975) initial studies is the complexity of the interaction process between stimulus colour properties and connotative associations. Likewise, Valdez and Mehrabian (1994, Study 2) could not support the hypothesis that long-wavelength hues are more arousing than short wavelength hues either. Conducting a very

systematic and comprehensive study, they found the mean arousal level for green-yellow to be significantly greater than the mean arousal levels for purple-blue, yellow-red and red-purple and the mean arousal level for blue-green to be significantly greater than the mean arousal level for purple-blue. A regression analysis to test for a possible significant parabolic inverted-U shaped relationship of arousal to wavelength (note that this is the opposite of Wilson's 1966 contention), revealed no significant effect either. The obtained results, relating hue and arousal, were generally weak and non-significant. The only noteworthy generalization is that, unexpectedly, the green hues (green-yellow, blue-green, and green) seem to elicit the highest arousal reactions from subjects. Gorn et al. (1997) conclude from their study with regard to the effects of colour in advertising, that when used as an executional cue in an ad, the hue (red vs. blue) of a colour at best has modest effects on feelings of arousal. Thus, studies using both approaches (physiological responses and perceptions of arousal) have found that certain colours, are indeed more activating than other colours (e.g. Nakshian, 1964; Clynes and Kohn, 1968; Sallis and Buckalew, 1984; Jacobs and Nordan, 1979, see Crowley, 1993). However there is a lot of inconsistency in the findings as to what colours are more and less arousing and whether there is indeed a relationship between colour wavelength and its arousal eliciting quality.

Remarkably, none of the studies dealing with physiological reactions to colour have investigated these reactions in relation to colour saturation levels. Nevertheless, studies based on semantic differential ratings generally suggest that arousal is a positive correlate of colour saturation (Wright and Rainwater, 1962; Hogg, 1969; Adams and Osgood, 1973; Sivik, 1974a, 1975). Wright and Rainwater (1962) even found colour saturation to exert the strongest influence in terms of colour meanings. Valdez and Mehrabian (1994, Study 1) also found a colour's saturation level to explain a substantial portion of the variance in the feelings of arousal it induces, with more saturated (more vivid and purer) colours evoking greater feelings of arousal in viewers. Moreover, conform to the findings by Wright and Rainwater (1962), Valdez and Mehrabian (1994, Study 1) noticed that the effect of saturation is considerably stronger than the effect of brightness in determining arousal responses to colour (almost twice the magnitude). Consistent with these findings, Gorn et al. (1997) also found support for the hypothesis that ads with higher chroma colours induce greater feelings of excitement.

The effect of brightness in achromatic colours on arousal responses was originally unclear. Contrary to Adams and Osgood's (1973) finding that the words grey and black were rated as inactive, implying low arousal, Birren (1978) and Sharpe (1974) found the colour black to be associated with anxiety, implying displeasure and high arousal. Psychophysiological research suggests that white has a calming effect in that white light seems to produce the least amount of tension in the form of hand tremor (James and Domingos, 1953). Consistent with the work of James and Domingos (1953), Ott (1976) reports that students in classrooms lit with full-spectrum white light were calmer and less fidgety than those in other lighting conditions. In a more systematic study, Valdez and Mehrabian (1994, Study 3) found that arousal reactions to achromatic colours tend to form a U-shaped function of brightness, with black eliciting the greatest arousal response, which diminishes steadily for the three successive greys of increasing brightness, but increases again to an intermediate value for white.

Also with regard to chromatic colours, the effect of brightness was originally unclear. None of the studies dealing with physiological reactions to colour have investigated these reactions in relation to colour brightness levels. Earlier studies, based on semantic differential ratings, seemed to indicate that arousal is a positive correlate of colour brightness (Wright and Rainwater, 1962; Profusek and Rainey, 1987). More recent studies, however, found exactly the opposite to be true (Valdez and Mehrabian, 1994 - Study 1; Gorn et al., 1997). Indeed, conducting a very comprehensive and systematic study, Valdez and Mehrabian (1994) revealed a negative relationship between colour brightness and induced arousal, indicating that less bright (i.e. darker) colours induce greater feelings of arousal in viewers. From this study the effect of brightness also appears to be considerably weaker than the effect of saturation in determining arousal responses to colour. Furthermore, Valdez and Mehrabian (1994) also found a second-order curvilinear relationship between colour brightness and the elicited arousal. Arousal declined steeply and monotonically with increasing brightness up to a brightness value of 43, beyond which arousal reversed and increased slightly for the highest brightness value. In other words, arousal appears to decrease as colours range from dark to light, but this trend is slightly reversed for the lightest colours. In agreement with the results obtained by Valdez and Mehrabian (1994), Gorn et al. (1997) also found support for the hypothesis that lighter, higher value colours are more relaxing than lower value, darker colours, without feelings of excitement being affected. Using a two-dimensional view on arousal, they found that those exposed to ads containing higher value colours (for red and blue

hues) reported experiencing greater feelings of relaxation, but no difference in the level of felt excitement.

3.5.5. COLOUR-EVOKED DOMINANCE

Dominance is a dimension of emotional response that has almost completely been ignored by colour researchers. However, examining emotional reactions to colours, Valdez and Mehrabian (1994) found support for the existence of a dominance dimension, in correspondence with the Pleasure-Arousal-Dominance Emotion Model introduced by Mehrabian and Russell (1974), (see also Russell and Mehrabian, 1977). Also earlier, researchers already found colour to elicit emotional responses that cannot be captured by pleasure or arousal dimensions, but seem to infer a dimension of dominance or potency (e.g. Osgood et al., 1957; Adams and Osgood, 1973; Sivik, 1974a). In the next paragraphs, these studies regarding the effects of colour on dominance will be reviewed. More specifically, we will first present the effects of colour hue on dominance responses, followed by the effects of colour saturation and brightness. Finally, the conclusions of these previous studies will be briefly summarized.

3.5.5.1. Effects of Hue

In a very comprehensive cross-cultural study in which subjects from 23 different cultures rated colour concepts (e.g. the words “blue”, “green”, “yellow”) using the semantic differential factors (Osgood et al., 1957), Adams and Osgood (1973) found the following chromatic hue effects on perceived ‘potency’: across the 23 samples yellow was rated as weak, whereas red was rated as strong.

Birren (1978) and Sharpe (1974) found the colour red to be associated with aggression and excitement, whereas green was associated with withdrawal.

In a more recent study among 121 undergraduates, focussing on the effects of colour hue on emotions, Valdez and Mehrabian (1994, Study 2) examined the dominance elicited by 10

hues, using 5 replication sets with equal brightness and saturation levels in order not to confuse the effects (this way a total of 50 colour samples were used). A univariate analysis of variance (ANOVA) was used to explore the effects of hue (10 levels) on averaged dominance reactions (each colour sample was rated by nearly 25 subjects), revealing a significant .01-level main effect: $F(9,80) = 3.06$. Figure 3-27 depicts a plot of the mean dominance responses to each of the 10 hues. From this plot, middle wavelength hues appear to elicit more dominance than either the extreme short or long wavelength hues.

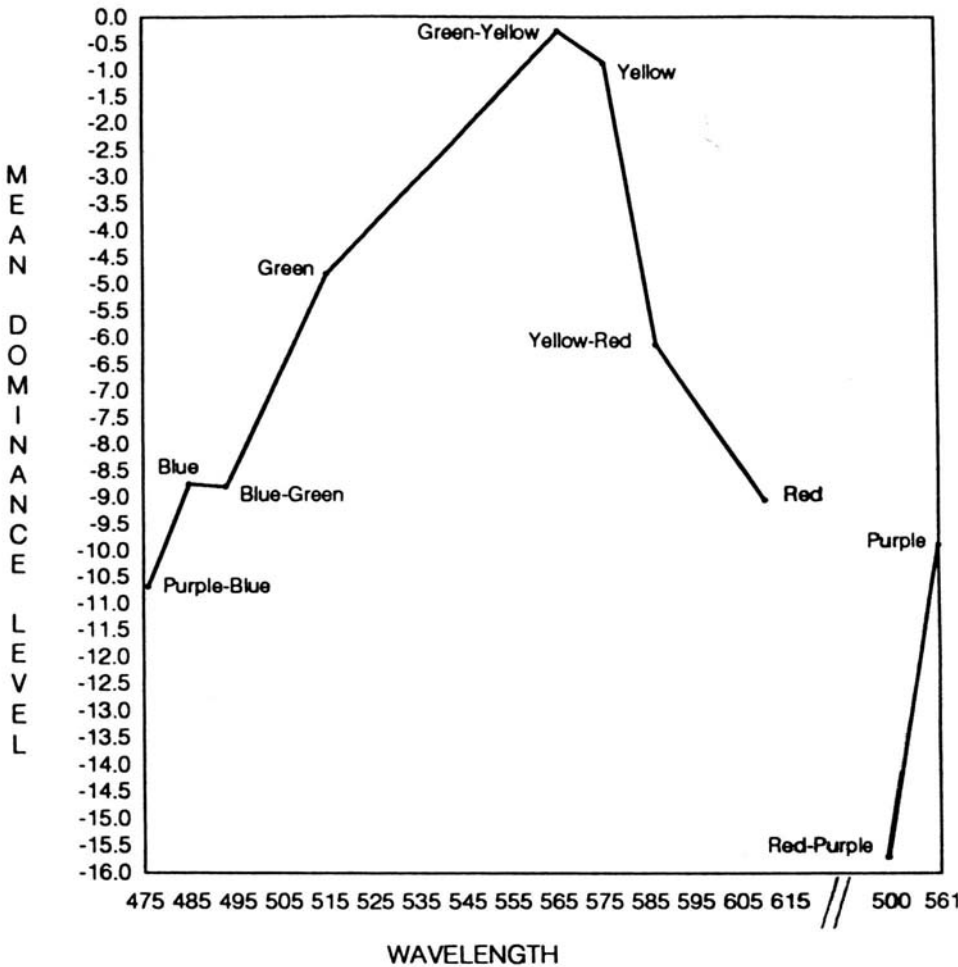


Figure 3-27: Mean dominance level as a function of colour wavelength
 Source: Valdez and Mehrabian, 1994, Study 2, p404

Yet, the obtained results were generally weak and non-significant. According to Tukey’s Multiple Comparison Procedure the only significant differences in mean dominance ratings

that could be revealed were that green-yellow and yellow were rated as significantly more dominant than red-purple.

The studies above demonstrate that empirical findings are inconsistent with regard to hue effects of colour on the dominance induced in viewers. The results obtained by Valdez and Mehrabian (1994) suggest the exact opposite of the earlier findings by Adams and Osgood (1973) who did not use actual colour stimuli but colour names, and by Birren (1978) and Sharpe (1974). A plausible explanation may be the failure of the earlier colour-studies to provide adequate specifications or controls of colour stimuli (i.e. absence of controls for saturation and brightness, while investigating effects of hue). Another possible explanation for these different findings could also be that colours that are rated as weak elicit feelings of dominance in viewers and vice versa (colours that are rated as strong might elicit feelings of submissiveness). However, further research is needed to find out if this is actually the case.

THE EFFECTS OF COLOUR ON EMOTIONS:
Table 3-8: The Dominance-eliciting Properties of Colours

EFFECTS OF HUE

Citation	Sample	Design	Stimuli	Dependent variable	Findings
Adams and Osgood (1973)	Subjects across 23 cultures		Colour names (words)	A potency dimension identified from a semantic differential scale	Across the 23 samples, “yellow” was rated as weak, whereas “red” was rated as strong.
Birren (1978) and Sharpe (1974)					Found the colour “red” to be associated with aggression and excitation, whereas “green” was associated with withdrawal.
Valdez and Mehrabian (1994) – Study 2	121 undergraduate students	Laboratory experiment Colour patches	50 colour samples: 10 hues, using 5 replication sets with equal brightness and saturation levels.	Dominance, measured according to Mehrabian’s (1978) PAD emotion scale	A univariate analysis of variance (ANOVA) was used to explore the effects of hue (10 levels) on averaged dominance reactions (each colour sample was rated by nearly 25 subjects), revealing a significant .01-level main effect : middle wavelength hues appear to elicit more dominance than either the extreme short or long wavelength hues. However, the obtained results were generally weak and non-significant. The only significant differences in mean dominance ratings that could be revealed were that green-yellow and yellow were rated as significantly more dominant than red-purple.

3.5.5.2. Effects of Saturation

Conducting one of the initial studies on the meaning of colours, Osgood et al. (1957) studied selected colours in the context of objects. In a first study one of six colours or an achromatic condition (black-white) was applied to either one of five objects (shirt, ice-cream, rug, car, cake mix) or as background. The object was then rated on 20 semantic differential scales, representing evaluative, activity and potency factors. Potency was found to be directly dependent upon a colour's saturation.

Hogg (1969) had subjects rate single colours and colour pairs (manipulating degree of colour contrast) on twelve 7-point semantic differential scales. For single colours, results showed 70.5% of the variance to be attributable to a factor labelled colour obtrusiveness, which was highly correlated with saturation. For colour pairs, sixty-one percent of the variance was accounted for by an activity-potency factor. Saturation was again the most important component of this factor – the more saturated a colour, the more potent/active it was perceived to be.

Using the Swedish Natural Colour System – NCS (Hard and Sivik, 1979; Hard, 1975) as his descriptive colour model, Sivik (1974a, 1975) initially investigated colours in isolation. Seventy-one colours (chosen to represent the NCS colour space) were judged on 26 semantic differential scales by a stratified sample of Swedish adults. Factor analysis yielded four factors: excitement, evaluation, potency and temperature. Sivik found that as chromaticness increased, so did perceived potency for all hues except for yellow. Also for the potency dimension a complex interaction appeared to exist between the three NCS parameters and a given hue.

In a comprehensive study of emotional reactions to colour among 250 undergraduates, Valdez and Mehrabian (1994) also found support for the hypothesis that dominance is a positive correlate of saturation. Stepwise multiple regression analysis was used to explore the contributions of brightness and saturation to dominance. The dominance elicited by 76 colour stimuli was measured by means of Mehrabian's (1978) verbal-report PAD (Pleasure, Arousal, Dominance) scales. Averaged dominance-submissiveness responses (each colour sample was rated by approximately 25 subjects) constituted the dependent variable, and brightness and

saturation the independent variables in the regression analysis, yielding the following equation:

$$\text{Dominance} = -.76 \text{ Brightness} + .32 \text{ Saturation}$$

From this study, a colour's brightness and saturation levels appear to explain a substantial portion of the variance in the feelings of dominance it induces (multiple regression coefficient = .87). More specifically, the equation above indicates that more saturated colours induce greater feelings of dominance in viewers. Thus, more saturated (more vivid and purer) colours appear to elicit feelings of dominance, strength or boldness. However, the regression analyses indicates the effect of brightness to be considerably stronger than the effect of saturation in determining dominance responses to colour.

THE EFFECTS OF COLOUR ON EMOTIONS:
Table 3-9: The Dominance-eliciting Properties of Colours

EFFECTS OF SATURATION

Citation	Sample	Design	Stimuli	Dependent variable	Findings
Osgood et al. (1957)	Studied selected colours in the context of objects	<u>Study 1</u> Colours were applied to either one of five objects (shirt, ice-cream, rug, car, cake mix) <u>Study 2</u> Colours were applied to abstract sculptures	Six colours + black and white	A potency dimension identified from a 20 item semantic differential scale	Potency was found to be directly dependent upon a colour's saturation
Hogg (1969)			Single colours and colour pairs (manipulating degree of colour contrast)	Twelve 7-point semantic differential scales	For single colours, results showed 70.5% of the variance to be attributable to a factor labelled colour obtrusiveness, which was highly correlated with saturation. For colour pairs, sixty-one percent of the variance was accounted for by an activity-potency factor. Saturation was again the most important component of this factor – the more saturated a colour, the more potent/active it was perceived to be. Also the greater the contrast in perceived value, the more potent and active a pair was judged to be.
Sivik (1974a)	A stratified sample of Swedish adults	Studied colours in isolation	71 colours chosen to represent the NCS colour space (based on the Swedish Natural Colour System)	A potency dimension, identified from a 26 item semantic differential scale	A complex interaction exists between hue, value and saturation. However, as chromaticness increased, so did perceived potency for all hues except for yellow.

Valdez and Mehrabian (1994) – Study 1	250 undergraduate students	Laboratory experiment with colour patches	76 colour samples : 10 hues, using 5 replication sets with equal brightness and saturation levels.	Dominance-submissiveness, measured according to Mehrabian's (1978) PAD emotion scale	<p>Stepwise multiple regression analysis was used to explore the contributions of brightness and saturation to dominance, yielding the following equation: $\text{Dominance} = -.76 \text{ Brightness} + .32 \text{ Saturation}$.</p> <p>From this study, a colour's brightness and saturation levels appear to explain a substantial portion of the variance in the feelings of dominance it induces (multiple regression coefficient = .87). More specifically, the equation above indicates that more saturated (more vivid and purer) colours induce greater feelings of dominance, strength or boldness in viewers.</p> <p>Yet, the regression analysis indicates the effect of brightness to be considerably stronger than the effect of saturation in determining dominance responses to colour.</p>
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3.5.5.3. Effects of Value

The case of achromatic colours:

With regard to achromatic colours such as white, grey and black (representing brightness variations only) empirical findings reveal much more consistent results.

Conducting a study dealing with associations between colour samples and words that describe feelings, Wexner (1954) found black to be associated with “powerful/strong/masterful”, implying high dominance.

Adams and Osgood (1973) also found black to be rated as strong, whereas white and grey were generally rated as weak.

Frank and Gilovich (1988) investigated the effects of black versus non-black uniforms of professional football and hockey teams on aggressive behaviour. They found that black uniforms, compared with non-black uniforms, not only were associated with greater degrees of perceived aggression, but also led to higher levels of player aggressiveness.

Valdez and Mehrabian (1994, Study 3) used five achromatic colour samples (ranging from white to black) to explore the effect of brightness in achromatic colours on dominance responses. A non-linear regression analysis with average dominance (25 subjects rated each sample) as the dependent variable and brightness as the independent variable revealed the following equation, expressing the relationship of dominance to brightness of achromatic colours (multiple regression coefficient = .65):

$$\text{Dominance} = 25 - 1.2675 (\text{Brightness}) + .0088 (\text{Brightness})^2$$

A plot of the actual and predicted mean dominance responses as a function of brightness is given in figure 3-28.

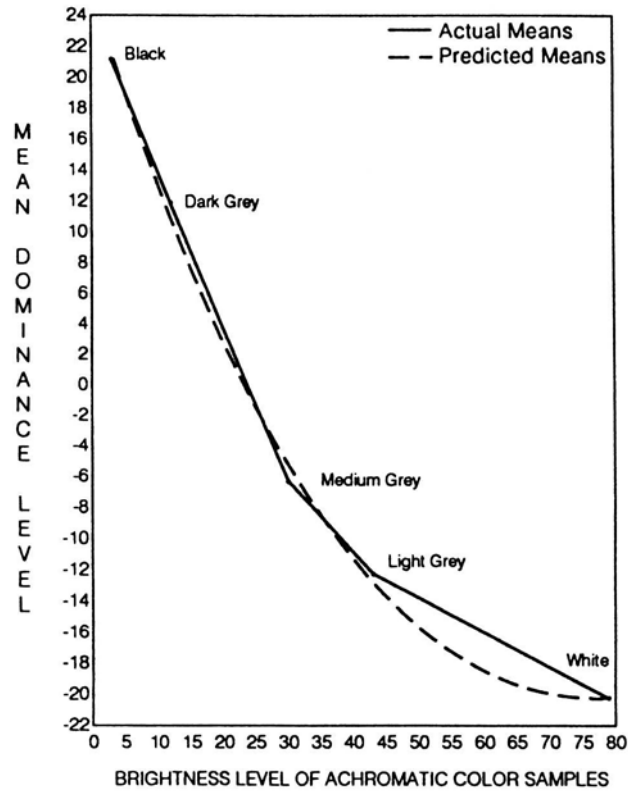


Figure 3-28: Actual and predicted average dominance levels as functions of brightness of achromatic colours

Source: Valdez and Mehrabian, 1994, Study 3, p405

Consistent with previous findings, black elicited the highest level of dominance, greys induced intermediate levels of dominance and white elicited the lowest level of dominance. The plotted results support the hypothesized negative relationship, but reveal a parabolic relation. Although dominance decreased monotonically with increasing brightness, the slope became less steep for brighter colours. Figure 3-28 also illustrates that the obtained dominance means for all five levels of brightness were predicted extremely well by the equation above.

The case of chromatic colours:

In their (1973) cross-cultural study in which subjects had to rate colour concepts (words) using the semantic differential factors (Osgood et al., 1957), Adams and Osgood found 'potency' to be correlated positively with darkness.

Sivik (1974a, 1975) used the Swedish Natural Colour System – NCS – (Hard and Sivik, 1979; Hard, 1975) as his descriptive colour model. Seventy-one colours (chosen to represent the NCS colour space) were judged on 26 semantic differential scales by a stratified sample of Swedish adults. Factor analysis yielded four factors: excitement, evaluation, potency and temperature. Blackness seemed to be the determinant of potency across all hues, but the extent of its effect varied among them. Also for the potency dimension a complex interaction appears to exist between the three NCS parameters and a given hue.

Damhorst and Read (1986), who investigated the effects of female job applicants' dark versus light clothing on male raters, found that men rated models who wore dark jackets as more powerful and competent than models who wore light jackets. Moreover, brightness of clothing was found to be even more important than facial expressions in determining judgements of 'potency'.

In a comprehensive study of emotional reactions to colour among 250 undergraduates, Valdez and Mehrabian (1994) also found support for the hypothesis that dominance is a negative correlate of brightness. Stepwise multiple regression analysis was used to explore the contributions of brightness and saturation to dominance. The dominance elicited by 76 colour stimuli was measured by means of Mehrabian's (1978) verbal-report PAD (Pleasure, Arousal, Dominance) scales. Averaged dominance-submissiveness responses (each colour sample was rated by approximately 25 subjects) constituted the dependent variable, and brightness and saturation the independent variables in the regression analysis, yielding the following equation:

$$\text{Dominance} = -.76 \text{ Brightness} + .32 \text{ Saturation}$$

From this study, a colour's brightness and saturation levels appear to explain a substantial portion of the variance in the feelings of dominance it induces (multiple regression coefficient

= .87). More specifically, the equation above indicates that less bright (i.e. darker) colours induce greater feelings of dominance in viewers. Thus, darker (i.e. less bright) colours appear to elicit feelings of dominance, strength or boldness. Moreover, the regression analyses indicates the effect of brightness to be considerably stronger than the effect of saturation in determining dominance responses to colour.

Furthermore, Valdez and Mehrabian (1994) found a second-order curvilinear relationship between colour brightness and the elicited dominance.

$$\text{Dominance} = 28.156 - 1.66 (\text{Brightness}) + .016 (\text{Brightness})^2$$

The multiple regression coefficient for this equation is .88. Actual mean values of dominance and those predicted from the equation above were plotted against brightness (for each of the six brightness values sampled) and showed extremely close agreement (see figure 3-29).

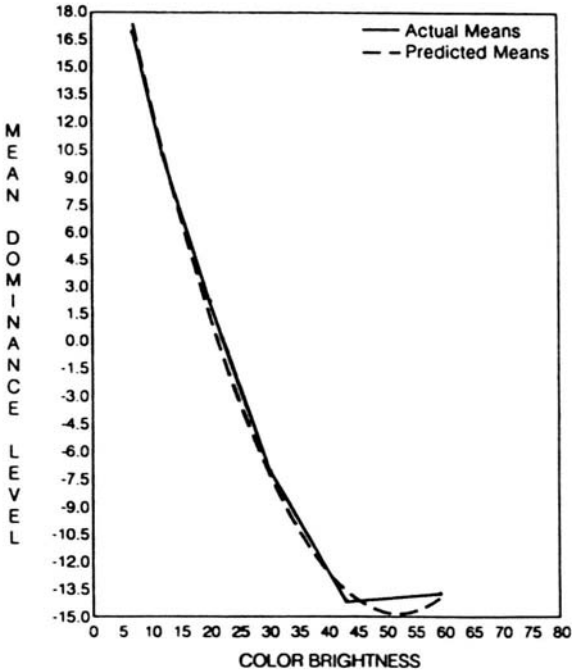


Figure 3-29: Actual and predicted average dominance levels as functions of colour brightness

Source: Valdez and Mehrabian, 1994, study 1.

Both the actual and predicted plots demonstrate that dominance declines steeply and monotonically with increasing brightness up to a brightness value of 43, beyond which dominance levels off. In other words, dominance appears to decrease as colours range from dark to light, but levels off for the lightest colours.

THE EFFECTS OF COLOUR ON EMOTIONS:
Table 3-10: The Dominance-eliciting Properties of Colours

EFFECTS OF BRIGHTNESS

Citation	Sample	Design	Stimuli	Dependent variable	Findings
<i>The case of achromatic colours</i>					
Wexner (1954)		Study concerning subjects' associations between colour samples and words that describe feelings	Eight coloured papers (not specified according to standard specifications)	Words that describe mood tones	Found black to be associated with "powerfull/strong/masterful", implying high dominance.
Adams and Osgood (1973)	Subjects across 23 cultures		Colour names (words)	A potency dimension identified from a semantic differential scale	The words "White" and "Grey" were found to be rated as weak across 23 cultures, whereas "Black" was rated as strong.
Frank and Gilovich (1988)		Investigated the effects of black versus non-black uniforms of professional football and hockey teams on aggressive behaviour	Black versus non-black uniforms of professional football and hockey teams	Observation of aggressive behaviour	They found that black uniforms, compared with non-black uniforms, not only were associated with greater degrees of perceived aggression, but also led to higher levels of player aggressiveness.

Valdez & Mehrabian (1994) – Study 3	125 undergraduate students	Laboratory experiment Colour patches	5 achromatic colour samples (ranging from white to black)	Dominance, measured according to Mehrabian's (1978) PAD emotion scale	A nonlinear regression analysis revealed the following equation, expressing the relationship of dominance to brightness of achromatic colours (multiple regression coefficient = .65): Dominance = 25 – 1.2675 (Brightness) + .0088 (Brightness) ² Consistent with previous findings, black elicited the highest level of dominance, greys induce intermediate levels of dominance and white elicited the lowest level of dominance. Although dominance decreased monotonically with increasing brightness, the slope became less steep for brighter colours.
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The case of chromatic colours

Adams and Osgood (1973)	Subjects across 23 cultures		Colour names (words)	A potency dimension identified from a semantic differential scale	Found 'potency' to be correlated positively with darkness
Sivik (1974a)	A stratified sample of Swedish adults	Studied colours in isolation	71 colours chosen to represent the NCS colour space (based on the Swedish Natural Colour System)	A potency dimension, identified from a 26 item semantic differential scale	Blackness seemed to be the determinant of potency across all hues, but the extent of its effect varied among them.
Damhorst & Read (1986)		Investigated the effects of female job applicants' dark versus light clothing on male raters	dark versus light clothing	female job applicants' ratings by male raters	Found that men rated models who wore dark jackets as more powerful and competent than models who wore light jackets. Moreover, brightness of clothing was found to be even more important than facial expressions in determining judgements of 'potency'.

Valdez and Mehrabian (1994) – Study 1	250 undergraduate students	Laboratory experiment with colour patches	76 colour samples : 10 hues, using 5 replication sets with equal brightness and saturation levels.	Dominance, measured according to Mehrabian's (1978) PAD emotion scale	<p>Stepwise multiple regression analysis was used to explore the contributions of brightness and saturation to dominance, yielding the following equation: $\text{Dominance} = -.76 \text{ Brightness} + .32 \text{ Saturation}$.</p> <p>From this study, a colour's brightness and saturation levels appear to explain a substantial portion of the variance in the feelings of dominance it induces (multiple regression coefficient = .87). More specifically, the equation above indicates that less bright (i.e. darker) colours induce greater feelings of dominance, strength or boldness in viewers. Moreover, the regression analysis indicates the effect of brightness to be considerably stronger than the effect of saturation in determining dominance responses to colour.</p> <p>Furthermore, Valdez and Mehrabian (1994) found a second-order curvilinear relationship between colour brightness and the elicited dominance: (multiple regression coefficient of .88). $\text{Dominance} = 28.156 - 1.66 (\text{Brightness}) + .016 (\text{Brightness})^2$.</p> <p>Dominance appears to decline steeply and monotonically with increasing brightness, up to a brightness value of 43, beyond which dominance levels off. In other words, dominance seems to decrease as colours range from dark to light, but levels off for the lightest colours.</p>
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3.5.5.4. Overview

Previous studies with regard to the effect of colour-hue on the dominance induced in viewers appear to demonstrate that empirical findings are inconsistent. Not using actual colour stimuli but colour names, Adams and Osgood (1973) found yellow to be rated as weak. Birren (1978) and Sharpe (1974) found green to be associated with withdrawal. In contrast they both found red to be rated as strong and associated with aggression (Adams and Osgood, 1973; Birren, 1978 and Sharpe, 1974). Although the results concerning the impact of colour-hue on dominance, obtained by Valdez and Mehrabian (1994), were generally weak and non-significant, they suggest the exact opposite. According to their findings, middle-wavelength hues appear to elicit more feelings of dominance in viewers than either the extreme short or long wavelength hues. A plausible explanation may be the failure of the earlier colour-studies to provide adequate specifications or controls of colour stimuli (i.e. absence of controls for saturation and brightness, while investigating effects of hue). Another possible explanation for these different findings could be that colours that are rated as weak elicit feelings of dominance in viewers and vice versa (colours that are rated as strong might elicit feelings of submissiveness). However, further research is needed to find out if this actually is the case.

Concerning the effect of colour saturation on dominance, empirical findings reveal much more consistent results. Potency was found to be directly dependent upon a colour's saturation (Osgood et al., 1957). The more saturated a colour, the more potent it is perceived to be (Hogg, 1969). Sivik (1974a, 1975) also found that as chromaticness increased, so did perceived potency. However he found this not to be true for yellow, revealing a complex interaction between the colour attributes for the potency dimension as well. Valdez and Mehrabian (1994) also found support for the hypothesis that dominance is a positive correlate of saturation. Apparently, more saturated (more vivid and purer) colours appear to elicit greater feelings of dominance, strength or boldness in viewers. Although they found that a colour's brightness and saturation levels appear to explain a substantial portion of the variance in the feelings of dominance it induces, a regression analyses indicates the effect of brightness to be considerably stronger than the effect of saturation.

With regard to achromatic colours, such as white, grey and black (representing brightness variations only) empirical findings also reveal consistent results. Consistent with previous findings (Wexner, 1954; Adam and Osgood, 1973; Frank and Gilovich, 1988), Valdez and

Mehrabian (1994) found that black elicited the highest level of dominance, greys induced intermediate levels of dominance and white elicited the lowest level of dominance. They did not only find support for a hypothesized negative relationship, but they also revealed a parabolic relation. Although dominance decreased monotonically with increasing brightness, the slope became less steep for brighter colours.

There is also a general consensus on the effects of colour brightness on feelings of dominance, as far as chromatic colours are concerned. Adams and Osgood (1973) found 'potency' to be correlated positively with darkness. Also Sivik (1974a, 1975) found blackness to be a determinant of potency across all hues, but the extent of its effect seemed to vary among them, revealing a complex interaction among the colour attributes. Damhorst and Read (1986) found brightness of clothing to be even more important than facial expressions in determining judgements of 'potency'. Indeed, men rated models who wore dark jackets as more powerful and competent than models who wore light jackets. In a comprehensive study of emotional reactions to colour among 250 undergraduates, Valdez and Mehrabian (1994) also found support for the hypothesis that dominance is a negative correlate of brightness. Less bright (i.e. darker) colours were found to induce greater feelings of dominance and strength in viewers. Moreover, the effect of brightness was found to be considerably stronger than the effect of saturation in determining dominance responses to colour. Furthermore, Valdez and Mehrabian (1994) found a second-order curvilinear relationship between colour brightness and the elicited dominance. Dominance appeared to decline steeply and monotonically with increasing brightness up to a brightness value of 43, beyond which dominance levels off. In other words, dominance appears to decrease as colours range from dark to light, but levels off for the lightest colours.

*"The key lies in not looking for the magic link
between colour and emotions,
but in exploiting the ways that colour affects
one's appreciation
of objects and people involved in the setting"*

BEACH, WISE & WISE

1988, p51

3.6. BEHAVIOURAL RESPONSES TO COLOUR

Colour can affect behaviour in one of three ways. First of all, it is generally accepted that colour can be used to convey meaning. By using colour-associations, thoughts and beliefs can be influenced, which may in turn impact attitudes, intentions and behaviours. Secondly, as mood can bias attitudes in a mood-congruent direction and colour can have a major impact on mood, it is clear that marketers and interior designers can use colour to actually influence moods and attitudes, and thus intentions and consumer behaviour. Finally, colour-evoked mood can also affect behaviour directly. Moreover, it has been suggested by industrial psychologists that the appropriate use of colour can enhance the overall quality of the environment and, thus, influence performance (Mahnke, 1981; Venolia, 1988; Ward, 1995; Pressly and Heesacker, 2001).

3.6.1. THE APPLICATION OF “COLOUR THEORY” TO REAL WORLD SITUATIONS

As colours applied to designed settings have been assumed to possess the same affect-eliciting qualities as those revealed by laboratory experiments, they have been judged capable of influencing the emotional state and behaviour or performance of an environment's occupant (Etnier and Hardy, 1997). In the Human Factors Design Handbook (Woodson, 1981), one and a half pages deal with “typical colours and their effects on humans”. Many prisons, hospitals, companies and schools have adopted systematic colour schemes, which may have been designed to produce particular mood states or behaviours in their inhabitants. Although Judd (1971) has suggested that the results of experimental colour research could serve as a tool (although crude and limited) by which one might begin to make colour decisions in the built environment, a severe lack of knowledge about colour research has been noted among specialists, like architects, interior designers and colour consultants (Janssens and Mikellides, 1998). The literature with regard to the effects of colours in the environment, is replete with anecdotal evidence, rather than based on systematic investigation. While there is no shortage of suggestions, they often lack empirical verification (Gorn et al., 1997).

As colour psychologists have discovered that warm colours such as red, orange and yellow tend to be more stimulating and exciting, whereas cool colours such as blue, green and violet

tend to be more soothing, divergent colour applications have often been based on this distinction.

Thus, high-energy, warm colours, which are considered to stimulate and encourage excitement, are deemed more appropriate in places such as health clubs and fast-food restaurants, where high levels of energy and activity are generally desirable (Lindsay and Norman, 1973). Bellizzi et al. (1983) found warm colours to be more likely to draw customers to an outlet, but caution that they can also create tension. When the goal is to stimulate quick purchases or activity, warm colours are suggested to be more appropriate. Discount stores such as Target and Kmart often use a red-based colour scheme. Kmart recently switched from light blue to red to remove a disadvantage in this area (Hoyer and MacInnis, 2001, p164-165).

A newspaper clipping (Argue, 1991) asserts that red is also supposed to be an effective colour to use in restaurants, “because it leads people to eat more”. According to Van Bergen (1995) Mc Donald’s initially used a high chroma red, but, because too much red led customers to complain of headaches, they switched it to a “more relaxing” higher value pastel-shade of red. Wienerschnitzel, a hot dog restaurant chain with 350 locations in the United States, changed, the colour of its buildings, as advised by Wagner, the creator of the Colour Research Institute. After adding a little orange to the colour, which had to convey the message that the chain sold inexpensive hot-dogs, Wienerschnitzel reported a 7% increase in sales (Lane, 1991).

Red supposedly also makes people lose track of time, making it a good colour for use in casinos (Argue, 1991).

According to Humphrey (1976) one’s response to red is a reflexive one. He argues that it serves the purpose of preparing (arousing) one to take some form of action, which is defined by the context. He notes that red is the most common colour signal in nature, arising from the fact that it contrasts well with both green foliage and the blue sky. Problems arise from the ambiguity of its signal: it can signal either approach (sexual display, edible food) or avoidance (aggressive behaviour, poisonous substance) (Mikellides, 1979; Beach et al., 1988).

Cool colours, on the other hand, are considered as restful and calming, and thus are deemed to be more appropriate in places such as hotel rooms, resorts, spas or doctors’ offices, where it is

desirable for consumers to feel calm and relaxed (Lindsay and Norman, 1973; Bellizzi et al., 1983; Hoyer and MacInnis, 2001, p164-165). Cool colours are also advised in places where consumers are supposed to spend some time deliberating, such as banks, or stores that sell expensive consumer durables. In contrast to what may be expected, the systematic use of green in hospitals is not initiated by its relaxing qualities. Instead, green has been used in hospitals as a means of minimizing the after images¹³ experienced by staff members in the operating rooms (Beach et al., 1988).

Nevertheless, based on the attributions to the colour green as being calm and restful, it has been selected for use in redecorating the main cell block and solitary confinement areas at Alcatraz (Porter and Mikellides, 1976a).

Miller-Baker Pink (a kind of bubble gum pink; R:255, G:145; B:175), also known as “drunk tank pink”, is also used in jails to calm violent prisoners, as this particular (low saturated, bright) colour was also found to have a tranquilizing effect and to suppress aggressive behaviour (Profusek and Rainey, 1987; Schauss, 1979; 1985; Color Voodoo, 1999; Honolulu Star Bulletin, 1999). The colour is now being used in more than 1400 government hospitals and correctional facilities in the U.S. (Walker, 1991).

The systematic application of colour has also been evident in sports. George Lumkin, associate head coach of the University of Hawaii football team, observed in 1991 that visitor locker rooms in the Universities of Iowa and Colorado were painted pink in the belief that the colour made players passive (Honolulu Star Bulletin, 1999). In an attempt to influence his own team’s emotions and ultimately to influence his team’s performance, Alonzo Stagg, a former head football coach at the University of Chicago, purposefully used a blue dressing room for rest periods and a red dressing room for fight talks (as cited in Etnier and Hardy, 1997). The Western Athletic Conference (WAC) has now enacted the rule that a visiting team’s locker room cannot be painted in a different colour than the one of the home team. Coaches try to use colour to their advantage not only by altering the colour of the locker rooms, but also by experimenting with the colour of the uniforms and helmets (Zurcher, 2001). Frank and Gilovich (1988) investigated the effects of black versus non-black uniforms

¹³ Opponent colour processing is responsible for the fact that we can experience afterimages. When looking at the colour red, for example, for a longer period of time, our eyes get adapted to seeing this red colour. If we subsequently turn to look at a white wall, we will experience seeing a green afterimage (the opponent of red) (we refer to Levine (2000), for more details on this visual phenomenon).

of professional football and hockey teams on aggressive behaviour. They found that black uniforms, compared with non-black uniforms, not only were associated with greater degrees of perceived aggression, but also led to higher levels of player aggressiveness.

Nevertheless, while the application of “colour theory” to real-world situations has been extensive, research examining the effect of environmental colour on actual behaviour and performance has been sporadic and inconclusive (Etnier and Hardy, 1997).

3.6.2. EMPIRICAL EVIDENCE OF COLOUR-BEHAVIOUR EFFECTS

Although some sporadic studies have been conducted to investigate the effects of colour with regard to behaviour, regrettably much of this research is weak due to one major methodological drawback: the failure to provide adequate specifications and controls of colour stimuli (i.e. absence of controls for saturation and brightness, while investigating hue effects). Moreover, there is a lack of systematic research on the topic.

In the next paragraphs an overview will be presented on some of the empirical findings with regard to the effects of colour on actual behaviour. First the impact of environmental colour on task performance will be examined. Subsequently, the effect of colour on time perceptions and actual time spending will be addressed. And finally we will review some of the findings concerning the effect of colour on actual behaviours such as voting behaviour, cooperative behaviour and gambling behaviour.

3.6.2.1. Task-performance

Researchers examining the influence of colour on task performance have typically hypothesized that the relationship between colour and performance is partially dependent upon the classification of the task as a gross motor skill, a fine motor skill or a cognitive skill (Jokl, 1982; Etnier and Hardy, 1997). Colours with long wavelengths (e.g., red, orange) have been hypothesized to facilitate the performance of gross motor tasks, whereas colours with short wavelengths (e.g., green, blue) have been hypothesized to facilitate the performance of fine motor tasks and cognitive tasks (Jokl, 1982; Etnier and Hardy, 1997).

Although research on the influence of environmental colour on cognitive task performance has been scarce (Pressey, 1921; Wohlfahr, 1986), results of these studies indicated that colour did not influence cognitive task performance.

Substantially more research has been dedicated to the assessment of the effect of colour on the performance of motor skills (Goodfellow and Smith, 1973; Green et al., 1982; James and Domingos, 1953; Nakshian, 1964).

The most cited work in terms of how colour affects behaviour, is provided by Goldstein (1942). From his work with brain-damaged individuals, he observed that in the presence of green abnormal behaviours (such as trembling or an unstable pace) became less deviant, while in the presence of red, these behaviours became exaggerated. Based on these observations Dr. Goldstein postulated an affective theory of colour, which he believed applied to all individuals. He viewed red as having an “expansive” effect on the senses and of being capable of inducing a state of excitation in both emotional and motor behaviour. Green, on the other hand, had in his opinion a contractive nature and promoted tranquillity (Nakshian, 1964). Based on these premises, Dr. Goldstein (1942) felt that one’s performance on certain motor tasks and judgements could be interfered with or disturbed by the colour red and facilitated by the colour green. However, neither numerical results, nor statistical analyses of his observations were ever presented (Beach et al., 1988; Nakshian, 1964; Norman and Scott, 1952; Goldstein, 1942).

In a study among 48 subjects, who had to perform a series of nine perceptual and motor tasks¹⁴ under red, green and grey colour conditions, Nakshian (1964) found little evidence to support Goldstein’s (1942) premise that a red surrounding impaired and a green one facilitated certain motor performances and judgement abilities. The environmental colour conditions he used in his experiment were coloured partitions on a tabletop apparatus. Although the colours were matched on lightness according to the Munsell colour System, the red was more saturated than the green (5R 4.5/12 vs. 7.5G 4.5/6). Nevertheless, significant

¹⁴ The perceptual tasks studied include judgements of length and time. The motor tasks examined were comprised of fine motor tasks (such as hand tremor and tweezer dexterity) and gross motor tasks (such as most comfortable arm position, outward arm movement and motor inhibition).

differences could be revealed for only two out of the nine tasks: hand tremor and motor inhibition¹⁵. Performance for both tasks was better under the green condition than under the red.

Hammes and Wiggins (1962) found that colour illumination had no effect on high- or low-anxious subjects in a perceptual motor steadiness task under three different lighting conditions (red, blue and white). Red and blue illumination were produced by Wratten filters and brightness among the three lighting conditions was equated by the method of limits. Hammes and Wiggins (1962) thus found no support for the hypothesis that subjects perform best under blue illumination, due to its calming nature.

In a study among 25 females who had to perform two psychomotor tasks, Goodfellow and Smith (1973) found no differences in performance across five colour conditions. The colour conditions used involved a tabletop booth, painted in either red, blue, green, yellow or gray, with medium brightness and high saturation, matched to Munsell notations.

Neri, Luria and Kobus (1986) had eight subjects engage in a CRT (Cathode Ray Tube) reaction task, under four different illumination conditions (red, blue, low level white and no light). Subjects had to select the appropriate button, representing the quadrant on a CRT screen in which a stimulus was initially presented, as quickly as possible. In addition to ambient lighting, both CRT background colours and target colours were manipulated. The manipulated ambient lights, falling on the CRT screen were equated for brightness, but had rather low illumination levels. No significant differences in mean reaction times could be detected under the four ambient lighting conditions.

Hamid and Newport (1989) studied the effect of colour on mood and physical strength in preschool children. Results indicated that children exhibited more positive moods and greater strength when in a pink room than when in a blue room.

Investigating the effect of colour (red, green and white) on mood and task productivity, Kwallek and Lewis (1990) found that workers in red offices made the fewest errors, whereas workers in white offices made the most errors. Moreover, workers in red offices reported less

¹⁵ In both tasks inhibitory control over motor performance was measured.

confusion than workers in green offices did. Nevertheless, employees in red offices reported the colour red to be more distracting than those in white offices.

According to Etnier and Hardy (1997), the results of the studies by James and Domingos (1953), Nakshian (1964), and Green et al. (1982) lend some support to Jokl's (1982) colour theory. However, since the tasks that were used in these studies were not clearly classifiable as fine or gross motor tasks, it remains unclear how colour influences performance on these tasks.

Etnier and Hardy, (1997) examined the effect of environmental colour on performance of mentally and physically demanding tasks. The tasks, a fine motor task with a large cognitive component (the McCloy Blocks Test¹⁶, McCloy, 1942) and a gross motor task (the Wingate Anaerobic Test¹⁷) had to be performed in a cool-coloured (dark saturated blue-green) room, a warm-coloured (saturated reddish-orange) room and a neutral coloured white room. Colours were chosen from Sherwin Williams Decorator Colours, with the intention to keep brightness and saturation equal, so that the rooms differed only in hue. 30 undergraduate volunteers (17 females and 13 males) participated in the experiment. In accordance with Jokl's (1982) hypothesis, it was hypothesized that the warm colour would improve the performance on the gross motor task, and would hinder performance on the fine motor task. On the other hand it was hypothesized that the cool colour would improve performance on the fine motor task and would hinder performance on the gross motor task. In contrast to results found by other researchers (Green et al., 1982; James and Domingos, 1953), Etnier and Hardy (1997) found that environmental colour did not directly affect performance of either a fine motor task or a gross motor task. However, colour and time¹⁸ did interact to impact positive affect, $F(8, 232) = 10.90$, $p < .0001$ and desire to cope, $F(2, 58) = 15.07$, $p < .0001$ (as measured by the Zuckerman Inventory of Personal Reactions), suggesting the possibility that tasks of a longer

¹⁶ The McCloy Blocks Test (McCloy, 1942) consists of an arrangement of blocks with different colours on the top and bottom (red, blue, yellow or green), which are supposed to be picked up according to specific rules. In deciding which block to select next, a mental sequence of colours needs to be followed. The time needed to complete the task is recorded to measure one's performance on the test. The authors note that the colours on the blocks could potentially confound the effects of environmental room colour, but assume that this would not systematically confound the results of their study.

¹⁷ The Wingate Anaerobic Test measures one's maximal anaerobic power with regard to the large muscle groups of the legs. The test involves a 30 sec. sprint on a cycle ergometer (Vandewalle, Peres & Monod, 1987). The number of revolutions is recorded as a measure of performance.

¹⁸ Affect was measured at several instances: when entering the main laboratory (1), before (2) and after (3) performing a cognitive task and before (4) and after (5) performing a motor task.

duration may be indirectly influenced by environmental colour. Positive affect decreased in the warm-coloured room more so than it did in the cool- and neutral-coloured rooms prior to performance of the cognitively demanding task. Thus subjects showed a less positive emotional response towards performing the cognitive task in the warm-coloured room. On the other hand, positive affect decreased to a lesser extent in the warm-coloured room prior to performance of the physically demanding task than it did in the cool- and neutral-coloured rooms. Thus subjects showed a more positive emotional response towards performing the physical task in the warm-coloured room. While these effects on positive affect did not influence performance in this study, it is possible that a task of a longer duration could make positive affect necessary for successful performance and thus the influence on positive affect could impact subsequent task performance. Additionally, after performance of the physically demanding task, desire to cope was found to increase more in the warm-coloured room than in either the cool- or neutral-coloured rooms. Again, while this effect did not influence performance, it is possible that in a situation in which repeated performance of a physically demanding task is required, the influence on desire to cope could impact subsequent task performance. These findings lend some support to the idea that colour influences the organism in a manner, which is dependent on the task type (Jokl, 1982).

Wolson and Case (2000) found players of a computer game with a blue screen to improve gradually over the session of five consecutive games, whereas players with a red screen peaked in the middle of the session and then deteriorated. A similar pattern for heart rate could be discerned, suggesting a mediating role of arousal in the effect. Players in the blue condition were found to make more errors than those confronted with the red background. Although varying sound had little impact, the red/loud combination was associated with feelings of “excitement” and “playing well”, although this was not reflected systematically in the players’ performance.

From this review of empirical studies on the effects of colour on task performance it is obvious that findings are inconclusive and that more research on the topic is called for.

3.6.2.2. Time Perceptions and Time Spending

In addition to hypothesizing specific effects of colour on psychomotor performance, Goldstein (1942) also postulated differences in psychophysical judgments of time passage under the colours red and green. Time distortions have since been investigated under more rigorous experimental settings (Beach et al., 1988).

The passage of time has been observed to be overestimated in a room painted with warm colours and underestimated in a cool-coloured room (National Aeronautics and Space Administration, Johnson Spacecraft Center, 1976).

Asking respondents to estimate the amount of time spent under two different lighting conditions and whether time exposure to a second light was equal to that of a first, provided in both cases shorter time estimations for the red as compared to the blue light conditions (Smets, 1969). However, Smets noted strong order effects in her data: perceived time duration was shorter for the first exposed colour light, whether it was red or blue.

Humphrey (1971) and Humphrey and Keeble (1977) found that monkeys seemed to prefer to spend more time in a blue light condition than in a red light condition. They also found that monkey responses were much faster in the red than in the blue light condition. They account for these findings by proposing that time appears to pass more quickly in red light than in blue light, referring to a kind of “subjective clock”.

Srivastava and Peel (1968) conducted an experiment in which they compared time spending and movement patterns in the attendance of art museum exhibits where the walls were painted light beige or dark brown. Visitors in the dark room as compared to those in the light room were found to spend less time in the room, but to cover twice as much area and to take more footsteps (as measured by a hodoscope which records footfalls unobtrusively).

Equalizing brightness through the method of averaged error, Caldwell and Jones (1985) found no significant difference in counting rates under red, blue or white illumination, nor did they observe differences under the three lighting conditions when subjects were required to estimate 35 and 45 second time intervals. They did however also find significant presentation

effects in both experiments. A post-experiment interview revealed that sixty percent of the subjects reported they thought to count faster in the red light condition than in the blue one.

Bellizzi, Crowley and Hasty (1983) suggested – based on their findings – that customers may shorten their shopping time when in a tense, unpleasant environment and discourage for this reason the use of red and other warm colours inside the retail store. In a first experiment, however, Bellizzi and Hite (1992) found display background colour not significantly related to actual shopping time. Nevertheless, in a second experiment, approach behaviour intentions -including two time-related items (i.e. the intension to browse around and spend time in the store)- were found to be more favourable in a blue as compared to a red store.

Beach et al. (1988) conclude in a review that if there is a distortion in subjective time estimation due to colour, it is not a very robust phenomenon.

3.6.2.3. Miscellaneous Behaviours

Very unsystematically, a number of studies have examined the effect of colour on a range of different behaviours, such as gambling behaviour, voting behaviour, food choice etc... Again, most of these studies are methodologically flawed and unsystematic with regard to the selection and specification of colour stimuli used. Nevertheless, they provide some evidence on actual colour-behaviour effects.

Stark, Saunders and Wookey (1982) investigated the influence of ambient lighting on gambling behaviour. Twenty-eight subjects played in groups of seven a variation on the game of three card brag under blue and red ambient light conditions (matched for brightness, but otherwise unspecified). The authors found that significantly more money was waged and more bets were placed in the red light condition. Yet, the difference in money waged between the groups amounted to less than one pence (Beach et al., 1988). An interaction was also observed: as time increased, subjects waged more money, increased the number of bets, and these behaviours were more prevalent in the red light condition. From these findings, Stark, Saunders and Wookey (1982) concluded that red had a more excitatory effect on gambling behaviour and that people's behaviour became riskier in red light. However, they did not provide information regarding the average sums of money won or lost in each light condition.

Beach et al. (1988) critically reviewed the study and cautioned casino's for major redecorating decisions based on these findings.

Garrett and Brooks (1987) found that ballot colour affected voting behaviour when the candidates' sex was not specified. In that case men showed greater preference for candidates whose positions were printed on green ballots, than for those whose positions were printed on pink ballots. Female subjects showed the reverse preferences.

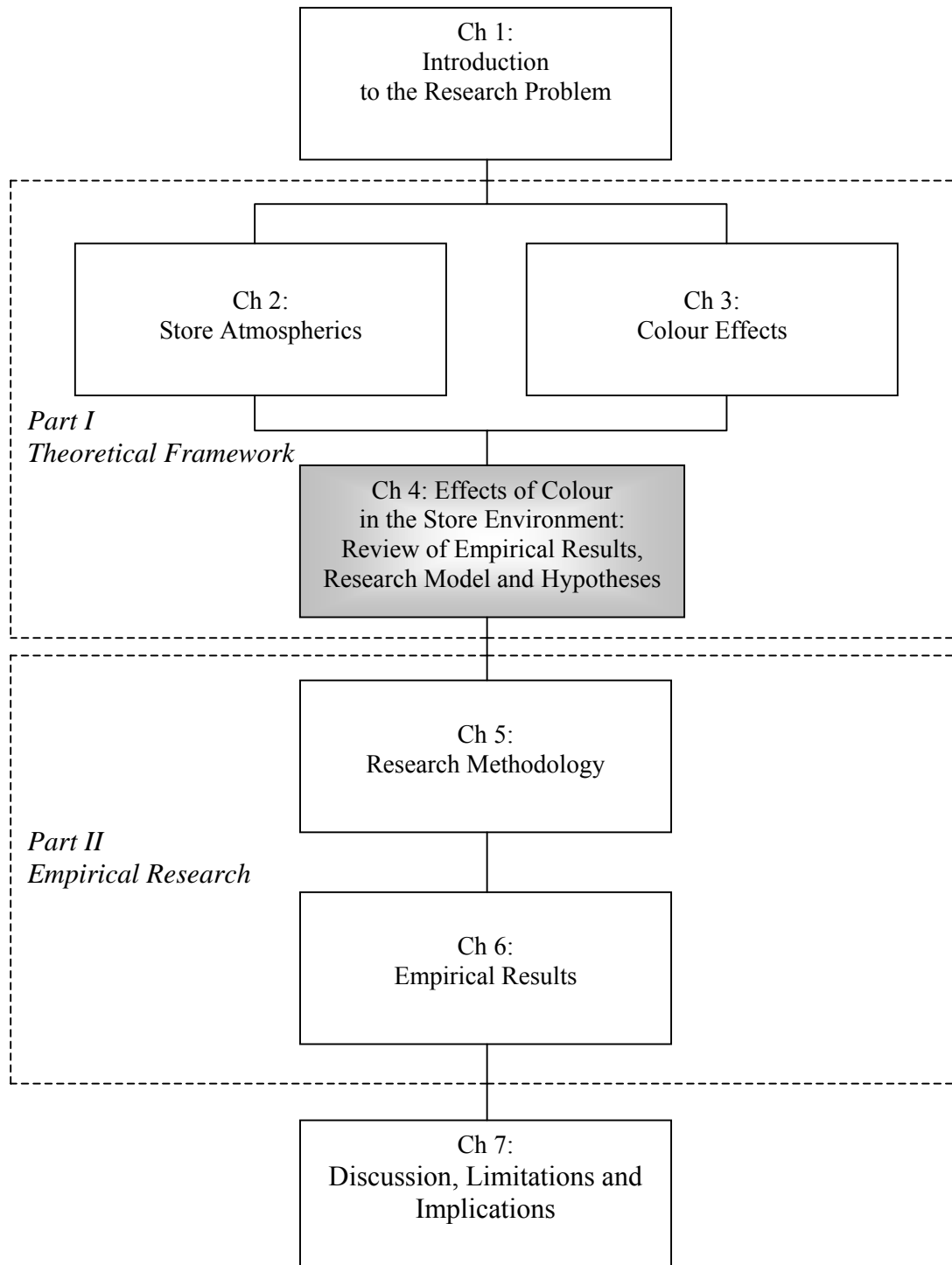
Roll's (1985) findings suggest that colour is an important variable in food selection. Walsh and Toma (1990) found children to prefer and choose candies (fruit-flavoured as well as candy-coated chocolate candies) on the basis of their colour. A main effect found for colour indicated that childrens' candy preferences ranged from red over green to orange with yellow being the least preferred.

Read et al. (1999) found changes in wall colour (red vs. white) and ceiling height to impact preschool children's cooperative behaviour.

Research on the influence of colour in the store environment demonstrates that colour also appears to influence shopper's emotions, beliefs, attitudes and behaviour (Bellizzi, Crowley and Hasty, 1983; Middlestadt, 1990; Bellizzi and Hite, 1992; Crowley, 1993). Indeed, colour appears to have the ability to physically attract consumers toward a retail display (Bellizzi, Crowley and Hasty, 1983). Furthermore, the colour in the store environment also appears to affect consumers' attitude towards buying a product (Middlestadt, 1990); it can influence simulated purchases (Bellizzi and Hite, 1992) and purchasing rates (Bellizzi and Hite, 1992), time spent in the store (Bellizzi and Hite, 1992), pleasant feelings (Bellizzi and Hite, 1992; Crowley, 1993), arousal (Crowley, 1993), product beliefs (Middlestadt (1990) and store and merchandise image (Bellizzi, Crowley and Hasty, 1983; Crowley, 1993). These studies will be discussed in more detail in the next chapter.

Chapter 4

*Effects of Colour
in the Store Environment:
Review of Empirical Results,
Research Model and Hypotheses*



CHAPTER STRUCTURE

Chapter 4: Effects of Colour in the Store Environment: Review of Empirical Results, Research Model and Hypotheses

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4.7.1. Age

4.7.2. Gender

4.1. INTRODUCTION

This chapter focuses on the effects of colour in the store environment. First, the research objectives of this study are outlined in section 4.2. In section 4.3. the need is established to study colour in context and specifically to study the effects of colours applied to environments. Section 4.4. presents the available empirical evidence regarding the influence of store-interior colour, provided respectively by Bellizzi, Crowley and Hasty (1983), Middlestadt (1990), Bellizzi and Hite (1992) and Crowley (1993). In section 4.5. the applied research model, which is based on environmental psychology, is proposed. Subsequently, in section 4.6. our hypotheses with regard to store-colour-evoked emotions and the impact of store-colour-evoked emotions on approach-avoidance behaviours are presented. Finally, in section 4.7. the possible moderating roles of the demographic characteristics, age and gender, are discussed.

4.2. RESEARCH OBJECTIVES

Research on store atmospherics is predominantly based on environmental psychology and specifically on the Mehrabian and Russell (1974) Stimulus-Organism-Response model, as introduced to the study of store atmosphere by Donovan and Rossiter (1982). In this context it has been proposed that approach/avoidance behaviours of customers are largely determined by individual internal (cognitive, emotional and physiological) responses to the store environment (Bitner, 1992). Thus, atmospheric variables have been found to influence a wide variety of consumer evaluations and behaviours (see Turley and Milliman, 2000 for a review).

The study, presented here, aims to fill a gap in this extensive stream of research concerning the impact of store atmospherics on the consumer. In their suggestions for further research with regard to atmospheric effects on shopping behaviour, Turley and Milliman (2000) draw the attention to store interior colour, which has not received the attention it probably deserves. As research on the impact of colour in the store environment is scarce and methodologically flawed, it is our challenge to assess the impact of this store design element more thoroughly.

Although it has been demonstrated that environmental colour can actually influence the emotions, beliefs, attitudes and behaviours of retail shoppers (e.g. Bellizzi et al., 1983; Middlestadt, 1990; Bellizzi and Hite, 1992; Crowley, 1993), it is still unclear how exactly colour affects approach behaviour.

Moreover, studies on the subject are flawed because they failed to provide adequate specifications and controls of colour stimuli, a caveat noted to be common among colour research (Gelineau, 1981, Beach et al., 1988; Valdez and Mehrabian, 1994). Indeed, colour stimuli have not been specified according to a standard colour system, but only vague verbal descriptions have been reported. Thus, hue effects have been tested, without controlling for saturation or brightness, this way confounding the effects of the three colour attributes. Moreover, only effects of colour-hue have been investigated in a retailing context, whereas effects of saturation and brightness have been ignored completely. Yet, these neglected colour dimensions may very well be the major determining factors in colour effects on human feelings and behaviour (Valdez and Mehrabian, 1994; Gorn et al., 1997).

In fact, Bellizzi, Crowley and Hasty note in their 1983 paper that the fully saturated colours used in their study may be too strong for many design applications and that it still has to be determined whether less saturated versions of these colours would have similar effects. Up to now, however, this simple question still has not been investigated yet. Indeed the scarce research on the topic published thus far, focused on the effects of hue, without considering effects of brightness and saturation and worse, not even controlling for them. Also Bellizzi and Hite (1992) call for further research into the area in order to develop an understanding of how colour may affect consumers. They also suggest to study the effects of other colours and “other” reds and blues, referring to reds and blues with different value and saturation levels.

In the current research endeavour we will attempt to address these vital issues. Two basic objectives are contemplated. First and foremost, a more accurate methodology will be proposed for assessing the impact of colour in the store environment on shopper behaviour. Applying an environmental psychology approach, the proposed study aims to assess (1) the direct effect of colour in the store environment on the emotions experienced in the store (notably pleasure, arousal and dominance) and (2) the direct and indirect effect of colour on consumers’ approach/avoidance behaviour through the store colour-evoked emotions. In particular, the specific effects of colour hue, saturation and brightness in the store design will be investigated. Moreover, the moderating impact of individual differences with regard to atmospheric responsiveness will be assessed.

Although Bellizzi et al. (1983) hoped that their initial study would serve as a catalyst to encourage additional research interest in the role of colour in retail store management, they did not have many academic adherents. With this research project we hope not only to gain a deeper understanding of the effects of colour in the store environment, but also to generate some revived academic interest into the subject.

Still, the booming retailing industry already shows a stupendous interest in the research topic (Breneman, 2002; Retail-Update, 2002; POPAI-Benelux; Cahan, 2002). Indeed, the fact that almost two thirds of all purchase decisions are made in the store (POPAI, 1998) has raised the attention to the point-of-purchase and to store atmospherics. From a more practical point of view, this research is intended to assist retailers in selecting and avoiding certain colours in order to produce desired consumer moods and in-store behaviours.

*"There is little
systematic empirical research
in marketing
on the effects of colour"*

*GORN et al.
1997, p1387*

4.3. THE NEED TO STUDY COLOUR IN CONTEXT

Norman and Scott (1952) criticize that a “primary defect” of colour preference research is that the colour-stimuli used almost always involve colour patches or colour names in isolation, ignoring the fact that colour is almost always associated with some object or context. According to Norman and Scott (1952), judged preferences for colours presented as small chips reveal little about preferences for coloured objects or environments.

An early study by Washburn, McLean and Dodge (1934) already revealed that even the size of the colour stimulus could affect preference judgements. They found that preference ratings for some colours (yellow and orange) varied with stimulus size, the smaller size (5x5 cm) being preferred while the larger size (25x25 cm) was judged as unpleasant. This may be yet another reason for inconsistencies reported by various researchers on colour preferences (Beach et al., 1988).

The findings of two studies by Osgood et al. (1957) also suggest that colour acceptance is defined by the object with which it is associated. Conducting one of the initial studies on the meaning of colours, Osgood et al. (1957) studied selected colours in the context of objects. In a first study one of eight colours was applied to either one of five objects (shirt, ice-cream, rug, car, cake mix) or as background. With regard to the “evaluative” dimension, a significant colour x object interaction was identified. In terms of evaluation, yellow was rated as the “most favourable” colour, in contrast with previous studies using colour patches, which have found yellow to be generally disliked. The authors suggested that their unexpected finding may have been an artifact of the objects used in the study. In a second study, colour was studied in relation to abstract sculptures. As in the first study, also with regard to abstract sculptures, the colour x object interaction was found to be significant. In this case, blue was the most preferred hue.

In the opinion that more work needed to be done, such as testing colours applied to objects, Guilford and Smith (1959) caution their readers with regard to applying their findings to real world situations.

Taft (1997) compared evaluative semantic ratings (beautiful-ugly, elegant-vulgar, loud-discrete, masculine-feminine and warm-cold) of colour chips and five objects of the same

colour for 13 colours. In contrast to the findings by Osgood et al. (1957), Taft's analyses indicate that generally few significant differences exist between chips and object ratings for the same colour. The results of this study have implications for the generalizability of the results of earlier colour meaning research and for the use of colour chips in colour planning.

Rather sceptical as to the effect of colour in the environment, Beach et al. (1988), nevertheless, point out, that studying colours in isolation (e.g. colour boards or colour samples) provides us with little information, other than how a subject at that moment rates a given colour on a given scale. They argue that colours need to be studied in context, especially in environmental contexts, and feel that even then caution must be taken with respect to the generalizability of the findings. Whereas Judd (1971) suggested that the results of experimental colour research could serve as a tool by which one might begin to make colour decisions in the 'built environment' (i.e. architectural design), Beach et al. (1988, p99) argue that "*it is fruitless to build up to a theory of colour application in settings from highly reductionist experiments alone*". In an extensive literature review on the effects of colour, Beach et al. (1988) note that the evaluation of colours needs to be studied in the context of a given object or situation to yield most meaningful results.

However, as studies on colour preference and colour meaning still systematically rely on the use of colour chips, and the study of colours in environmental contexts is scarce, it remains a critical question whether preferences for and meanings of isolated colour-chips are generalizable to contextual colours, such as store colour.

Anyway, as findings from early laboratory experiments on the affective and connotative qualities of colours did become spread, these associations were believed to hold when applied to environmental settings as well. Thus colours were believed capable of influencing the emotional state of an environment's occupant (e.g. Birren, 1983). For this reason specific colours have been applied in sports locker rooms, hospitals, jail cells, fast-food restaurants and other places. With regard to the "effects" of colours in the environment, however, the literature seems to contain mostly anecdotal evidence, revealing a severe lack of systematic empirical research.

As it is the aim of this particular study to investigate the effects of colour in the store environment, we will first review the studies on colour effects that have been conducted in a retail setting more carefully.

*"Marketing and retail managers should be aware
that colour can have negative or positive
marketplace implications that may affect not
only mood or feelings,
but also in-store behaviour"*

BELLIZZI & HITE

1992, p361

4.4. THE INFLUENCE OF COLOUR IN THE STORE ENVIRONMENT: EMPIRICAL EVIDENCE

Two decades ago, Bellizzi, Crowley and Hasty (1983) observed that while many studies had investigated the effects of colour, little research had been addressed to the specific use of colour in retail applications. They suggested that retailers should be careful in attempting to create exciting and attracting store environments, because too much excitement and attraction may lead to shopper avoidance of uncomfortable environments. Up until this day only four laboratory experiments have been published on the influence of colour on retail shoppers. Although scarce (Turley and Milliman, 2000), research on the influence of colour in the store environment demonstrates that colour appears to influence shoppers' emotions, beliefs, attitudes and behaviour (Bellizzi, Crowley and Hasty, 1983; Middlestadt, 1990; Bellizzi and Hite, 1992; Crowley, 1993). Indeed, colour appears to have the ability to physically attract consumers towards a retail display (Bellizzi, Crowley and Hasty, 1983). Furthermore, the colour in the store environment also appears to affect consumers' attitude towards buying a product (Middlestadt, 1990); it can influence simulated purchases (Bellizzi and Hite, 1992) and purchasing rates (Bellizzi and Hite, 1992), time spent in the store (Bellizzi and Hite, 1992), pleasant feelings (Bellizzi and Hite, 1992; Crowley, 1993), arousal (Crowley, 1993), product beliefs (Middlestadt (1990) and store and merchandise image (Bellizzi, Crowley and Hasty, 1983; Crowley, 1993).

In spite of the fact that these studies have found that colour influences the behaviour of retail shoppers, it is still unclear how exactly colour affects shoppers' emotions and behaviour. As mentioned previously, these past studies are flawed, because they have a major methodological drawback in that they failed to provide adequate specifications or controls of colour stimuli (e.g., absence of controls for saturation and brightness while investigating effects of hue), a caveat noted to be common among colour research (Gelineau, 1981, Beach et al., 1988; Valdez and Mehrabian, 1994). In fact, colour stimuli can be characterized completely in terms of hue (i.e., wavelength), brightness or value (i.e., black-to-white quality) and saturation or chroma (i.e., purity or vividness, with lower saturation colours containing more grey) (Munsell, 1966; Valdez and Mehrabian, 1994). In the studies by Bellizzi, Crowley and Hasty (1983), Middlestadt (1990), Bellizzi and Hite (1992) and Crowley (1993) however, only vague verbal descriptions are reported with regard to the colour stimuli used. Moreover, only effects of hue have been investigated, but saturation and brightness have not been

controlled for. Effects of saturation or brightness have never been tested in a retailing context although these neglected colour dimensions may well be the major determining factors in colour effects on human feelings and behaviour (Valdez and Mehrabian, 1994; Gorn et al., 1997).

Nevertheless, a comprehensive review of the methodologies used in these previous studies and the findings obtained may be interesting to situate our own empirical study and will be presented next.

4.4.1. EMPIRICAL EVIDENCE PROVIDED BY BELLIZZI, CROWLEY AND HASTY (1983): “THE EFFECTS OF COLOUR IN STORE DESIGN”.

The first and most cited empirical study with respect to the impact of colour on retail shoppers was conducted by Bellizzi, Crowley and Hasty (1983). Their results suggest that colours can physically attract shoppers toward a retail display and that they may affect consumer perceptions of the store environment and merchandise carried.

A convenience sample of 125 female subjects, aged between 18 and 64, was randomly assigned to 5 colour conditions in a laboratory setting, in order to investigate whether the colour of a retail store display area affects approach orientation, physical attraction and store and merchandise image.

To bring the participants in the right frame of mind during *the first phase of the experiment*, each subject, consecutively, was handed a lightweight chair upon entering the experimental room, together with a distracting questionnaire related to shopping habits. Subjects were observed and photographed through a one-way mirror while filling out this initial questionnaire. For each colour condition, fabric panels in five experimental colours alternately covered the entire far wall of the experimental area. The five experimental colours used, were full strength hues taken from the “Color Vu Corporation Standard Color Chart”: Red (#1), Yellow (#57), Green (#161), Blue (#129) and White. The floor and other walls of the experiment room were covered in M/7 gray. Approach orientation was operationally defined as the direction the subjects faced in relation to the experimental far wall upon entering the experimental room. It was recorded where and how participants sat in relation to this coloured wall. This was recorded on a six-point scale with those directly facing the

coloured wall on the one extreme receiving a score of six and those facing the exact opposite direction on the other extreme receiving a score of zero. Subjects facing other directions were assigned scores from 1 to 5, depending on the angle with the experimental wall. In measuring approach orientation the authors were attempting to measure a construct linked to attention (i.e. the attention-grabbing quality of the colour). The physical attraction of the colour was defined as the linear distance that subjects sat from the experimental wall, measured in inches with a standard tape measure placed at a right angle of the experimental wall.

Although no relationship could be revealed between colour and approach orientation, colour was found to be associated with physical attraction (ANOVA, $p=.043$). Subjects participating in the experiment sat closest to the yellow wall and furthest from the green wall. Duncan's multiple-range test indicated that the distance that subjects sat from the yellow wall significantly differed from all the other treatments except for red. Warm (yellow, red) coloured walls were found to generate a stronger physical attraction on the subjects than cool (green, blue) coloured walls (t-test, $p=.02$). Colour preference and the interaction between colour treatment and colour preference were not significant. Subjects sat significantly closer to the warm walls regardless of colour preference.

Subsequently, in the *second phase of the experiment*, subjects were presented two slides projected on an 8-foot square screen on the near wall of the experimental room. The first slide depicted the front of a furniture store and the second one represented an architectural drawing of the interior of the store, with for each colour condition a different colour fabric placed underneath the slide, creating the effect of background colours. These background colours matched the colours of the far wall of the experimental room. A questionnaire, consisting of 20 7-point bipolar items, was administered to capture perceptions of the store environment and merchandize. The first thirteen of these items were taken from the "Judgements of Environmental Quality Scale" (Fisher, 1974), a scale designed to assess general perceptions of environmental quality. The remaining questions related to the subjects' perceptions of various aspects of the retail store and merchandise. Information on age, occupation and colour preference was also requested.

With regard to the influence of colour on perceptions of the retail environment and merchandise, seven of the twenty items were found to have a significant influence (at the .10 level). Duncan's multiple-range test indicated that the red store interior was seen as

significantly more colourful than the other store interiors. Yellow, blue, green and white interiors did not score significantly different on the drab/colourful scale, nor were warm colours considered more or less colourful than cool colours. With regard to the negative/positive scale, the red and the blue colour treatments significantly differed in their assigned scores: the red interior was seen as more negative, while the blue interior was judged to be more positive. More general, warm coloured interiors were judged more negative than cool coloured interiors. The red interior was also found to be more tense than the other treatments. The Duncan test also indicated that yellow was seen as more tense than blue, but not green, and that blue was found to be more relaxed than red and yellow. In general warm interiors were judged more tense than cool interiors. The red interior was also viewed as the brightest of all the interiors. In general warm interiors were judged to be brighter than cool interiors. Blue was found just as lively as red, while white was definitely judged less lively... In general warm coloured interiors were thought to carry more up-to-date merchandise than the cool coloured stores. In fact merchandise in the red store environment was rated as most up-to-date.

To summarize, certain perceptive differences were noted: warm colours, red in particular, were viewed as bright and colourful yet also as negative and tense. On the contrary cool colours, blue in particular, were rated as positive and relaxing. In general, cool coloured interiors were viewed as more attractive than warm coloured interiors and respondents also associated the cool coloured stores with a more pleasant shopping environment. There was no perceived difference between the colour treatments among perceptions of merchandise prices, merchandise quality and friendliness of store personnel.

After studying the colour-notations with regard to the individual items, the 20 items were also factor analysed using VARIMAX rotation, revealing three meaningful factors:

- (1) a non-evaluative “*activity*” dimension (i.e. unlively/lively, unmotivating/motivating, boring/stimulating, confer Osgood, Suci and Tannenbaum’s “activity aspect of meaning”, 1957).
- (2) an “*evaluation*” dimension (i.e. negative/positive, unattractive/attractive, tense/relaxed, uncomfortable/comfortable, bad/good and unpleasant/pleasant), confer Osgood, Suci and Tannenbaum’s “evaluative aspect of meaning”, 1957).
- (3) a price-quality dimension (i.e. low price/high price and low quality/high quality)

The red coloured store scored significantly higher on the activity dimension than the other treatments (Duncan's test). In general the warm coloured stores were perceived as significantly more active than the cool coloured stores. On the evaluative dimension, the blue coloured store received a significantly higher score than the stores in other colours (except for green and white). In general the cool coloured stores were rated significantly higher on the evaluation dimension than the warm coloured stores. No significant differences were found between the colour treatments on the price-quality dimension.

Thus warm colours, red in particular, appear to score high on an activity factor, but low on an evaluative factor. On the contrary cool colours, blue in particular, were rated as favourable on an evaluative factor and low on an activity factor. Colours used in the study did not affect price-quality perceptions.

According to the authors the most interesting finding of this study is that, regardless of colour preference, subjects appear to be physically drawn to warm colours; however they feel that warm-coloured environments are generally unpleasant. Subjects perceived red and warm coloured store environments as tense and negative, while cool coloured store environments were perceived as calm and positive. Therefore, it is suggested to use warm colours for display windows and a retail store's exterior design. Using red and other warm colours inside the retail store is discouraged, because customers may shorten their shopping time when in a tense, unpleasant environment and the shopping trip may even be reduced up to the point where purchase decisions are postponed. It is interesting to note that the colours used in the study did not affect perceptions of price nor quality of merchandize.

4.4.2. EMPIRICAL EVIDENCE PROVIDED BY MIDDLESTADT (1990):

"THE EFFECT OF BACKGROUND AND AMBIENT COLOUR ON PRODUCT ATTITUDES AND BELIEFS".

Following a more cognitive approach (Fishbein and Ajzen, 1975), arguing that attitudes, intentions and behaviours are determined by underlying beliefs and that change ultimately occurs by changing this cognitive structure, Middlestadt (1990) investigated the effects of blue and red background colours on product beliefs. In her study, Middlestadt (1990) does not focus on the effects of colour per se, but rather on the process by which colour produces

attitude change. She suggests that belief-based change processes may be responsible for some of the changes previously assumed to be affect-based.

84 female undergraduate students participated in this study. Subjects were, in groups of about 6 to 10, randomly assigned to one of two experimental conditions, red or blue. In each condition three products were subsequently presented: a bottle of perfume, a gold and silver pen and a bottle of mineral water, projected against either a red or blue background. Not only the background colour of the slides was manipulated, but also the surrounding (i.e. ambient) colour of the room. For this purpose additional lights in the slide-background colour (red or blue) were projected at the ceiling in the front of the room. No attempt was made to control the luminance of the projected light and it was not specified what exact hues were used, nor was there a control for saturation or brightness of the hues.

For each product, the attitude towards buying the products was assessed directly by means of six seven-point bipolar semantic differential items (e.g. buying the pen would be pleasant/unpleasant, enjoyable/unenjoyable, I like/I dislike, good/bad, wise/foolish, beneficial/harmful). The underlying cognitive structure was measured as recommended by Ajzen and Fishbein (1980). For each of eight salient consequences of performing the purchase behaviour, a belief item assessed the likelihood that this outcome would occur if the product was bought and an evaluation item assessed the evaluation of the outcome (i.e. each respondent indicated on a seven-point bipolar scale, how good or bad the outcome was).

No significant effects of the colour manipulations could be revealed on attitudes or beliefs with respect to two of the products, the perfume and the mineral water. In contrast, a significant effect was found of colour on the attitude towards buying the pen pictured in the slide. Respondents who were exposed to the pen with the blue background and ambient colour had a more positive attitude towards buying the product than those exposed to the pen with the red background and ambient colour. Over the six items, the multivariate F (Approx. $F(6, 77)=3.21$) was statistically significant at beyond the .01 level. For each of the individual items the relation was in the hypothesized direction, however, only for two of them (pleasant/unpleasant and enjoyable/unenjoyable) the mean difference was statistically significant at beyond the .01 level.

For the pen a difference in attitude towards buying the product was found between the two colour conditions. Middlestadt (1990) investigated whether this effect could be mediated by an effect on the underlying cognitive structure. For this reason the sum of the eight beliefs times evaluation was calculated, which provides an indirect assessment of attitude and represents the evaluative implications of the underlying cognitive structure. The correlations of this measure with the individual semantic differential items were all statistically significant ranging from .45 to .59. Also for this measure, those exposed to the pen in the blue condition were more positive towards buying the pen than those who were assigned the red condition ($F(1,82)=63.57$, significant at beyond the .01 level). This difference implies that the cognitive structure of those in the blue condition had significantly more positive evaluative implications than those in the red condition; i.e. they believed that buying the pen was likely to lead to positive outcomes and unlikely to lead to negative ones.

Concerning the effect of colour on beliefs and evaluations of individual outcomes, multivariate analyses of variance on the individual outcomes revealed a significant effect of colour over the eight beliefs (Approx. $F(8, 75)=3.14$) at beyond the .01 level, but no significant effect over the eight evaluations (Approx. $F(8, 75)=1.32$). The background and ambient colour appeared to have the strongest effect on two beliefs: the degree to which buying the pen was found to be something which is elegant and which is unique. Compared to those in the red condition, subjects in the blue condition believed it to be more likely that the pen was elegant as well as unique. With regard to the beliefs that buying the pen would mean buying something of good quality and something which has a pleasant colour, marginal, however not significant, colour effects were found in favour of the blue condition. Although not statistically significant, the pen presented in the blue condition was perceived as slightly more likely to be more expensive than the pen presented in the red condition.

To summarize, in this study, it was shown that background and ambient colour had an effect on the attitude towards buying a product. Respondents presented a slide with a pen against a blue background (with blue ambient colour) exhibited a more positive attitude towards buying the product than those who were shown the same pen against a red background (with red ambient colour). It was also demonstrated that subjects in the blue condition also held different beliefs about buying the product. Thus although background and ambient colour would seem, on the surface, to carry no product information, it was found to affect the underlying belief structure as well as the attitude towards the product.

Middlestadt (1990) attempted to determine how colour could produce this effect on product attitudes. Since the background colour does not explicitly convey any product information, it might be argued that the affect associated with the colour is directly transferred to the product and thus created a positive attitude. Middlestadt measured the underlying cognitive structure in detail and demonstrated that the colour affected the subject's beliefs about buying the product. Compared to subjects in the red condition, those who were exposed to the pen in the blue condition believed more strongly that buying the pen would lead to two positive outcomes: buying a pen which was elegant and which was unique. This difference in beliefs resulted in a cognitive structure that was more positive for those exposed to the pen against a blue background.

Thus it could be argued that the change in attitude toward buying the pen found in this study was caused by a belief-based change process. However, the data do not prove that a cognitive difference mediated the attitude and behaviour effects found. As argued by Gorn (1982), it is possible that the change in the beliefs occurred after and in justification of the change in attitude.

4.4.3. EMPIRICAL EVIDENCE PROVIDED BY BELLIZZI AND HITE (1992): “ENVIRONMENTAL COLOUR, CONSUMER FEELINGS AND PURCHASE LIKELIHOOD”.

Bellizzi and Hite (1992) tested the effects of red and blue in a shopping-related context. They selected red and blue because of their opposite colour properties. Two laboratory experiments were conducted to test hypotheses concerning the effects of colour to induce moods or feelings that subsequently may induce behaviour or behavioural intentions in a simulated purchase context. For both experiments retail environments were simulated using predominantly red or blue colours. In the first experiment a behavioural dependent measure was used. In the second experiment, in addition to the behavioural intention measure, several mood-related measures were included in order to identify the specific mood-states that may be induced by different colour environments.

Experiment 1:

During the course of the first experiment 70 female subjects were, one-by-one, exposed to one of two experimental conditions. Either a red or a blue retail environment was created, by

projecting five slides on 5-foot square screens, placed side by side along the wall of the experimental room. On the slides four different models of console televisions were depicted along with descriptions. The televisions were pictorially very similar, screen sizes and cabinets were the same for each set; however features and sizes were different. The fifth slide represented a no-purchase option. All the slides had either a red or a blue background, depending on the experimental condition. The colour stimuli used were Canson Paper – red #505 and Canson Paper – blue #595. The colours were clearly specified, however they were not controlled for saturation or brightness.

Subjects were told to assume that they had decided to buy a console (not big screen) model television and that they could start shopping in the experimental store. During this simulated shopping trip participants were asked to examine different televisions and to decide which one they would buy. To help them in their decision, a handout with descriptions of the T.V. features highlighted in the displays was given. Finally subjects had to indicate which television-set they would buy. In case they did not feel comfortable in selecting one of the television sets, assuming they had decided to buy one, subjects were also given a “no-buy” option, which would give them the possibility to shop around in another store before making a decision. The subjects were unobtrusively timed while shopping with an electronic stopwatch. After making their purchase selection, they were asked to complete a short questionnaire.

The effects of the red and blue displays on two dependent variables (purchase/non-purchase and shopping time) were examined. Based on the finding that blue is perceived as more positive, pleasant and calm (Bellizzi et al., 1983), it was assumed that a more positive, pleasant and calm environment would make shoppers feel more comfortable and, therefore more likely to make a purchase. With their first experiment Bellizzi and Hite (1992) found support for the hypothesis that the blue display would produce higher purchase rates (lower postponement rates) than the red display. A total of 39% of the shoppers in the red store postponed selection, compared to only 18% of the shoppers in the blue store (with χ^2 significant at the .05 level). During the simulated shopping trip, shoppers in the red store spent an average of 314\$, which was significantly less than the average spending of 458\$ in the blue store. The findings also revealed that the shoppers in the blue store selected the most expensive television set significantly more often, than shoppers in the red store. One half of the shoppers viewing the blue displays selected the most expensive set (\$599), compared to only 19% of the shoppers viewing the red displays (t-test, significant at the .01 level).

Because red was expected to be more distracting (Gerard, 1957) than blue and to increase task difficulty and anxiety, Bellizzi and Hite (1992) hypothesized that shopping time would be longer in the red display condition and shorter in the blue display condition (Jacobs & Suess, 1975; Goldstein, 1939; Smets, 1969). However, they found no support for this hypothesis. The colour treatment was not found to be significantly related to shopping time. Shoppers spent an average of 169 seconds in the red store as compared to 145 seconds in the blue store, which was in the hypothesized direction, however the difference was not significant. In retrospect, Bellizzi and Hite (1992) admitted that using time as an indicator of distraction may not have been appropriate. They suggest that an alternate hypothesis could be advanced which would link the comfort induced by the blue environment with increased shopping time. Indeed, Bellizzi, Crowley and Hasty (1983) suggested, based on their findings, that customers may shorten their shopping time when in a tense, unpleasant environment and discourage for this reason the use of red and other warm colours inside the retail store. Bellizzi and Hite (1992) suggest that although distraction may always be negative, arousal may be desired and only become negative at extreme levels. They suggest that future research should attempt to measure colour effects such as distraction and arousal more directly (rather than using shopping time as a proxy).

Experiment 2

107 graduate marketing students participated in the second experiment. Again two colour stimuli were utilized: subjects were randomly assigned to either a red or a blue colour condition. This time the stimulus involved the projection of an architectural drawing of the interior of a furniture store transferred on a transparency with coloured fabrics underneath, creating the effect of a background colour. The colours were full-strength hues taken from Color Vu Corporation Standard Colour Chart red (#1) and blue (#129). Note that they were not controlled for saturation nor brightness.

A questionnaire was administered containing three major sections. The first section assessed consumers' emotional state while in the store. Subjects were instructed to respond on how they would feel while they would be shopping in the store depicted on the slide. The measurement items included the semantic differential pleasure-arousal-dominance (PAD) measures of Mehrabian and Russell (1974) (as modified for retail environments by Donovan and Rossiter, 1982). The second section included the 8-item approach/avoidance (purchase) intentions used by Mehrabian and Russell (1974), as adapted by Donovan and Rossiter

(1982). The last section included a demographic item (subjects' gender), a shopping interest item and an item involving colour blindness.

Purchase intention, as measured by the approach/avoidance scale, was expected to be higher in the blue coloured store, than in the red coloured store, because both the arousal and negative evaluation properties of red, were expected to enhance anxiety and, therefore uneasiness with shopping in the red store environment. The blue environment was expected to produce more pleasurable as well as less arousing feelings. The dominance scale was administered in an exploratory fashion.

As expected, subjects in the blue environment expressed a greater intention to shop, browse and buy in the simulated store. Five out of the eight items in the approach-avoidance scale produced statistically significant results (at the .09 level or lower), favouring the blue environment. Moreover, all items generated results in the expected direction. An average score ($\alpha=.86$) (as used by Donovan and Rossiter, 1982), produced a significant result at the .045 level, indicating greater intention to approach in the blue store and to avoid in the red store.

With regard to the PAD scores, factor analysis with varimax rotation identified 4 factors: pleasure ($\alpha=.89$), arousal ($\alpha=.88$), dominance ($\alpha=.79$) and a freedom-of-movement factor (α not mentioned – explaining only 5.5% of the variance). Colour effects were observed on the pleasure dimension only and not on the arousal, dominance or freedom-of-movement dimensions. Respondents were found to report a more pleasant feeling in the blue store than in the red store ($p<.01$). Not only were more pleasurable scores reported for the blue environment, purchase intentions were also linked to more pleasurable feelings.

No gender difference with regard to approach-avoidance and the colour conditions could be revealed.

The results of experiments 1 and 2 clearly show more positive consumer reactions to blue. The use of blue displays, instead of red ones, appears to have a favourable effect on simulated purchases (experiment 1) and approach/avoidance behaviour (experiment 2). Arousal could not be identified as a possible causal link, since no effect of colour on arousal could be revealed for the two hues (blue and red) used in this study. Therefore, experiment 2 suggests

that colour-evoked pleasure is solely responsible for the outcome. The identification of an evaluative link (good/bad; negative/positive), was also reported by Bellizzi et al. (1983), who also concluded that consumers view red retail environments as more negative and unpleasant than blue ones. In contrast to the findings by Bellizzi and Hite (1992), Bellizzi et al. (1983), did find warm coloured store environments (red in particular) also to be more active or arousing than cool coloured store environments (such as blue).

The work of Bellizzi and Hite (1992) goes beyond that of Bellizzi et al. (1983) by demonstrating the impact on a behavioural consumer reaction, simulated purchase (experiment 1) and approach behaviour intentions (experiment 2). Bellizzi and Hite (1992, p361) notice that: *“marketing and retail managers should be aware that colour can have negative or positive marketplace implications that may affect not only mood or feelings, but also in-store behaviour”*.

Bellizzi and Hite (1992) warn, nevertheless, that because of the artificial laboratory environments used in both experiments, practical retail recommendations can be advanced only with great caution. Although in experiment 2 a different product was selected, a different set of stimuli was used and a separate sample was obtained, the results of this second experiment are consistent with those of experiment 1 and yield support for the overall conclusion regarding the positive effects of blue and the negative effects of red. Moreover, they also suggest an explanation for the findings. Still, Bellizzi and Hite (1992) call for further research into the area in order to develop an understanding of how colour may affect consumers. They also suggest to study the effects of other colours and other reds and blues.

4.4.4. EMPIRICAL EVIDENCE PROVIDED BY CROWLEY (1993): “THE TWO-DIMENSIONAL IMPACT OF COLOUR ON SHOPPING”

Crowley (1993) studied 100 females (age 18-64, convenience sample). For the testing conditions four fully saturated colours (i.e. pure colours, containing no black or white to dilute the colour) were used: blue, green, yellow and red. The colour of the stimulus was operationalized as the background colour of a furniture store (with the walls, floor and ceiling of the store depicted in the treatment colour). The furniture itself was neutral in colour. The questionnaire used to measure perceptions of the store environment and merchandise

consisted of twenty semantic differential items (cfr. Bellizzi et al., 1983). The first thirteen of these items were taken from the “Judgements of Environmental Quality Scale” (Fisher, 1974), a scale designed to assess general perceptions of environmental quality. The remaining questions related to the subject’s perceptions of various aspects of the retail store and merchandise.

To examine the existence of distinct components within consumer responses to the stimuli, the twenty semantic differential scales were subjected to principle components analysis using VARIMAX rotation, revealing two key factors:

- (1) a non-evaluative “*activation*” dimension (i.e. motivating, modern, colourful, stimulating, cheerful, lively and bright, with coefficient alpha = .85), explaining 23.1% of the total variance.
- (2) an “*evaluation*” dimension (i.e. positive, attractive, relaxed, comfortable, good and pleasant, with coefficient alpha = .91), explaining 22.2% of the total variance (confer Osgood, Suci and Tannenbaum’s “evaluative aspect of meaning” (bad/good, tense/relaxed, unpleasant/pleasant) (1957).

Thus in consumers’ ratings of the store environment two distinct dimensions were found: an activation and an evaluation dimension. These two dimensions have also been identified by Russell and Pratt (1980).

The hypothesis that consumer evaluations exhibit an increasingly positive linear trend from longer (warmer) to shorter (cooler) wavelengths was supported. Evaluations became steadily more positive as wavelength moved from red to blue.

Support was also found for the hypothesis that the activation dimension within consumers’ response to colour exhibits a U-shaped pattern across wavelengths. Retail store environments in the more extreme wavelength colours (red and blue) were perceived as more active environments.

The results of the study also indicate that colour can affect perceptions of the merchandise within the store environment. Perceptions of merchandise quality did not differ across the colour treatments, although these perceptions were significantly correlated with the composite ratings on the activation dimension ($r = -.41$, $p < .01$) and the evaluation dimension ($r = .38$,

$p < .01$). A linear trend in the treatment means was found for perceptions of merchandise style ($p < .05$) and merchandise price ($p < .10$), with merchandise in the red environment being perceived as most up-to-date and higher in price. Merchandise in the green environment was perceived as relatively outdated. Regarding merchandise selection, a quadratic trend in the means was found ($p = .08$), with the blue environment being the most effective for enhancing these perceptions. Thus, while perceptions of merchandise quality were not significantly impacted by store colour, other aspects of merchandise perceptions (such as style and price perceptions), appeared to be partially driven by the colour of the store environment.

A limitation of this study is that only 4 colours were tested from the visible spectrum, whereas the hypothesis implies a continuous function across the visible spectrum.

Crowley (1993) suggested that the activation dimension may be more relevant to impulse buying situations. He suggests that an activated consumer may be more likely to engage in impulse buying and that for this type of situation the more activating colours such as red and blue are most appropriate, while moderate wavelength colours such as green should be avoided. Crowley (1993) also suggested that for some consumer behaviour contexts, such as waiting in line, a lower level of activation may be more desirable. Crowley (1993) suggested that the evaluative dimension may be more relevant in other contexts. For example to obtain more positive responses to constructs such as attitude towards an advertisement, shorter wavelength colours, such as blue are likely to be most effective. Crowley (1993) suggested that in retail environments such as financial institutions, upscale jewelry stores and exclusive restaurants creating an evaluatively pleasing atmosphere is more important than activating the consumer.

Crowley (1993) described the two-dimensional impact of colour as a function of colour wavelength. The results of his study support that evaluative effects are most positive at the short wavelength (blue) end of the visible spectrum, while the activation response engendered by colour exhibits a U-shaped pattern across wavelengths.

Crowley (1993) encourages further research to develop our understanding of consumer response to colour in a wider variety of contexts.

4.4.5. OVERVIEW OF EMPIRICAL EVIDENCE

A comprehensive overview of the few studies on the impact of colour in a retail context is presented in the following tables.

Actually, store colour has not been found to affect price-quality perceptions (Bellizzi et al., 1983), however, warm-coloured interiors (especially red) were thought to carry more up-to-date merchandise than cool coloured interiors. Middlestadt (1990) also found no significant effects of ambient and background colour on attitudes or beliefs for perfume or mineral water. However, the attitude towards buying a pen did significantly differ when presented against a blue or a red background. Middlestadt (1990) found respondents exposed to a pen with a blue background and ambient colour to have a more positive attitude towards buying the product than those exposed to the pen with a red background and ambient colour. As opposed to respondents in the red condition, those in the blue condition believed that buying the pen was more likely to lead to positive outcomes (especially elegance and uniqueness) and less likely to lead to negative ones. Crowley's (1993) findings also indicate that colour can affect perceptions of the merchandise within the store environment, however, for merchandise quality no direct relationship with store colour was found. On the other hand, merchandise style and price perceptions did show an increasingly positive linear trend with increasing wavelengths. With regard to merchandise selection, a quadratic trend was found, with the blue environment being the most effective for enhancing these perceptions. Although Crowley (1993) could not discern a direct relationship between store colour and perceptions of merchandise quality, these perceptions appeared to be significantly correlated with an evaluation and activation dimension of judgements of environmental quality.

With regard to colour effects on actual approach behaviour, Bellizzi et al. (1983) found subjects to be physically drawn to warm colours, regardless of colour preference (Bellizzi et al., 1983). In contrast to cool colours, warm colours (red in particular) appeared to score high on an activity factor (Bellizzi et al., 1983). Confining their study to red and blue hues, Bellizzi and Hite (1992) however, did not observe a colour effect on the arousal dimension. Crowley (1993) eventually, found support for the hypothesis that the activation dimension within consumer's response to colour exhibits a U-shaped pattern across wavelengths. It has to be noted though, that in all of these studies fully saturated hues were used as stimuli, which were not controlled for brightness or saturation.

With concern to an evaluative factor, warm colours (red in particular) appear to score low, in contrast to the less activating cool colours, which appear to be more preferred (Bellizzi et al., 1983). Bellizzi and Hite (1992) also found that a blue store environment was found more pleasant than a red store environment. The hypothesis that consumer evaluations exhibit an increasingly positive linear trend from longer (warmer) to shorter (cooler) wavelengths was supported by Crowley (1993) as well.

In a first experiment, Bellizzi and Hite (1992) also found blue displays to produce higher purchase rates (lower postponement rates) than red displays. Moreover, shoppers in the blue store were found to spend on average significantly more than those in the red store and they were found to select the most expensive TV-set significantly more often. However, contrary to expectations they did not find the colour treatment to be significantly related to shopping time. In a second experiment, Bellizzi and Hite (1992) also found, as expected, that subjects in a blue environment expressed a greater intention to shop, browse and buy in a simulated store (i.e. they exhibited more approach behaviour). Moreover, in this follow-up study, they found purchase intentions to be linked to more pleasurable feelings, revealing an indirect effect of store colour on approach behaviour through colour-evoked feelings as well. Bellizzi and Hite (1992) observed only colour effects on the pleasure dimension, and not on the arousal or dominance dimensions. This could, however, be due to the fact that only two fully saturated hues (red and blue) were investigated.

From these initial studies it is clear that there are indeed apparent effects of store-colour on attitudes and beliefs, in-store emotions and shopping behaviour. Nevertheless, more research is needed to grasp these effects more clearly. It is obvious that the effects of more colours need to be investigated, taking into account not only hue effects, but also brightness and saturation effects, which have been ignored up until now, but appear to have a significant impact on the emotions elicited by colours (e.g. Valdez and Mehrabian, 1994; Gorn et al., 1997).

Table 4-1: Empirical evidence provided by Bellizzi, Crowley and Hasty (1983)

Empirical Study	Research Design	Sample	Colour Stimuli	DEPENDENT VARIABLES		Findings	
				Internal Responses			Approach Behaviour
				Emotions	Cognitions		
<p>Bellizzi, Crowley and Hasty (1983)</p> <p>“The effects of colour in store design”</p> <p><i>Journal of Retailing</i></p>	<p>Laboratory experiment:</p> <p><u>Experiment 1:</u> Manipulated wall colours in experimental area</p> <p><u>Experiment 2:</u> Manipulated background colours of projected furniture store interior</p>	<p>Convenience sample 125 females age 18-64</p>	<p>Four full strength hues and white:</p> <p>“<i>Color Vu Corporation Standard Color Chart</i>”:</p> <ul style="list-style-type: none"> - Red (#1) - Yellow (#57) - Green (#161) - Blue (#129) - White 	<p><u>Experiment 2:</u></p> <p>Semantic differential (cf. Osgood et al. 1957) 20 items</p> <p>(13 items from the ‘Judgements of environmental quality-scale’ – Fisher 1974)</p> <p>3 dimensions</p> <ul style="list-style-type: none"> - evaluation - activation - price/quality 	<p><u>Experiment 1:</u></p> <ul style="list-style-type: none"> - Approach orientation (i.e. attention) - Physical Attraction 	<p><u>Experiment 1:</u></p> <ul style="list-style-type: none"> - No relation between colour and attention/approach orientation - Subjects appear to be physically drawn to warm colours (regardless of colour preference) <p><u>Experiment 2:</u></p> <ul style="list-style-type: none"> - Warm colours (red in particular) appeared to score high on an activity factor, but low on an evaluative factor (i.e. tense and unpleasant) - Cool colours (blue in particular) appeared to score low on an activity factor, but high on an evaluative factor (i.e. relaxed and pleasant) - The colours used in the study did not affect price-quality perceptions, however warm coloured interiors (especially red) were thought to carry more up-to-date merchandise than cool coloured interiors. 	

Table 4-2: Empirical evidence provided by Middlestadt (1990)

Empirical Study	Research Design	Sample	Colour Stimuli	DEPENDENT VARIABLES		Approach Behaviour	Findings
				Internal Responses			
				Emotions	Cognitions		
<p>Middlestadt (1990)</p> <p>“The effect of background and ambient colour on product attitudes and beliefs”</p> <p><i>Advances in Consumer Research</i></p>	<p>Laboratory experiment: Manipulated ambient and background colours of product displays (perfume, pen and mineral water)</p>	<p>Convenience sample 84 female undergraduate students</p>	<p>- Red - Blue (not specified)</p>		<p>Underlying cognitive structure: beliefs (i.e. likelihood and evaluation of 8 salient consequences of buying the product) (cf. Fishbein and Ajzen, 1975)</p>	<p>Attitude towards buying the product (6-item semantic differential)</p>	<ul style="list-style-type: none"> - No significant effects of colour on attitudes or beliefs for perfume and mineral water - Respondents exposed to the pen with blue background and ambient colour had a more positive attitude towards buying the product than those exposed to the pen with the red background and ambient colour. - As opposed to respondents in the red condition, those in the blue condition believed that buying the pen was more likely to lead to positive outcomes (especially elegance and uniqueness) and less likely to lead to negative ones.

Table 4-3: Empirical evidence provided by Bellizzi and Hite (1992)

Empirical Study	Research Design	Sample	Colour Stimuli	DEPENDENT VARIABLES		Findings	
				Internal Responses			Approach Behaviour
				Emotions	Cognitions		
<p>Bellizzi and Hite (1992)</p> <p>“Environmental colour, consumer feelings and purchase likelihood”</p> <p><i>Psychology and Marketing</i></p>	<p>Laboratory experiment:</p> <p><u>Experiment 1</u> Manipulated background colours of television displays in a simulated store</p> <p><u>Experiment 2</u> Manipulated background colours of projected furniture store interior (cfr. Bellizzi et al., 1983)</p>	<p><u>Experiment 1</u> Convenience sample 70 females age 18+</p> <p><u>Experiment 2</u> Convenience sample 107 graduate marketing students</p>	<p>Two hues: brightness and saturation not controlled</p> <p><u>Experiment 1</u></p> <ul style="list-style-type: none"> - Red (Canson Paper – red #505) - Blue (Canson Paper – blue #595) <p><u>Experiment 2</u> “Color Vu Corporation Standard Color Chart”:</p> <ul style="list-style-type: none"> - Red (#1) - Blue(#129) 	<p><u>Experiment 2</u> Emotions: PAD (Pleasure-Arousal-Dominance) emotion scale (Mehrabian and Russell, 1974; Donovan and Rossiter, 1982)</p>	<p><u>Experiment 1</u> Shopping behaviour</p> <ul style="list-style-type: none"> - Purchase behaviour - Shopping time <p><u>Experiment 2</u> Approach/avoidance purchase intentions 8 items (cfr Donovan and Rossiter, 1982)</p>	<p><u>Experiment 1</u></p> <ul style="list-style-type: none"> - The blue displays were found to produce higher purchase rates (lower postponement rates) than the red displays - Shoppers in the blue store spent on average significantly more than those in the red store and they were found to select the most expensive TV-set significantly more often - The colour treatment was not found to be significantly related to shopping time <p><u>Experiment 2</u></p> <ul style="list-style-type: none"> - As expected, subjects in the blue environment expressed a greater intention to shop, browse and buy in the simulated store (i.e. they exhibited more approach behaviour) - Colour effects were observed on the pleasure dimension only, and not on the arousal or dominance dimensions - The blue store environment was found to be more pleasurable than the red store environment - Purchase intentions were linked to more pleasurable feelings 	

Table 4-4: Empirical evidence provided by Crowley (1993)

Empirical Study	Research Design	Sample	Colour Stimuli	DEPENDENT VARIABLES		Approach Behaviour	Findings
				Internal Responses			
				Emotions	Cognitions		
<p>Crowley (1993)</p> <p>“The two-dimensional impact of colour on shopping”</p> <p><i>Marketing Letters</i></p>	<p>Manipulated background colours of projected furniture store interior</p>	<p>Convenience sample 100 females age 18-64</p>	<p>Four fully saturated hues:</p> <ul style="list-style-type: none"> - Blue - Green - Yellow - Red <p>Not specified, brightness and saturation not controlled</p>	<p>Semantic differential (cf. Osgood et al. 1957) 20 items</p> <p>(13 items from the ‘Judgements of environmental quality-scale’ – Fisher 1974)</p> <p>2 dimensions</p> <ul style="list-style-type: none"> - evaluation - activation <p>(cf. Russel and Pratt, 1980)</p>	<p>Perceptions of merchandize</p> <ul style="list-style-type: none"> - quality - style - price - selection 		<ul style="list-style-type: none"> - The hypothesis that consumer evaluations exhibit an increasingly positive linear trend from longer (warmer) to shorter (cooler) wavelengths was supported. - Support was also found for the hypothesis that the activation dimension within consumer’s response to colour exhibits a U-shaped pattern across wavelengths. - The results of the study also indicate that colour can affect perceptions of the merchandize within the store environment. (In particular merchandize style and price perceptions show an increasingly positive linear trend with increasing wavelength. For merchandize quality no direct relationship with store colour was found, however merchandize quality perceptions were significantly correlated with the evaluation and activation dimensions. With regard to merchandize selection, a quadratic trend was found, with the blue environment being the most effective for enhancing these perceptions)

4.5. THE INFLUENCE OF COLOUR IN THE STORE ENVIRONMENT: RESEARCH MODEL

To investigate the influence of colour in the store environment, an environmental psychology approach will be applied. As the first level of response to an environment is generally accepted to be affective (Ittelson, 1973, p16), we will, more specifically, apply the classic ‘emotional’ approach of environmental psychology, which is based on the fundamental premise that emotions elicited by the environment determine human behaviour (Mehrabian, 1978, p14).

Mehrabian and Russell (1974) explored such an emotional theory of environmental psychology. According to this theory, an environment evokes primary emotional reactions, which as intervening variables, determine approach or avoidance reactions to that environment. Our research will be based upon this particular Stimulus-Organism-Response model, which was first applied to the study of store atmosphere by Donovan and Rossiter (1982), and has been adopted by many other atmospheric researchers since (e.g. Donovan et al., 1994; Van Kenhove and Desrumaux, 1997; Sherman, Mathur and Smith, 1997; Tai and Fung, 1997; Gröppel-Klein, 1998; McGoldrick and Pieros, 1998; Matilla and Wirtz, 2001; Sweeney and Wyber, 2002; ...). Based on this model, various atmospheric variables have been found to influence a wide variety of consumer evaluations and behaviours (see Turley and Milliman, 2000 for a review).

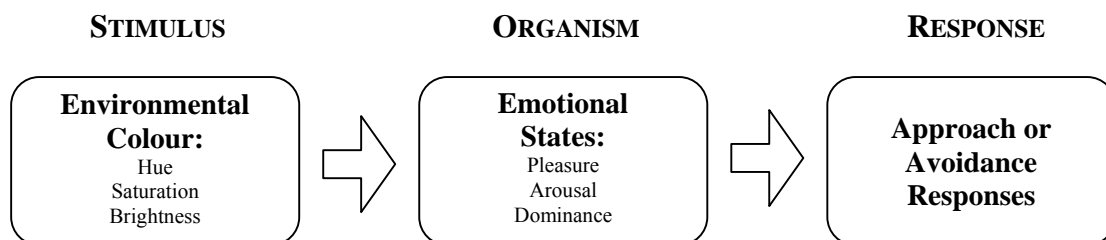


Figure 4-1: An environmental psychology approach to the study of colour in the store environment

Source: Model based on Mehrabian & Russell, 1974

With regard to the environmental stimulus (S), the specific effects of colour hue, saturation and brightness in the store design will be investigated. In particular the latter two of these colour dimensions have been totally ignored in previous studies on the effects of colour in a retail context. Worse, they have not even been controlled for, thus confounding the effects of the disparate colour attributes. As far as the internal responses in the organism (O) are concerned, we will focus on the feelings of pleasure, arousal and dominance, evoked by the store colour (e.g. Donovan and Rossiter, 1982). The responses (R) we are interested in, involve approach and/or avoidance intentions with regard to the store.

Thus, applying this model (illustrated in figure 4-1), the proposed study aims to assess (1) the direct effect of colour in the store environment on the emotions experienced in the store (notably pleasure, arousal and dominance) and (2) the direct and indirect effect of colour on consumers' approach/avoidance behaviour through the store-colour evoked emotions.

The specific hypotheses, generated from the literature review, will be presented in the following paragraph.

4.6. THE INFLUENCE OF COLOUR IN THE STORE ENVIRONMENT: HYPOTHESES

4.6.1. STORE COLOUR-EVOKED PLEASURE

With regard to the effect of store colour on feelings of pleasure, three hypotheses are abstracted from our review of the literature on colour effects, one in relation to each of the three colour attributes: hue, brightness and saturation. Whereas the hypothesis concerning the effect of colour-hue could be based upon the initial empirical findings in a retail context, for brightness and saturation effects we had to rely on the available research based on laboratory experiments with colour patches, because these colour-attributes have been ignored in studies on the impact of colour in the store environment.

4.6.1.1. Store Colour Hue

H1: A negative U-shaped relationship is hypothesized between store-colour wavelength and store-elicited pleasure, with the stores with extreme long wavelength colours (red) expected to be judged less pleasant than the stores with extreme short wavelength colours (blue) and the mid-wavelength colours (yellow-green) at the bottom of the U, being judged least pleasant.

Although it is obvious that a lot of the early studies on the effects of hue on pleasure are methodologically flawed -confounding brightness and saturation effects with the effects of colour hue- there appears to be some consistency in the findings. Extreme short wavelength colours (blue, green) seem to be generally preferred, followed by the extreme long wavelength colour red. Yellow-green, yellow and orange appear to be generally disliked (Walton, Guilford and Guilford, 1933; Guilford, 1934; Eysenck, 1941; Wexner, 1954; Granger, 1955; Guilford and Smith, 1959; Helson and Lansford, 1970; Hopson, Cogan and Batson, 1971; Adams and Osgood, 1973; Sivik, 1974a, 1975; Mehrabian and Russell, 1974;

Jacobs and Suess, 1975; Madden et al., 2000). Thus, pleasure-displeasure reactions to spectral colours appear to approximate a U-shaped function of wavelength, with yellows (green-yellow, yellow and red-yellow) at the bottom portion of the U (Valdez and Mehrabian, 1994).

Nevertheless, Osgood et al. (1957), suggest that an acceptable colour is defined by the object with which it is associated. Studying selected colours in the context of objects, they found yellow to be rated as the “most favourable” colour, which is in contrast with the general finding from using colour patches, that yellow is mostly disliked.

In a store context, a simple negative relationship has been revealed between colour wavelength and colour preference. Warm colours (red in particular) have been found to score low on an evaluative factor, in contrast to the less activating cool colours, which appear to be more preferred (Bellizzi et al., 1983). Bellizzi and Hite (1992) found that a blue store environment was found more pleasant than a red store environment and the hypothesis that consumer evaluations exhibit an increasingly positive linear trend from longer (warmer) to shorter (cooler) wavelengths was supported by Crowley (1993) as well. Nevertheless, in these studies only fully saturated hues have been examined, without controlling for brightness or saturation levels. Moreover, the studies have been confined to examining the effects of two to four hues at the most. Therefore, these findings may not be very reliable, confounding hue effects with saturation and brightness effects.

Based on previous research, by Valdez and Mehrabian (1994) in particular, we propose a negative U-shaped relationship between store-colour wavelength and store-elicited pleasure, with the stores with extreme long wavelength colours (red) expected to be judged less pleasant than the stores with extreme short wavelength colours (blue) and the mid-wavelength colours (yellow-green) at the bottom of the U, being judged least pleasant.

4.6.1.2. Store Colour Brightness

H2: Store colour value is expected to have a positive effect on store-elicited pleasure, with higher value coloured or brighter stores expected to be judged more pleasant than the lower value coloured or darker stores.

There appears to be a general consensus in the literature that lighter colours seem to be preferred over darker ones (Washburn, 1911; Guilford, 1934; Guilford and Smith, 1959, Adams and Osgood, 1973; Sivik, 1974a; 1975; Valdez and Mehrabian, 1994). Guilford and Smith (1959) and Sivik (1974a, 1975) demonstrated the complexity of the relationship between the three dimensions of colour as they relate to pleasantness, but they also noted that as brightness increased, perceived pleasantness also increased, which appeared to be a consistent finding, across all hues. In contrast to Guilford and Smith (1959), who found the positive relationship tending to be curvilinear, Valdez and Mehrabian (1994) found no second-order curvilinear relationship between colour brightness and the elicited pleasure. Examining the contribution of colour brightness to perceived pleasantness in greater detail, Smets (1982) found brightness, as compared to saturation, to account for only a small amount of induced pleasure variance, whereas Valdez and Mehrabian (1994) found the effect of brightness to be considerably stronger than the effect of saturation in determining pleasure responses to colour. In contrast to these findings on general colour effects, Gorn et al. (1997) did not find support for the hypothesis that lower value, darker colours generate more unpleasant feelings when manipulating the colour of a big “swoosh” in the centre of an ad (confining their study to red and blue hues).

Nevertheless, based on our review of the literature on general colour effects, we hypothesize store colour value to have a positive effect on store-elicited pleasure, with higher value coloured or brighter stores expected to be judged more pleasant than the lower value coloured or darker stores.

4.6.1.3. Store Colour Saturation

H3: Store colour saturation is expected to have a positive effect on store-elicited pleasure, with more saturated coloured stores expected to be judged more pleasant than the less saturated coloured stores.

With regard to the contribution of colour saturation to evoked pleasure, the literature is rather straight forward : saturated colours have systematically been found to be preferred over unsaturated ones (Washburn, 1911; Guilford, 1934; Granger, 1955; Guilford and Smith, 1959; Valdez and Mehrabian, 1994). Granger (1955) noted that as saturation increased, so did preference, but only up to a certain point. He found colours seen as too vivid to be less preferred. Guilford and Smith (1959) also found that the greater the saturation within a given hue, the greater its perceived pleasantness appeared to be, with the relationship tending to be curvilinear. In contrast, Valdez and Mehrabian (1994) did not find support for a second-order curvilinear relationship between colour saturation and the elicited pleasure. Examining the contribution of colour saturation to perceived pleasantness in greater detail, Smets (1982) found saturation, as compared to brightness, to account for most of the induced pleasure variance. In contrast, Valdez and Mehrabian (1994) found the effect of saturation to be considerably weaker than the effect of brightness in determining pleasure responses to colour. Conform to these findings on general colour effects, Gorn et al. (1997) found that respondents exposed to ads containing higher chroma colours reported a greater liking for the ad, and that this effect was mediated by greater feelings of excitement experienced, which besides high arousal also involves pleasant feelings.

Thus, based on our review of the literature, we hypothesize store colour saturation to have a positive effect on store-elicited pleasure, with more saturated coloured stores expected to be judged more pleasant than the less saturated coloured stores.

4.6.2. STORE COLOUR-EVOKED AROUSAL

It has been widely accepted that people's feelings are affected by colour. In particular, colour is believed to affect the degree of felt arousal (e.g., Walters et al., 1982; Mikellides, 1990). From the results of early studies, various authors cite support for the premise that certain colours have the capacity to excite and arouse an individual, while others have a calming and relaxing effect. In an attempt to better understand the effect of colour on human behaviour, prior research has examined both arousal perception (i.e., how active a stimulus is perceived to be), as well as the actual physiological arousal engendered by exposure to various colours. In the consumer behaviour literature, colour arousal effects have only recently been addressed (Crowley, 1993; Gorn, 1997). With regard to the effect of store colour on arousal, three hypotheses are abstracted from our review of the literature on colour effects, one in relation to each of the three colour attributes: hue, brightness and saturation. Whereas the hypothesis concerning the effect of colour-hue could be based upon the initial empirical findings in a retail context, for brightness and saturation effects we had to rely on the available research based on laboratory experiments with colour patches, because these colour-attributes have been ignored in studies on the impact of colour in the store environment.

4.6.2.1. Store Colour Hue

H4: A positive U-shaped relationship is hypothesized between store-colour wavelength and store-induced arousal with the stores with extreme long wavelength colours (red) expected to be judged more arousing than the stores with extreme short wavelength colours (blue) and the mid-wavelength colours (green-yellow) at the bottom of the U, being judged least arousing.

With regard to the effect of colour hue on saturation, a great deal of inconsistency exists in the literature, arising from incomplete operational definitions of the stimulus conditions and the multifaceted nature of response measures defined as arousal (Kaiser, 1984; Beach et al., 1988; Valdez and Mehrabian, 1994).

The hypothesis that long-wavelength colours (e.g., red and yellow) are more arousing than short wavelength colours (e.g., blue and green) (Goldstein, 1942; Gerard, 1958, 1959; Ali, 1972) has been very persistent in the literature, despite the fact that numerous studies involving physiological reactions to arousal could not confirm this contention (Erwin, Lerner, Wilson and Wilson, 1961; Jacobs and Hustmyer, 1974; Caldwell and Jones, 1985; Kuller, 1985; Etnier and Hardy, 1997). Studies using semantic differential scales to capture “perceptions of arousal”, have more systematically found excitement and activity to be related to the hue dimension, with red and yellow generally seen as active, stimulating and exciting, while green, violet and blue are perceived to be passive, relaxing, soothing and calm (Wexner, 1954; Osgood et al., 1957 Wright and Rainwater, 1962; Aaronson, 1970; Adams and Osgood, 1973; Sharpe, 1974; Jacobs and Suess, 1975; Porter and Mikellides, 1976a; Birren, 1978; Walters et al., 1982; Madden et al., 2000).

Following a Darwinian logic, on the other hand, Wilson (1966) posited a U-shaped relationship between colour wavelength and arousal effects, predicting that the colours with more extreme wavelengths are the most activating, a contention that also has received some support (Erwin, Lerner, Wilson and Wilson, 1961; Wilson, 1966; Nourse and Welch, 1971).

However, contradicting the long-held stereotype that warm colours are exciting, while cool colours are calming, Sivik (1974a, 1975) concluded on the basis of his comprehensive study, that no difference is exhibited between hues with equal chromaticness on the excitement factor. Sivik hypothesizes that the reason why red and yellow have generally been labelled as exciting, might be attributed to the fact that pure, saturated reds and yellows are more prevalent than pure and highly saturated greens and blues. Likewise, Valdez and Mehrabian (1994, Study 2) could not support the hypothesis that long-wavelength hues are more arousing than short wavelength hues either. Conducting a very systematic and comprehensive study, they found the mean arousal level for green-yellow to be significantly greater than the mean arousal levels for purple-blue, yellow-red and red-purple and the mean arousal level for blue-green to be significantly greater than the mean arousal level for purple-blue. A regression analysis to test for a possible significant parabolic inverted-U shaped relationship of arousal to wavelength (note that this is the opposite of Wilson’s 1966 contention), revealed no significant effect either. The obtained results, relating hue and arousal, were generally weak and non-significant. The only noteworthy generalization is that, unexpectedly, the green hues

(green-yellow, blue-green, and green) seem to elicit the highest arousal reactions from subjects. Gorn et al. (1997) conclude from their study with regard to the effects of colour in advertising, that when used as an executional cue in an ad, the hue (red vs. blue) of a colour at best has modest effects on feelings of arousal.

Thus, studies using both approaches (physiological responses and perceptions of arousal) have found that certain colours, are indeed more activating than other colours (e.g. Nakshian, 1964; Clynes and Kohn, 1968; Sallis and Buckalew, 1984; Jacobs and Nordan, 1979, see Crowley, 1993). However there is a lot of inconsistency in the findings as to what colours are more and less arousing and whether there is indeed a relationship between colour wavelength and its arousal eliciting quality.

In a retail context, Bellizzi et al. (1983) found that warm colours (red in particular) appeared to score high on an activity factor, in contrast to cool colors. Confining their study to red and blue hues, Bellizzi and Hite (1992) however, did not observe a colour effect on the arousal dimension. Crowley (1993) eventually, found support for the hypothesis that the activation dimension within consumer's response to colour exhibits a U-shaped pattern across wavelengths. It has to be noted though, that in all of these studies fully saturated hues were used as stimuli, which were not controlled for brightness or saturation.

Based on this review of the literature, it is not entirely clear what can be expected with regard to the effect of colour hue on arousal. In accordance with Crowley (1993) (see also Erwin, Lerner, Wilson and Wilson, 1961; Wilson, 1966; Nourse and Welch, 1971), a positive U-shaped relationship is hypothesized between store-colour wavelength and store-induced arousal with the stores with extreme long wavelength colours (red) expected to be judged more arousing than the stores with extreme short wavelength colours (blue) and the mid-wavelength colours (yellow-green) at the bottom of the U, being judged least arousing.

4.6.2.2. Store Colour Brightness

H5: Store colour value is expected to have a negative effect on store-induced arousal, with higher value coloured or brighter stores expected to be judged less arousing than the lower value coloured or darker stores.

The effect of colour brightness on arousal was originally unclear. None of the studies dealing with physiological reactions to colour have investigated these reactions in relation to colour brightness levels. Earlier studies, based on semantic differential ratings, seemed to indicate that arousal is a positive correlate of colour brightness (Wright and Rainwater, 1962; Profusek and Rainey, 1987). More recent studies, however, found exactly the opposite to be true (Valdez and Mehrabian, 1994 - Study 1; Gorn et al., 1997). Indeed, conducting a very comprehensive and systematic study, Valdez and Mehrabian (1994) revealed a negative relationship between colour brightness and induced arousal, indicating that less bright (i.e. darker) colours induce greater feelings of arousal in viewers. From this study, the effect of brightness appears to be considerably weaker than the effect of saturation in determining arousal responses to colour. Furthermore, Valdez and Mehrabian (1994) also found a second-order curvilinear relationship between colour brightness and the elicited arousal. Arousal declined steeply and monotonically with increasing brightness up to a brightness value of 43, beyond which arousal reversed and increased slightly for the highest brightness values. In other words, arousal appears to decrease as colours range from dark to light, but this trend is slightly reversed for the lightest colours. In agreement with the results obtained by Valdez and Mehrabian (1994), Gorn et al. (1997) also found support for the hypothesis that lighter, higher value colours are more relaxing than lower value, darker colours. Using a two-dimensional view on arousal, they found that those exposed to ads containing higher value colours (for red and blue hues) reported experiencing greater feelings of relaxation, but no difference in the level of felt excitement.

Based on our review of the literature and more in particular in accordance to the more recent findings by Valdez and Mehrabian (1994) and Gorn et al. (1997), we hypothesize store colour value to have a negative effect on store-induced arousal, with higher value coloured or

brighter stores expected to be judged less arousing than the lower value coloured or darker stores.

4.6.2.3. Store Colour Saturation

H6: Store colour saturation is expected to have a positive effect on store-induced arousal, with more saturated coloured stores expected to be judged more arousing than the less saturated coloured stores.

Although none of the studies dealing with physiological reactions to colour have investigated these reactions in relation to colour saturation levels, studies based on semantic differential ratings generally suggest that arousal is a positive correlate of colour saturation, with more saturated (more vivid and purer) colours evoking greater feelings of arousal (Wright and Rainwater, 1962; Hogg, 1969; Adams and Osgood, 1973; Sivik, 1974a, 1975; Valdez and Mehrabian, 1994). Valdez and Mehrabian (1994, Study 1) found a colour's saturation level to explain a substantial portion of the variance in the feelings of arousal it induces, in viewers and noticed the effect of saturation to be considerably stronger than the effect of brightness in determining arousal responses to colour (almost twice the magnitude). Consistent with these findings, Gorn et al. (1997) also found support for the hypothesis that ads with higher chroma colours induce greater feelings of excitement.

Based on a thorough review of the literature with regard to colour saturation effects, we hypothesize this contention to hold also in a store environment, with store colour saturation to have a positive effect on store-induced arousal, with more saturated coloured stores expected to be judged more arousing than the less saturated coloured stores.

4.6.3. STORE COLOUR-EVOKED DOMINANCE

With regard to the effect of store colour on feelings of dominance, three hypotheses are abstracted from our review of the literature on colour effects, one in relation to each of the three colour attributes: hue, brightness and saturation. We had to rely on the available research based on laboratory experiments with colour patches, because dominance effects have been largely ignored in studies on the impact of colour in the store environment. Dominance is a dimension of emotional response that has often been ignored by colour researchers as well. Nevertheless, colour researchers have found colour to elicit emotional responses that cannot be captured by pleasure or arousal dimensions, but seem to infer a dimension of dominance or potency (e.g. Osgood et al., 1957; Adams and Osgood, 1973; Sivik, 1974a; Valdez and Mehrabian, 1994), which is in line with the Pleasure-Arousal-Dominance Model of Emotions proposed by Mehrabian and Russell (1974) (see also Mehrabian, 1995; 1996).

4.6.3.1. Store Colour Hue

H7: An inverted U-shaped relationship is hypothesized between store-colour wavelength and store-elicited dominance, with the stores with mid-wavelength colours (Yellow-Green) expected to elicit most dominance and extreme short or long wavelength coloured stores eliciting less dominance.

Previous studies with regard to the effect of colour-hue on the dominance induced in viewers appear to demonstrate that empirical findings are inconsistent. Not using actual colour stimuli but colour names, Adams and Osgood (1973) found yellow to be rated as weak. Birren (1978) and Sharpe (1974) found green to be associated with withdrawal. In contrast they both found red to be rated as strong and associated with aggression (Adams and Osgood, 1973; Birren, 1978 and Sharpe, 1974). Although the results concerning the impact of colour-hue on dominance, obtained by Valdez and Mehrabian (1994), were generally weak and non-significant, they suggest the exact opposite. According to their findings, middle-wavelength

hues appear to elicit more feelings of dominance in viewers than either the extreme short or long wavelength hues. A plausible explanation for this inconsistency in the findings may be the failure of the earlier colour-studies to provide adequate specifications or controls of colour stimuli (i.e., absence of controls for saturation and brightness, while investigating effects of hue). Another possible explanation for these contrasting findings could also be that colours that are rated as weak elicit feelings of dominance in viewers and vice versa (colours that are rated as strong might elicit feelings of submissiveness). However, further research is needed to find out if this actually is the case.

In a store-context, Bellizzi and Hite (1992) observed no colour effects on the dominance dimension. This could, however, be due to the fact that only two fully saturated hues (red and blue) were investigated.

Nevertheless, based on our review of the literature on general colour effects, and on the research by Valdez and Mehrabian (1994) in particular, we hypothesize an inverted U-shaped relationship between store-colour wavelength and store-elicited dominance, with the stores with mid-wavelength colours (Yellow-Green) expected to elicit most dominance and extreme short or long wavelength coloured stores eliciting less dominance.

4.6.3.2. Store Colour Brightness

H8: Store colour value is expected to have a negative effect on store-induced feelings of dominance, with higher value coloured or brighter stores expected to be judged less dominant than the lower value coloured or darker stores.

On the effects of colour brightness on feelings of dominance, there is general consensus in the literature: dominance appears to be a negative correlate of brightness (Adams and Osgood, 1973; Sivik, 1974a, 1975; Damhorst and Read, 1986; Valdez and Mehrabian, 1994). Indeed, less bright (i.e. darker) colours have been found to induce greater feelings of dominance.

Nevertheless, Sivik (1974a, 1975) notes that the extent of its effect seems to vary across hues, revealing a complex interaction among the colour attributes. Valdez and Mehrabian (1994) found the effect of brightness to be considerably stronger than the effect of saturation in determining dominance responses to colour. Furthermore, Valdez and Mehrabian (1994) found a second-order curvilinear relationship between colour brightness and the elicited dominance. Dominance appeared to decline steeply and monotonically with increasing brightness up to a brightness value of 43, beyond which dominance levels off. In other words, dominance appears to decrease as colours range from dark to light, but levels off for the lightest colours.

Based on our review of the available literature, we hypothesize store colour value to have a negative effect on store-induced feelings of dominance, with higher value coloured or brighter stores expected to be judged less dominant than the lower value coloured or darker stores.

4.6.3.3. Store Colour Saturation

H9: Store colour saturation is expected to have a positive effect on store-elicited dominance, with more saturated coloured stores expected to be judged more dominant than the less saturated coloured stores.

Concerning the effect of colour saturation on dominance, empirical findings reveal consistent results. Potency was found to be directly dependent upon a colour's saturation (Osgood et al., 1957; Hogg, 1969). Although Sivik (1974a, 1975) also found that as chromaticness increased, so did perceived potency, he found this not to be true for yellow, revealing a complex interaction between the colour attributes for the potency dimension as well. Valdez and Mehrabian (1994) also found support for the hypothesis that dominance is a positive correlate of saturation. Apparently, more saturated (more vivid and purer) colours appear to elicit greater feelings of dominance, strength or boldness in viewers. Although they found that a colour's brightness and saturation levels appear to explain a substantial portion of the

variance in the feelings of dominance it induces, a regression analyses indicates the effect of saturation to be considerably weaker than the effect of brightness.

Based on our review of the available literature, we hypothesize store colour saturation to have a positive effect on store-elicited dominance, with more saturated coloured stores expected to be judged more dominant than the less saturated coloured stores.

4.6.4. THE IMPACT OF STORE-COLOUR-EVOKED EMOTIONS ON APPROACH/AVOIDANCE BEHAVIOURS

H10: Approach intentions towards a store are positively related with the pleasure elicited by the store.

H11: Avoidance intentions towards a store are negatively related with the pleasure elicited by the store.

In line with previous findings in a retailing context (Donovan and Rossiter, 1982; Baker, Levy and Grewal, 1992; Sherman et al., 1997; Obermiller and Bitner, 1984; Donovan et al., 1994; Hui and Bateson, 1991; Chebat et al., 1995; Van Kenhove and Desrumaux, 1997), we hypothesize approach intentions towards the store to be positively related with the pleasure elicited by the store. With regard to avoidance, we expect the relationship to be reversed (cfr. Foxall, 1997).

H12: Approach intentions towards a store are positively related with the arousal induced by the store (for pleasant stores).

H13: Avoidance intentions towards a store are not (or negatively) related with the arousal induced by the store.

In line with Mehrabian and Russell (1974) and Russell and Mehrabian (1976), we expect approach intentions towards a store to be positively related with the arousal induced by the store (for pleasant stores). Support for this proposition in a retailing context has been found in earlier studies (Donovan and Rossiter, 1982; Holbrook and Gardner, 1993; Sherman et al., 1997; Van Kenhove and Desrumaux, 1997). According to the presumed pleasure-arousal interaction effect, we should expect the inverse in the case of unpleasant stores. However, few support for this part of the relationship has been found (Holbrook and Gardner, 1993; Donovan et al., 1994)

With regard to the effect of store-evoked arousal on avoidance behaviour, we expect the inverse, however, considering Foxall's (1997) finding that approach and avoidance are not simply opposites and that arousal exerts an independent influence on both, we could argue to find no relationship between arousal and avoidance, as he did.

H14: Approach intentions towards a store are positively related with the dominance elicited by the store.

H15: Avoidance intentions towards a store are not (or negatively) related with the dominance elicited by the store.

Although Donovan and Rossiter (1982), Yalch and Spangenberg (1988) and Greenland and McGoldrick (1994) could not find an important role for dominance in shaping in-store behaviour, Foxall (1997), Foxall and Greenley (1999) and Turley and Milliman (2000) argue that the findings with regard to dominance may be context specific and depending on the independent (store) environmental variables investigated. Babin and Darden (1995) suggest that the lack of findings associated with dominance in previous studies involving retail store environments may also be due to the moderating impact of personality. Based on their findings, Babin and Darden (1995, p61) emphasize that “*rather than dismissing dominance, as some studies have done, future theory development should include dominance as an important emotion influencing shopping behaviour*”. Also Gröppel-Klein (1998) points to the possible importance of the dominance factor.

As feelings of dominance have been demonstrated to be evoked by colour (Valdez and Mehrabian, 1994; Osgood, et al., 1957; Adams and Osgood, 1973; Sivik, 1974), we assume that store-colour-elicited dominance can potentially influence approach/avoidance behaviours towards the store. As originally suggested by Mehrabian and Russell (1974) and Proshansky, Ittelson and Rivlin (1974), we hypothesize approach intentions towards a store to be positively related with the dominance elicited by the store.

With regard to the effect of store-evoked feelings of dominance on avoidance behaviour, we expect the inverse, however, considering Foxall’s (1997) finding that approach and avoidance are not simply opposites and that dominance exerts an independent influence on both, we could argue to find no relationship between dominance and avoidance, as he did.

4.7. THE MODERATING ROLE OF DEMOGRAPHIC CHARACTERISTICS

It has been generally acknowledged that the physical environment interacts with characteristics of individuals to determine their response (Turley and Milliman, 2000). Therefore, an atmosphere that produces a certain response in one individual or group at a given point in time may produce an entirely different response in another individual or group (Bitner, 1992; Turley and Milliman, 2000). Indeed, different people can have different emotional reactions to the same event or circumstance (Bagozzi, Gopinath and Nyer, 1999). Bitner (1992, p64) included personal characteristics in her conceptual 'servicescape'¹⁹ framework as 'response moderators', which may alter the strength and direction of relationships among environmental response variables. Nevertheless, relatively little attention has been given to the effect of personal characteristics on the relationships between store-evoked emotions and their outcomes (Dawson et al., 1990; Babin and Darden, 1995). Although personal characteristics may be important moderators of colour effects as well, up until now, most studies have examined colour effects also only at the aggregate level (Crowley, 1993). Furthermore, the available empirical findings in this regard remain inconclusive. While some studies have proposed a universal order of colour preferences (Eysenck, 1941; Guilford, 1934; Child et al., 1968), others have suggested that preferences are dependent on such variables as gender and age (e.g., Dorcus, 1926; Guilford and Smith, 1959; Granger, 1955; Jastrow, 1897; Warner, 1949; Meerum Terwocht and Hoeksma, 1995).

In order to extend our research with regard to the impact of colour in the store environment, the moderating effects of individual differences on the hypothesized relationships will also be investigated. More specifically, the moderating impact of two demographic characteristics, age and gender, will be assessed. We intend to investigate whether these demographic characteristics affect (1) the emotions elicited by store-colours and (2) the effects of store-colour induced emotions on consumers' approach-avoidance intentions.

¹⁹ The 'servicescape' framework, proposed by Bitner (1992) offers an explanation of behavioural responses to a retail environment

4.7.1. AGE

Colour preferences have been shown to be age dependent (Norman and Scott, 1952; Birren, 1978; Meerum Terwocht and Hoeksma, 1995). According to Norman and Scott (1952), several studies report a preference for yellow and red in young children, and a preference for blue and green in children in later years of elementary school (Ellis, 1900; 1906; Gale, 1933; Staples and Walton, 1933). The preference for yellow has been found to diminish rather early and is very often found in the least preferred position for older children and adults, whereas the preference of blue appears to build up gradually through the grades, to become the most preferred colour of all (Norman and Scott, 1952). Investigating the preferences for six colours (the primary colours red, blue, yellow and green + black and white - not further specified) among three age groups (72 respondents), Meerum Terwocht and Hoeksma (1995) also found the preference for yellow to decrease with age, whereas the preference for green increased with age. Choungourian (1969) observed a similar trend. The results of a study among children by Boyatzis and Varghese (1994) also suggest an age-related trend in emotional responses to colour: in their study older children tend to show an increasing affinity with bright colours (in this study bright colours referred to the colours pink, red, yellow, green, purple and blue, all taken together for the analyses, whereas black, grey and brown denoted dark colours). Silver and Ferrante (1995) could reveal differences in colour preferences between undergraduate college students and older adults aged 60 to 83 as well.

Moschis (1987) indicates that with increasing age, consumers are less sensitive to external stimuli such as light and colours. Their information-processing abilities appear to decline in general. Moreover, studies with a developmental perspective suggest that there are some age-related changes in emotion preferences (Russell and Bullock, 1985; Russell and Ridgeway, 1983; Meerum Terwocht and Hoeksma, 1995).

It is evident that an atmosphere that produces a positive response in teenagers may produce a negative response in older shoppers. d'Astous (2000), for instance, found the degree of perceived irritation in the shopping environment to be significantly affected by shoppers' age. Playing loud music in the store caused more irritation among older shoppers, while the store being unclean or having a bad smell caused more irritation among younger shoppers. Age therefore is a factor that should not be ignored when studying the impact of store colour on consumers. Nevertheless, because previous research on the effects of colour in a store

environment has not included this demographic variable, it is not clear how exactly it will affect the proposed relationships. For this reason no specific hypotheses will be proposed. We will assess its moderating impact in our analyses.

4.7.2. GENDER

Although the findings are very ambiguous, many investigations have indicated that there are significant differences between gender in preference for colour (Khouw, 1999a,b). Jastrow (1897) found men to prefer blue to red and women to prefer red to blue. Dorcus (1926) found yellow to have a higher affective value for men than for women. St George (1938) claimed that blue stands out for men far more than for women. Marston (1927) argues that blue is the colour of dominance, preferred primarily by males, while yellow represents submission and is supposedly preferred by females. Eysenck (1941) found no gender difference in colour preferences, except for the colours yellow and orange. He found yellow to be preferred to orange by women and orange to yellow by men, a finding that was confirmed later by Birren (1952) who also found men to prefer orange to yellow, while women tended to rank orange the lowest. McInnis and Shearer (1964) found blue-green to be more preferred among women than men; according to their findings, 56% of men and 76% of women favoured cool colours. Helson and Lansford (1970), on the other hand, reported men to find cool colours most pleasant, while women found warm colours more pleasant. In a study among children, Boyatzis and Varghese (1994) found that when asked to name their favourite colour, boys (26%) cited blue, followed by red, and girls (50%) preferred pink, followed by purple. They found boys more likely than girls to have positive emotional reactions to dark colours (in this study dark colours referred to the colours black, grey and brown, which are actually low in saturation as compared to the colours referred to as bright in the study). Guilford and Smith (1959) found men generally more tolerant towards achromatic colours than women. Analysing the colour-emotion associations among 40 undergraduate students, Hemphill (1996) found women to respond more positively than men to bright colours and to respond more negatively than men to dark colours (in this study bright colours referred to the colours pink, red, yellow, green, purple and blue, whereas black, grey and brown denoted dark colours). Whereas blue was cited as the favourite colour by an equal number of men and women, for other colours some gender differences in colour preferences could be discerned. For women other favourite colours were orange, yellow, purple, green and red. Other

favourite colours for men were black, brown, green and red. However, responses to individual colours were very similar for the men and women. In a study among elderly, Silver and Ferrante (1995) found women to prefer black and purple more often than men.

With regard to saturation level, Plater (1967) found that men tended to prefer more saturated colours than women. Likewise, Radeloff (1990) found women to prefer soft, unsaturated colours, whereas men preferred bright, saturated ones. McInnis and Shearer (1964) also found women to prefer lighter colours more than darker ones. Nevertheless, Radeloff (1990) found no significant differences between men and women in the preference for light versus dark colours.

In an exploratory study with regard to colour in interior environments, Khouw (1999a,b) found reinforcing evidence that colour responses are influenced by gender differences. Men were found to rate interiors with highly saturated colours more favorable than women. In contrast, investigating environmental effects on workers' moods, Kwallek et al. (1996) found women to associate depression, confusion and anger with working in low-saturated coloured offices (white, grey and beige), whereas men associated depression, confusion and anger with working in high-saturated coloured offices (green, blue, purple, red, yellow and orange). Despite these psychological responses, both sexes were found to prefer to work in white offices.

Other reviews on sex differences in colour preferences have suggested general similarities in male and female colour preferences, while noting sex differences in the strengths of those preferences (Norman and Scott, 1952; Whitfield and Wiltshire, 1990). Norman and Scott (1952, p189) note that: "while the *order* of preference is apparently not a function of sex, there is a good reason to suppose a difference in *strength* of the preferences". Valdez and Mehrabian (1994) also found men and women to react with highly similar emotional responses to brightness and saturation levels of colour samples, with results for women being slightly stronger. (e.g. colour saturation appeared to relate significantly to pleasure for women, but not for men). These results suggest that women are slightly more sensitive as compared to men, in terms of their emotional reactions to brightness and saturation levels of colours. As far as hue is concerned, however, Valdez and Mehrabian (1994) found no significant difference in the emotional reactions between men and women.

From his comparison of various studies, Guilford (1934) did observe some sex differences with regard to the affective reactions to colour: the three dimensions of colour accounted for 71% of the affective value judgements of women, but only for 26% of men's affective value judgements. Moreover, Radeloff (1990) found women to be more likely to have a favourite colour than men.

In general, the term "*emotional*" is also considered more typical of women than of men (Antill, 1987; Shields, 1987; Spence et al., 1975). In general women are thought to display more emotion than men and to feel emotion more intensely (Grossman and Wood, 1993; Johnson and Shullman, 1988; Shields and Koster, 1989). Women also appear to report emotions more intensely (Diener, Sandvik and Larsen, 1985; Fujita, Diener and Sandvik, 1991, as reported in Robinson, Johnson and Shields, 2001, p158). Women have also been found to process information in more detail as compared to men, making them more sensitive to environmental factors (Meyers-Levy and Maheswaran, 1991; Meyers-Levy and Sternthal, 1991).

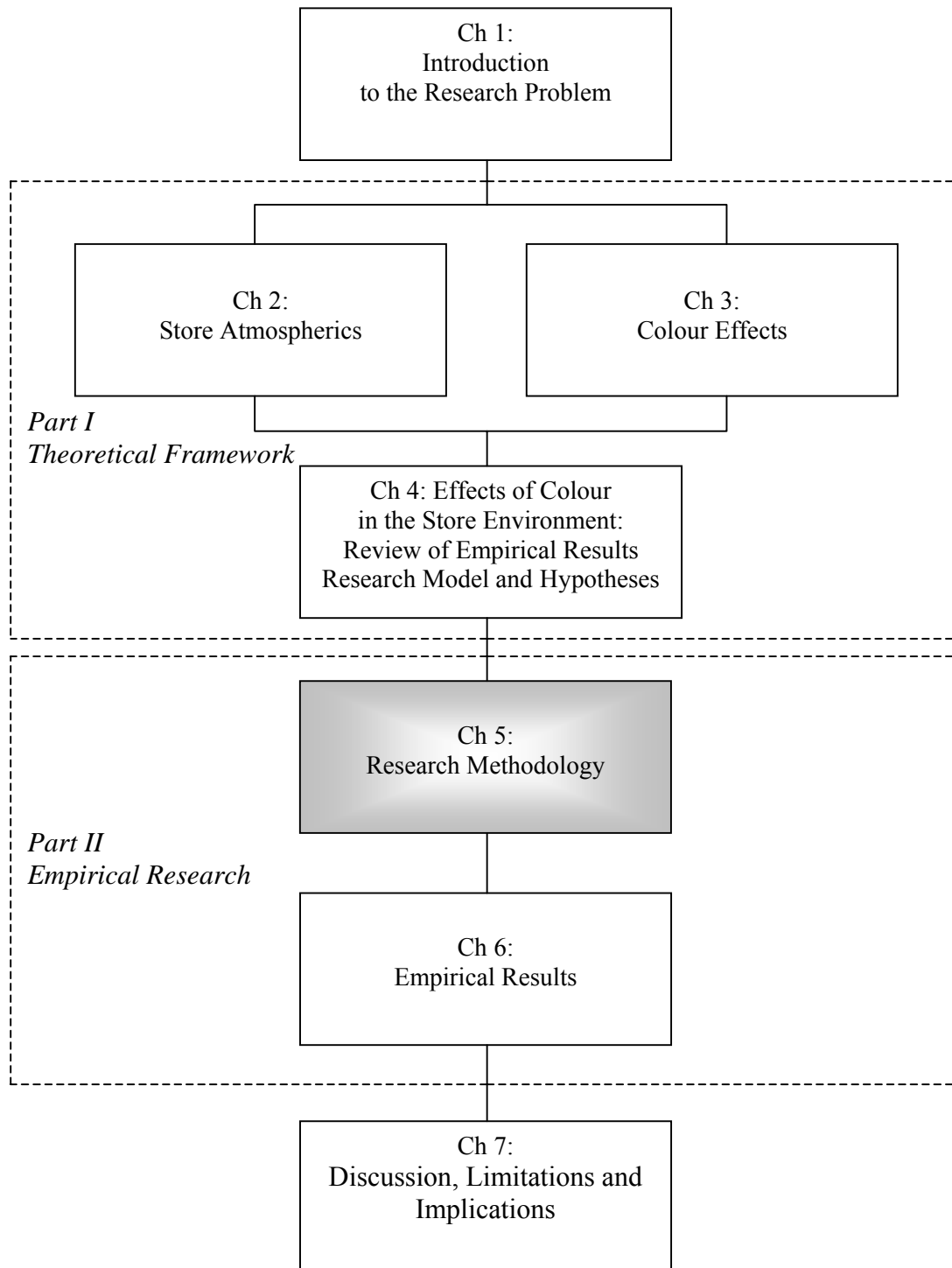
Shopping has been demonstrated to be a gendered activity (Dholakia, 1999). More specifically, d'Astous (2000) found the degree of perceived irritation in the shopping environment to be significantly affected by shoppers' gender. Women appeared to be generally more irritated than men by displeasing aspects of the shopping environment. It is also conceivable that an atmosphere that produces a positive response in females may produce a less positive response in male shoppers. Gender, therefore, is another demographic factor that should not be ignored when studying the impact of store colour on consumers. For this reason, we will assess its moderating impact in our analyses. Nevertheless, because investigations in a retailing context have focussed almost exclusively on females, it is not clear how exactly gender will affect the proposed relationships. Based on the findings with regard to gender differences in emotional reactions to colours in general, by Norman and Scott (1952), Whitfield and Wiltshire (1990) and Valdez and Mehrabian (1994), we hypothesize that for females the effects of colour in the store environment will be stronger than for males. Thus, we do not expect to find any differences in the direction of the proposed relationships between males and females; however, we do expect a difference in strength of the relationships, with the relationships being stronger for women.

Thus far the presentation of the proposed hypotheses. These will be tested in the empirical study, which will be elaborated in the second part of this dissertation.

Part II
Empirical Research

Chapter 5

Research Methodology



CHAPTER STRUCTURE

Chapter 5: Research Methodology

- 5.1. Introduction
- 5.2. Experimental Design
- 5.3. Stimuli
- 5.4. Subjects & Procedures
- 5.5. Measures

5.1. INTRODUCTION

As indicated in the previous chapter, this study aims to assess the impact of one store design element, namely colour, on consumers' feelings and subsequent shopping intentions. Since the prevalent research on the impact of colour in the store environment is scarce and methodologically flawed, the employed methodology of the current study will be elaborately presented here. The development of the experimental design, outlined in section 5.2., was guided by our objective to investigate the specific effects of the three attributes of store-interior-colour: hue, saturation and brightness. In section 5.3., the actual store-environment, which was especially developed in computer aided design to serve as a stimulus for this study, is presented. The selection of the specific colour tones for the manipulations of the stimuli is also elucidated here. Section 5.4. overviews the procedures followed for sampling and questioning the subjects. A brief account of the participants is given here as well. Finally the measurement instrument, used to capture their reactions to the manipulated stores, is discussed in section 5.5.

*"Experimentation
involves the manipulation
of one or more variables by the experimenter
in such a way
that its effects on one or more other variables
can be measured"*

TULL AND HAWKINS

1993, p211

5.2. EXPERIMENTAL DESIGN

Experimentation allows us to establish and measure the causal relationships between store colour and consumers' affective and behavioural responses (Tull and Hawkins, 1993, p212). The proposed experimental study can be classified as a 'judgment study' (Aronson, Brewer and Carlsmith, 1985; Judd, Smith and Kidder, 1991), in that the participants are asked to evaluate a stimulus, presented by the experimenter. Effects of variations in the characteristics of the stimulus materials are the key focus of interest. In this case store colour will function as the independent variable and is therefore manipulated.

In contrast to previous studies on the subject, in this study, special attention is devoted towards establishing an experimental design that allows us to investigate causal relationships with respect to each of the three colour attributes: hue, brightness and saturation. Accordingly, the resulting experimental design is a three-way factorial design (colour hue by colour saturation by colour brightness). In fact an 8 by 2 by 2 factorial design was opted for, as will be detailed in the next section.

In order to achieve adequate power, about 25 observations per cell are called for, especially since the colour-effects are expected to be subtle. The selected experimental design is a between-subjects design, in the sense that each respondent is exposed to only one colour condition. This procedure is deemed necessary in order not to reveal the specific nature of the study. Due to the monadic nature of the experiment, the 32 (i.e. 8x2x2) treatment groups will each have to consist of about 25 subjects. Subjects will be matched as much as possible on the basis of gender and three age categories. The experimental procedures, as well as those followed for sampling and questioning the subjects, are described in section 5.4.

5.3. STIMULI

A kind of laboratory experiment, using photographic environmental simulations, was opted for in this study, since such an experiment provides a level of control that would be hard to achieve in a field study (Bateson and Hui, 1992). Moreover, laboratory experiments tend to cost substantially less in terms of resources and time than field experiments (Tull and Hawkins, 1993, p246). Numerous techniques are available for simulating retail environments, ranging in realism from verbal descriptions to actual store interiors (see Eroglu, Scholder and Machleit, 1992 and Bateson and Hui, 1992 for an overview). Photographic slides and pictures, representing static, perceptual simulations (McKechnie, 1977), have been demonstrated to be able to adequately represent the environment (e.g. Hershberger and Cass, 1974; Bitner, 1990; Eroglu and Machleit, 1990; Hui and Bateson, 1991; Areni, Sparks and Dunne, 1996). Hui and Bateson (1991), for example, successfully operationalized consumer density by means of coloured slides portraying different numbers of consumers in a setting. Previous studies on the impact of store colour have also utilized projections of store interiors (e.g. Bellizzi, Crowley and Hasty, 1983; Bellizzi and Hite, 1992; Crowley, 1993).

A major strength of laboratory experiments is the minimization of the effects of 'history', by the removal of a majority of possibly confounding extraneous variables, which provides a high degree of internal validity or replicability (Kerlinger, 1973, p398; Tull and Hawkins, 1993, p246). Unfortunately, as a direct consequence, laboratory experiments are generally rather weak in external validity or generalizability. Nevertheless, the use of photographic slides as environmental simulations has been proven to be a valid method for studying the effects of environments on evaluations, affective responses and behaviour (Hershberger and Cass, 1974; Russell and Mehrabian, 1976; Bateson and Hui, 1992). Russell and Mehrabian (1976) have provided empirical evidence for the generalizability of data based on slides representing physical settings. The use of photographic slides to simulate service settings has also been demonstrated to have 'ecological validity' (McKechnie, 1977, p169), in the sense that (a) they can represent realistic service settings and (b) they are able to elicit the same experience as the actual service setting (Bateson and Hui, 1992). These arguments justify our choice to utilize manipulated pictures to simulate the store interior in the current study.

More specifically, the picture of a store in design furniture and accessories was chosen as stimulus. This choice was made on the basis of two considerations. First of all, to ensure that emotional state and store environment would be relevant to the shopper's buying experience, a store-type carrying high-involvement goods should be selected for this kind of study (Flicker & Speer, 1990, Sherman et al., 1997). Moreover, in the selected store format, the consumer would not be suspicious of the perhaps unusual colours used in the manipulations. This may also be an important factor, especially since Yoo, Park and MacInnis (1998) surmise that consumers' frames of reference and expectations regarding "typical" store characteristics may play a more central role in affecting consumers' emotional responses than the actual store characteristics themselves. Indeed, examining the potential role that store atmosphere expectations play in influencing emotional responses to the shopping experience, Machleit and Eroglu (2000), revealed that as the store atmosphere differed more from what the shopper had expected, then he or she is less likely to feel some of the positively valenced emotions and more likely to feel negatively valenced emotions. Specifically, they found that as the store atmosphere deviated from expectations, the shoppers felt less pleasure, interest and joy and more sadness and disgust. Not unexpectedly, surprise was also significantly higher when the environment was not as anticipated. Moreover, they found that the significant correlations varied by store type and note that it is possible that in a recreational shopping environment, such as a mall, some deviations from expectations could be consistent with the stimulation sought by recreational shoppers. A store in design furniture and accessories involves a store-type carrying high-involvement goods, offered in a recreational shopping environment in which the use of extraordinary colours should not be suspicious. Thus the requirements posed to the stimulus used in this study are fulfilled.

The store in design furniture and accessories was developed in Computer Aided Design (ARKEY), allowing us to realistically manipulate colour in the store environment. As colours can be defined according to three dimensions, appropriate colour-stimuli have to be selected according to these distinct colour attributes. Accordingly, the experimental design is an 8 x 2 x 2 factorial design (colour hue by colour saturation by colour brightness). For the experimental manipulation, initially only four hues from the Munsell Colour System were selected for their divergent pleasure and arousal eliciting properties: blue-green (high pleasantness, high arousal), purple-blue (high pleasantness, low arousal), green-yellow (low pleasantness, high arousal) and yellow-red (low pleasantness, low arousal) (see also Ziemis and Christman, 1998; based on Valdez and Mehrabian's 1994 results on affective responses

regarding colour patches). However, since a manipulation check performed on a first set of data revealed that these hues did not elicit pleasure and arousal in respondents as intended, four more hues from the Munsell Colour System were included in the study. For each hue, four specific tones were selected (as indicated in figure 5-1), with low versus high saturation levels (Munsell chroma 6 versus 14) and low versus high brightness levels (Munsell value 5 versus 8, for all hues, except for those for which the former values exceed the existing range, which was the case for blue and red, in which case Munsell value 4 versus 7 was used; purple-blue in which case Munsell value 3 versus 6 was applied and yellow, in which case Munsell value 6 versus 9 was selected).

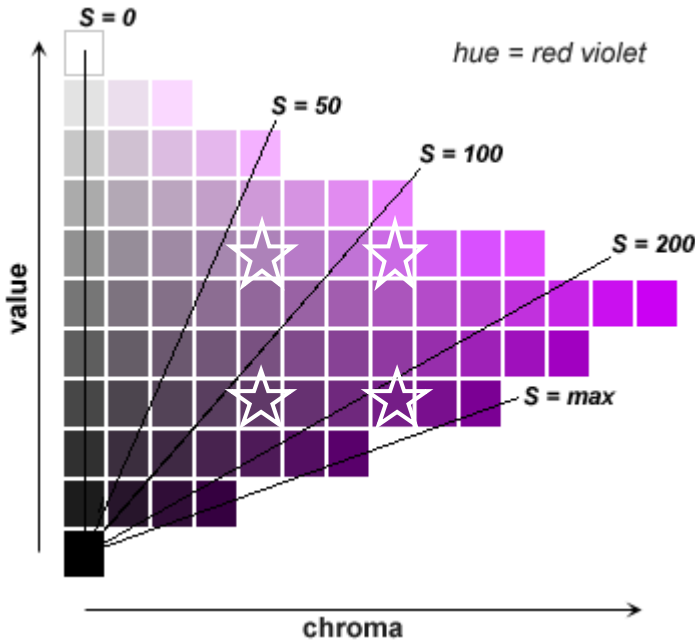


Figure 5-1: Selected values and chromas for each hue²⁰
 Source: Adapted from Handprint Media, 2001
<http://www.handprint.com/HP/WCL/color2.html>

²⁰ To view displays like this of all the different Munsell hues, we refer to the Gretag Macbeth website (<http://standards.gretagmacbeth.com/cmcc/index.htm>, last updated March 11, 2002), from which Munsell Conversion Software - V6.13 (Win 95/98/NT/2000/XP) Conversion of Munsell > XYZ > L*a*b* > RGB > CYMK > Color on Screen - can be downloaded for free.

The selection of particular colour-tones to use in the experimental design was certainly not obvious, as the three dimensional colour space is highly irregular, which is clearly illustrated in figure 5-2 , as discussed earlier, in chapter 3 (paragraph 3.3.4.). In fact, not all brightness-saturation combinations appear to exist for all hues, as different hues reach their maximum chroma at different values. Rather than limiting this study by excluding hues because of their dissimilar chroma-value patterns (as Gorn et al., 1997 did), we have attempted to select a combination of brightness and saturation levels existent in a majority of hues. Only when there was no other possibility because the selected values were out of the exceeding range for a particular hue, brightness levels were slightly adapted.

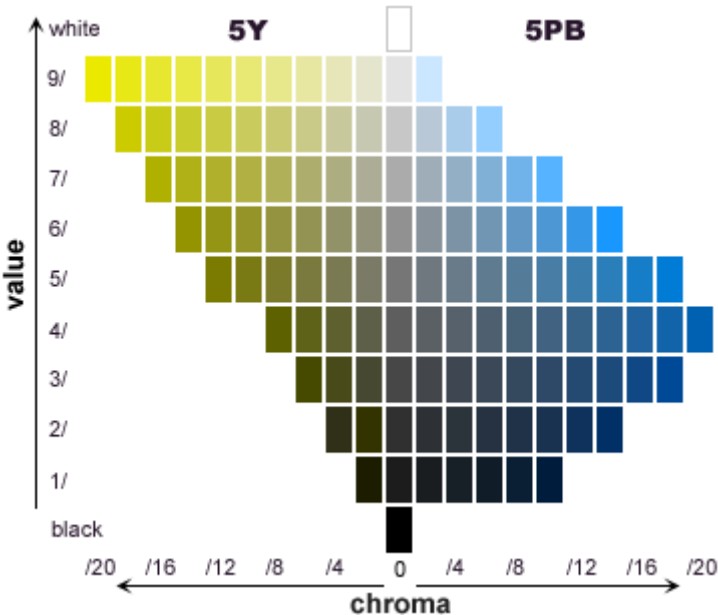


Figure 5-2: Value and chroma ranges for yellow and purple-blue demonstrate that the natural colour space is highly irregular.

Source: Handprint Media, 2001
<http://www.handprint.com/HP/WCL/color6.html>

Accordingly the following 32 colours were used in the experiment (Munsell notation, 1905: hue value/chroma, we refer to appendix 1 for a table with the corresponding RGB values):

- blue-green: (5.00 BG 5/6), (5.00 BG 5/14), (5.00 BG 8/6), (5.00 BG 8/14)
- purple-blue: (5.00 PB 3/6), (5.00 PB 3/14), (5.00 PB 6/6), (5.00 PB 6/14)
- green-yellow: (5.00 GY 5/6), (5.00 GY 5/14), (5.00 GY 8/6), (5.00 GY 8/14)
- yellow-red: (5.00 YR 5/6), (5.00 YR 5/14), (5.00 YR 8/6), (5.00 YR 8/14)
- green: (5.00 G 5/6), (5.00 G 5/14), (5.00 G 8/6), (5.00 G 8/14)
- blue: (5.00 B 4/6), (5.00 B 4/14), (5.00 B 7/6), (5.00 B 7/14)
- red: (5.00 R 4/6), (5.00 R 4/14), (5.00 R 7/6), (5.00 R 7/14)
- yellow: (5.00 Y 6/6), (5.00 Y 6/14), (5.00 Y 9/6), (5.00 Y 9/14)

This way 32 colour manipulations of the store are obtained, some of which are presented in the following figures.





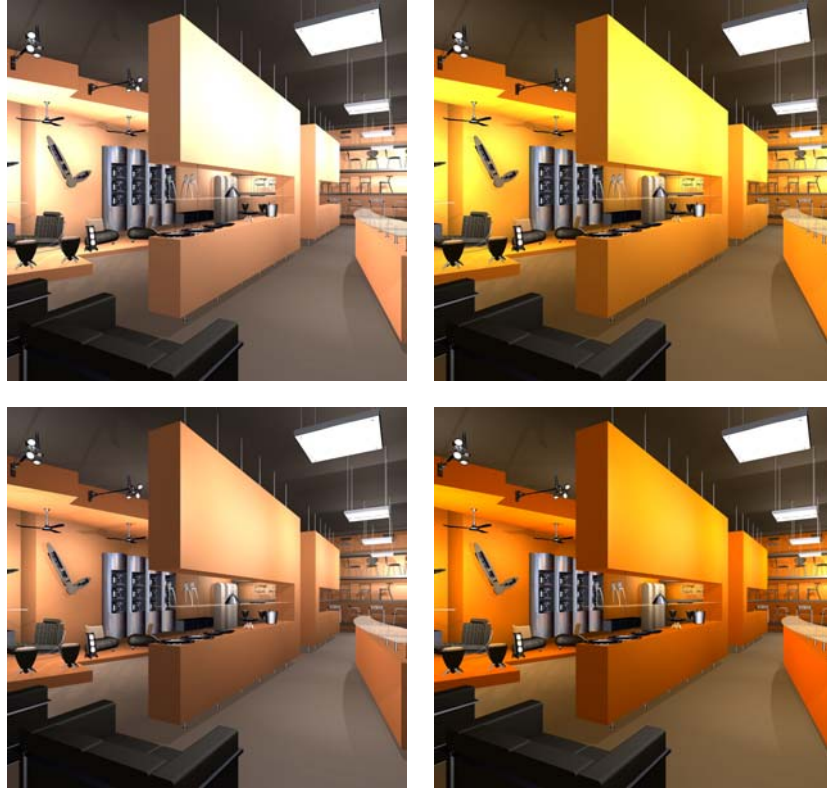


Figure 5-3: The four stimuli selected to represent the Munsell 5 Yellow-Red Hue region, with respectively

High Brightness – Low Saturation	(upper left corner)
High Brightness – High Saturation	(upper right corner)
Low Brightness – Low Saturation	(lower left corner)
Low Brightness – High Saturation	(lower right corner)

Source: Store environments developed especially for this study by Wim Goris, in ARKEY (Computer Aided Design), BAT NV.

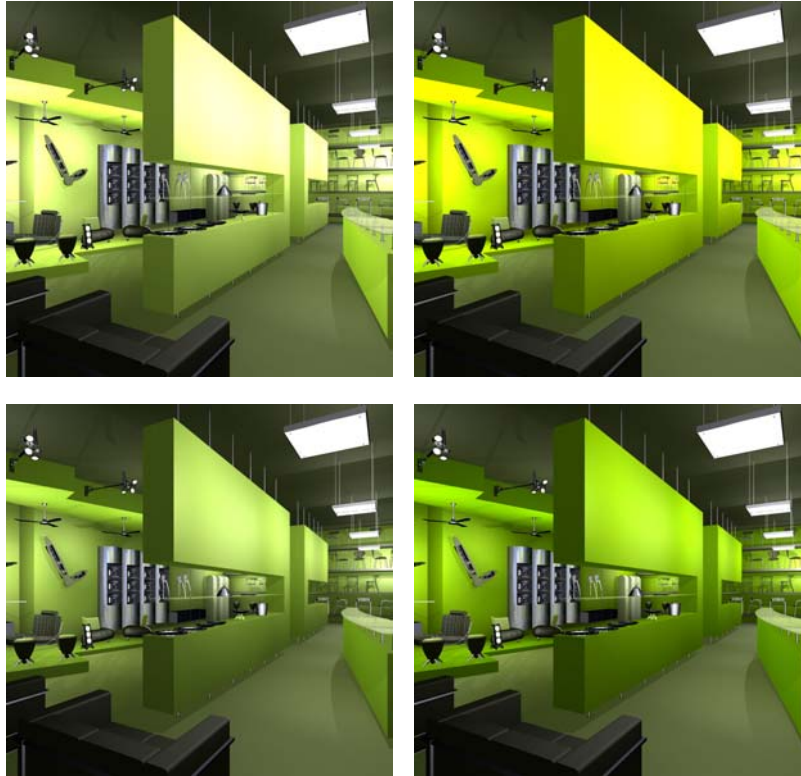


Figure 5-4: The four stimuli selected to represent the Munsell 5 Green-Yellow Hue region, with respectively

- | | |
|-----------------------------------|----------------------|
| High Brightness – Low Saturation | (upper left corner) |
| High Brightness – High Saturation | (upper right corner) |
| Low Brightness – Low Saturation | (lower left corner) |
| Low Brightness – High Saturation | (lower right corner) |

Source: Store environments developed especially for this study by Wim Goris, in ARKEY (Computer Aided Design), BAT NV.

5.4. SUBJECTS & PROCEDURES

The experiment was carried out in Belgium. Subjects were intercepted by means of a random walk sampling procedure, with predetermined quota for age and gender. About 25 respondents were selected per manipulation. They were matched as much as possible on the basis of gender and three age categories: 18-30, 30-45 and 45-60 year olds. Tables 5-1 and 5-2 give an overview of the demographic and socio-economic characteristics of all the 874 participants.

Table 5-1: Respondents according to age and gender (n=874)

		Age			Total
		18-30	30-45	45-60	
Gender	Male	159 18.2%	136 15.6%	131 15.0%	426 48.9%
	Female	162 18.6%	151 17.3%	133 15.3%	446 51.1%
Total		321 36.8%	287 32.9%	264 30.3%	872 100.0%

In order to conceal the particular focus and goal of the research, the interviewers presented themselves as working for a market-research company, investigating the market-potential of an Italian store in design furniture and accessories, which is interested in opening up an outlet in Belgium. The presumed objective of the study was to determine whether people would be interested in this store. An incentive was proposed in order to stimulate people to participate to the study. Participants were eligible for a 25 Euro prize of choice (either movie-theatre tickets or book-value-coupons), five of which were raffled at the end of the study.

Table 5-2: Demographic and socio-economic characteristics of respondents (n=874)

Household Size:		%
Mean: 3.23 Std. Dev.: 1.44		
1		11.4
2		23.5
3		19.6
4		29.4
5+		16.1
Number of Kids in Household:		%
Mean: 1.43 Std. Dev.: 1.33		
0		32.1
1		20.1
2		29.9
3+		17.8
Occupation:		%
Full-Time Employed		62.1
Part-Time Employed		11.0
Unemployed / Housewife / Retired		6.6
Student		20.3
Level of Education:		%
Junior High School Diploma or less		6.2
Technical or Professional Education		15.7
General High School Diploma		23.7
Short Type Higher Education		18.8
Long Type Higher Education		6.6
University		29.0
Net Average Monthly Household Income:		%
< 30.000 BEF		7.4
30.000 - 45.000 BEF		10.4
45.000 - 60.000 BEF		19.9
60.000 - 75.000 BEF		15.2
75.000 - 95.000 BEF		10.4
95.000 - 115.000 BEF		14.8
115.000 - 135.000 BEF		9.5
> 135.000 BEF		12.5

Respondents were asked to fill out a short mood inventory before the actual stimulus – a manipulated picture of the store (16 by 16 cm)– was shown. Each participant was randomly allocated to one of the 32 experimental conditions and shown the corresponding stimulus. As the experiment is monadic in nature, each subject was presented only one store.

The participants were asked to take a look at the picture of the store and fill out the remainder of the questionnaire, including questions pertaining to the emotions elicited by the store and approach/avoidance intentions towards the store. Socio-demographic characteristics of respondents were tapped as well.

Since inherited defects of colour vision affect about 8% of men and 0.5% of women, it is important to screen respondents for colour blindness. However, respondents were not screened for colour vision deficiency before selection, in order not to reveal the purpose of the study. This was done at the end of the experiment.

Finally, respondents were thanked for their participation.

5.5. MEASURES

Each of the 874 respondents, participating in this study, was administered a lengthy questionnaire. The survey instrument contained questions pertaining to participants' general pre-existing mood state, the emotional reactions elicited by the experimental store and their approach/avoidance intentions towards the store. All scales, included in the questionnaire, were carefully translated, with a forward and backward check (Brislin, 1980).

First of all, pre-existing mood was measured, before exposure to the stimulus, by a short 4-item mood inventory (Peterson and Sauber, 1983). This Mood Short Form (MSF) has been generated to reflect the 'mood' content domain and was developed, based on a large pool of items, drawn amongst others from Mehrabian's (1972) nonverbal communication scale and Nowlis' (1962) Mood Adjective List. The purified uni-dimensional four-item scale was derived after factor analysis, detailed item analyses and reliability checks. Coefficient alpha for the scale was reported to be .78, .74 and .77 for samples of respectively 1,434, 713 and 248 respondents (Baerden and Netemeyer, 1999). That the transient and varying nature of mood is captured by the MSF, was demonstrated by a test-retest reliability over a 30-day period (n=177) of only .18. Items were measured on a 7-point Likert-type scale (from -3: strongly disagree to +3: strongly agree). Two out of the four items were reversed. The scale is illustrated in table 5-3. Item scores are supposed to be summed to acquire a uni-dimensional MSF index.

Table 5-3: Mood Short Form - MSF (Peterson and Sauber, 1983)

Mood Short Form - MSF (Peterson and Sauber, 1983) (measured on a 7-point Likert-type scale - <i>strongly disagree</i> to <i>strongly agree</i>):	
MOOD1	Currently, I am in a good mood. <i>Ik ben momenteel in een goede bui.</i>
MOOD2	As I answer these questions I feel cheerful. <i>Bij het invullen van deze vragenlijst voel ik me opgewekt.</i>
MOOD3	For some reason I am not very comfortable right now. (-) <i>Door omstandigheden voel ik me op dit moment niet erg op mijn gemak.(-)</i>
MOOD4	At this moment I feel edgy or irritable. (-) <i>Ik voel me voor het ogenblik gespannen en prikkelbaar. (-)</i>

Subsequently, three six-item semantic differential scales, measuring the PAD-dimensions of emotions elicited by the experimental store (Mehrabian and Russell, 1974; Russell and Mehrabian, 1977), were incorporated in the questionnaire. The background and validity of these scales (illustrated in table 5-4) have been discussed previously in chapter 2 (paragraph 2.5.). Items of the respective scales were intermixed within an 18-item inventory to minimize respondent awareness of the scale dimensions, thereby enhancing validity (see Mehrabian, 1998). The direction of about half of the items in the scales was reversed.

Table 5-4: PAD measurement scale (Mehrabian and Russell, 1974)

Pleasure items (measured on a 7-point semantic differential scale):						
	<i>In this store I feel ...</i>			<i>Deze winkel geeft mij ...</i>		
P1	depressed	–	contented	<i>een bedrukt gevoel</i>	–	<i>een aangenaam gevoel</i>
P2	unhappy	–	happy	<i>een ongelukkig gevoel</i>	–	<i>een gelukkig gevoel</i>
P3	unsatisfied	–	satisfied	<i>een ontevreden gevoel</i>	–	<i>een tevreden gevoel</i>
P4	annoyed	–	pleased	<i>een geërgerd gevoel</i>	–	<i>een behaaglijk gevoel</i>
P5	bored	–	relaxed	<i>een verveeld gevoel</i>	–	<i>een ontspannen gevoel</i>
P6	despairing	–	hopeful	<i>een wanhopig gevoel</i>	–	<i>een hoopvol gevoel</i>
Arousal items (measured on a 7-point semantic differential scale):						
	<i>In this store I feel ...</i>			<i>Deze winkel geeft mij ...</i>		
A1	relaxed	–	stimulated	<i>een ontspannen gevoel</i>	–	<i>een gestimuleerd gevoel</i>
A2	calm	–	excited	<i>een rustig gevoel</i>	–	<i>een opgewonden gevoel</i>
A3	sluggish	–	frenzied	<i>een loom gevoel</i>	–	<i>een uitzinnig gevoel</i>
A4	dull	–	jittery	<i>een futloos gevoel</i>	–	<i>een zenuwachtig gevoel</i>
A5	sleepy	–	wide-awake	<i>een slaperig gevoel</i>	–	<i>een wakker gevoel</i>
A6	unaroused	–	aroused	<i>een niet geprikkeld gevoel</i>	–	<i>een geprikkeld gevoel</i>
Dominance items (measured on a 7-point semantic differential scale):						
	<i>In this store I feel ...</i>			<i>Deze winkel geeft mij ...</i>		
D1	controlled	–	controlling	<i>een geremd gevoel</i>	–	<i>een vrij gevoel</i>
D2	influenced	–	influential	<i>een gemanipuleerd gevoel</i>	–	<i>een ongedwongen gevoel</i>
D3	cared for	–	in control	<i>een geholpen gevoel</i>	–	<i>een autonoom gevoel</i>
D4	awed	–	important	<i>een minderwaardig gevoel</i>	–	<i>een superieur gevoel</i>
D5	submissive	–	dominant	<i>een onderdanig gevoel</i>	–	<i>een dominant gevoel</i>
D6	guided	–	autonomous	<i>een begeleid gevoel</i>	–	<i>een zelfstandig gevoel</i>

Next, the questionnaire contained an eight-item scale measuring approach/avoidance behaviour intentions towards the store (Donovan and Rossiter, 1982). The approach/avoidance items (illustrated in table 5-5) were measured on 7-point Likert scales (from -3: strongly disagree to +3: strongly agree). In order to avoid response bias, the order of the items was mixed and the direction of three of the items in the scale was reversed. The background and validity of this scale has been discussed previously in chapter 2 (paragraph 2.6.).

Table 5-5: Approach/avoidance measurement scale (Donovan and Rossiter, 1982)

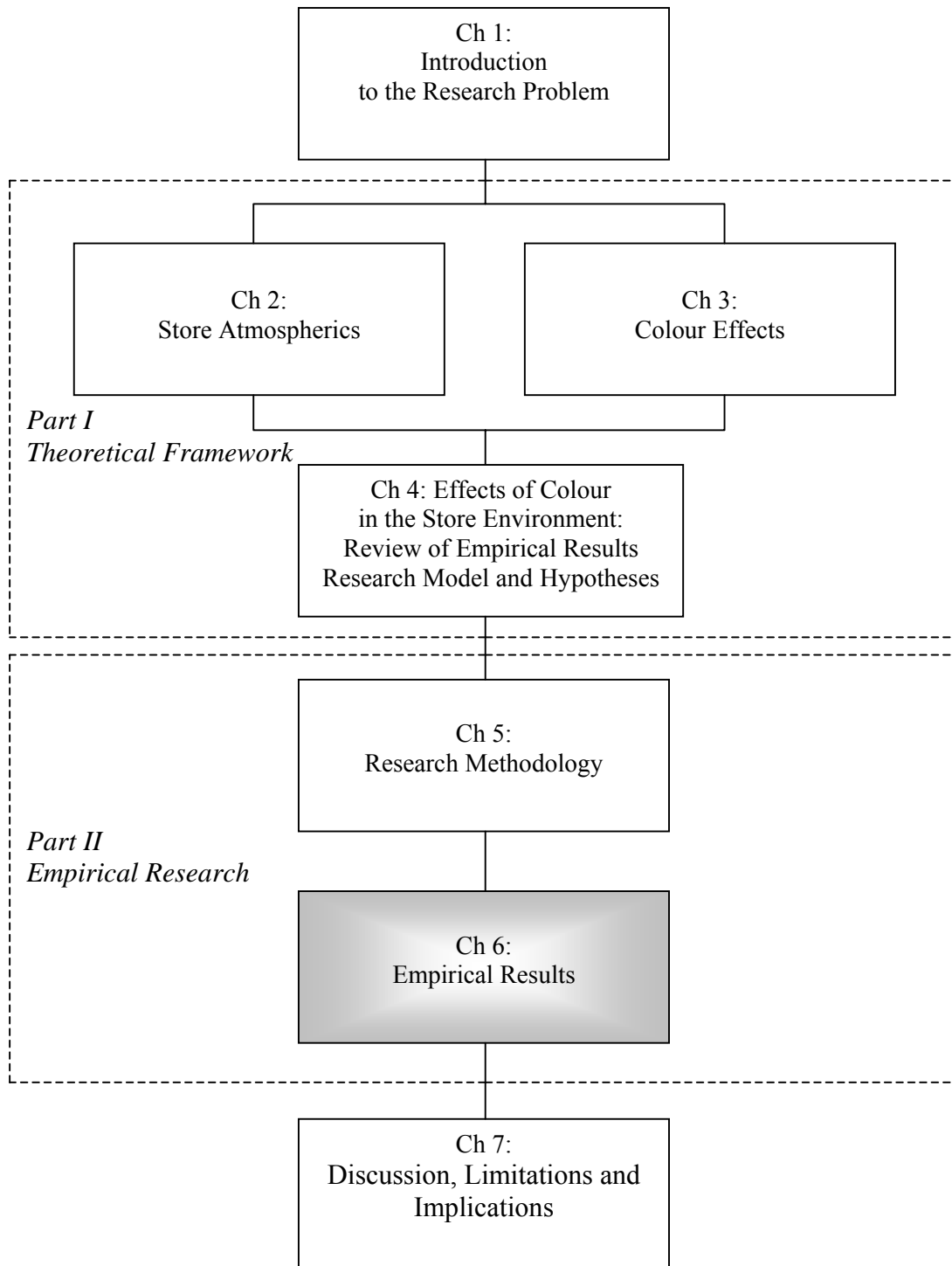
Approach/avoidance items (measured on a 7-point Likert-type scale - <i>strongly disagree</i> to <i>strongly agree</i>):	
<i>Time dimension:</i>	
APAV1	I like to spend much time browsing in this store <i>Ik zou in deze winkel graag veel tijd willen doorbrengen om rustig rond te kijken</i>
APAV2	I want to avoid looking around or explore this store (reversed) <i>In deze winkel zou ik vermijden rond te kijken en de winkel te verkennen</i>
<i>Affiliation:</i>	
APAV3	This is a place where I try to avoid other people, and avoid to talk with them (reversed) <i>In deze winkel zou ik trachten mensen te mijden of vermijden ermee te moeten praten</i>
APAV4	This is a place in which I feel friendly and talkative to store personnel who happens to be near me <i>In deze winkel zou ik mij goed gezind voelen en zou ik open staan voor een praatje</i>
<i>Affect:</i>	
APAV5	I like this store environment <i>Ik hou van deze winkelomgeving</i>
APAV6	I enjoy shopping in this store <i>Ik zou er van genieten in deze winkel te komen winkelen</i>
<i>Spending:</i>	
APAV7	I would avoid ever having to return to this store (reversed) <i>Ik zou zoveel mogelijk vermijden naar deze winkel te moeten komen</i>
APAV8	This is the sort of place where I might end up spending more money than I originally set out to spend <i>Ik zou in deze winkel meer geld kunnen uitgeven dan oorspronkelijk voorzien</i>

Finally, the questionnaire also contained questions pertaining to the socio-demographic characteristics of participants, including age, gender, household size, number of kids in household, the respondent's occupation and level of education and the net average monthly household income.

At the very end of the questionnaire, respondents were asked, directly, whether they knew to suffer from any form of colour vision deficiency. To conclude the experiment, respondents' colour vision was also tested by the experimenter by means of three pseudo-isochromatic plates from the Ishihara Colour Vision test (Ishihara, 1969, 1980), for which partially concealed figures have to be identified from a mass of different coloured dots.

Chapter 6

Empirical Results



CHAPTER STRUCTURE

Chapter 6: Empirical Results

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6.1. INTRODUCTION

The research model, proposed in chapter 4, was tested by an experimental design, as reviewed in chapter 5. In the current chapter, the research findings are presented, starting of by discussing in section 6.2. how screening for colour vision deficiency among respondents was carried out. In section 6.3. the data screening procedure, which was executed prior to the analyses, is discussed. An account of the respondents in the final sample is given in section 6.4. Subsequently, section 6.5. overviews the construct validation process of both the PAD-emotion scale and the approach-avoidance scale: the uni-dimensionality, within-method convergent validity and reliability of the respective scales are conscientiously assessed. The actual hypotheses testing falls apart in two main parts: In section 6.6. the hypotheses concerning store-colour-evoked emotions are tested by means of multivariate analysis of variance (MANCOVA). Here pre-existing mood is introduced as a covariate and the different emotions elicited by store-colour hue, brightness and saturation are examined in detail. Moreover, the moderating effects of age and gender on the emotions elicited by store-interior-colours are assessed. In section 6.7. a second set of hypotheses, concerning the impact of store-colour-evoked emotions on approach/avoidance intentions, is tested by means of structural equation modelling (SEM). The moderating effects of age and gender are also investigated with regard to these relationships. Finally, the preceding findings are linked together, in section 6.8., by verifying whether it is reasonable to assume that store-colour-evoked emotions act as a mediator in the relationship between store colour and approach-avoidance responses towards the store.

6.2. SCREENING FOR COLOUR BLINDNESS OR COLOUR VISION DEFICIENCY

As mentioned in chapter 3 (paragraph 3.2.3), colour blindness is a visual defect resulting in the inability to distinguish colours (Medical Post, 1997; Neitz, 1998). About 8% of men and 0.5% of women experience some difficulty in colour perception

Due to the specific nature of this study, respondents suffering from colour vision deficiency, or colour blindness have to be removed from the sample, in order to eliminate any possible bias that may be induced this way.

To determine the extent of colour-deficiencies, many researchers have used Ishihara plates (illustrated in figure 6-1) and other colour-discrimination methods (Benjamin, Press, Maoz & Belmaker, 1993; Corsino, 1985; Miyao et al., 1991; Shepard & Cooper, 1992). Others have relied on individuals' self-identification (Kaufman-Scarborough, 2000). However, as the colour vision of perfectly colour-normal persons can be affected over time by age, progressive illness or the use of certain medications and can change subtly, either temporary or permanently (Braus, 1995; Wilson, 1998), an individual who has had normal colour vision, may not realize a gradual decline in perceptual ability for some time.

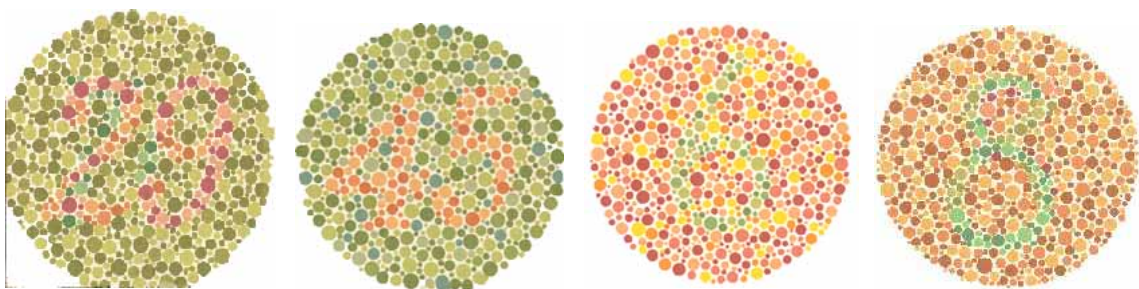


Figure 6-1: Illustration of pseudo-isochromatic plates from the Ishihara Colour Vision Test

Source: Ishihara, 1969, 1980

In the current study colour vision deficiency was measured in two ways, at the end of the questionnaire, in order not to reveal the particular purpose of the study. First of all respondents were asked whether they suffered from any form of colour vision deficiency (i.e. stated colour vision deficiency). We then also tested our respondents' colour vision, using three pseudo-isochromatic plates (identifying partially concealed figures from a mass of different coloured dots) from the Ishihara Colour Vision test (i.e. revealed colour vision deficiency) (Ishihara, 1969, 1980).

Crosstabulations of stated and revealed colour vision deficiency (see table 6-1), demonstrate that the majority of respondents reporting to have good colour vision, scored good on the Ishihara colour vision test (98.6%). Of the 14 participants who were unsure about their colour vision 11 (78.6%) appeared to have good colour vision after all. 59 or 6.8% of all the respondents indicated to be aware of problems with their colour vision. Nevertheless of these participants 32 (54.2%) had good results on the Ishihara colour vision test.

Table 6-1: Colour blindness among respondents (n=874)

Revealed Colour Vision Deficiency (Ishihara Colour Test)	Stated Colour Vision Deficiency			Total
	Good Colour Vision	Unsure	Deficient Colour Vision	
Good Colour Vision Within Stated	790 98.6%	11 78.6%	32 54.2%	833 95.3%
Deficient Colour Vision Within Stated	11 1.4%	3 21.4%	27 45.8%	41 4.7%
Total	801 91.6%	14 1.6%	59 6.8%	874 100%

In order to eliminate any possible bias that may be induced by colour blindness, all respondents that indicated having deficient colour vision (stated colour vision deficiency), as well as all respondents who failed the Ishihara Colour Vision Test (revealed colour vision deficiency) were eliminated from the sample. This totals up to 73 participants who could not be retained for further analyses. When we take a look at the demographic characteristics of these respondents (Table 6-2) it is clear that especially males (76.7%) suffer from this condition of inadequate colour vision. With regard to age the group of 45-60 year-olds seems to be a little stronger represented among the colour blind in our sample.

Table 6-2: Demographic characteristics of colour-blind respondents (n=73)

Gender	Age			Total
	18-30	30-45	45-60	
Male	18 24.7%	17 23.3%	21 28.8%	56 76.7%
Female	5 6.8%	5 6.8%	7 9.6%	17 23.3%
Total	23 31.5%	22 30.1%	28 38.4%	73 100.0%

That colour vision deficiency affects more males than females is clear from the following table (Table 6-3). In our sample 13.1% of males suffer from deficient colour vision as compared to only 3.8% of females.

Table 6-3: The impact of gender on colour vision deficiency

Colour Vision Deficiency	Gender		Total
	Male	Female	
Good Colour Vision	370 86.9%	431 96.2%	801 91.6%
Deficient Colour Vision	56 13.1%	17 3.8%	73 8.4%
Total	426 100.0%	448 100.0%	874 100.0%

$\chi^2 = .000$

Only 801 respondents with good colour vision are retained in our sample for further analyses.

6.3. DATA SCREENING

As the first step of data analysis should always be a detailed examination of the data (Norusis, 1993, p181), the raw data were inspected before starting with the actual data analyses. Using descriptive statistics, the data set was first checked for typing and coding errors (e.g. out-of-range values). The original questionnaires were consulted in these cases where such errors appeared to be present (Baumgartner and Homburg, 1996). Then, negatively stated items were reverse scored. For the cases where missing values were found, it was double-checked whether the missing data were not simply omitted during data-input. 24 surveys had to be eliminated because of rather incomplete responses.

Since cases that have unusual values for the independent variables can have a substantial impact on the results of analyses, these should be identified (Norusis, 1993, p331). A multivariate procedure for identifying outliers was used, based on the Mahalanobis D^2 measure (Hair et al., 1998). Mahalanobis D^2 is a measure of the distance in the multidimensional space of each observation from the mean centre (i.e. centroid) of the observations (see Tacq, 1997, p251). Thus, in order to locate outliers, for each observation the Mahalanobis Distance was calculated based on all items used in the independent constructs²¹. The value obtained by dividing Mahalanobis D^2 by its degrees of freedom (i.e. the number of independent variables in the analysis) is approximately t-distributed. By means of this statistic, observations can be identified as potential outliers. In our sample only one case was observed with a D^2/df -value of 3.75, slightly exceeding the threshold value (i.e. critical t-value ($p=.0005$, $df=30$) = 3.646). Nevertheless, this case was not considered to be a real outlier, because it appeared not to be influential (Cook's Distance $<.002$)²². Therefore, no real multivariate outliers were found with respect to the items used in the analyses.

²¹ The analysis was based on a total of 30 items: 18 PAD-items, 8 approach/avoidance items and 4 mood items.

²² Cook's distance considers changes in all residuals when the case is omitted (Cook, 1977; Norusis, 1993, p333).

Subsequently, concerning the distribution of the variables, both univariate and multivariate normality were examined. With regard to the individual variables, histograms, normal probability plots and detrended normal plots²³ were visually checked for departures from normality. From the histograms, the distributions of all items appear to be roughly bell-shaped. With regard to the normal probability plots, some slight departures from the diagonal can be identified. However, the detrended normal plots did not reveal any striking patterns. Both skewness and kurtosis approximately ranged between -1.5 and $+1.5$ (Muhtén and Kaplan, 1985). Although some variables exhibit a statistically significant departure from univariate normality, these violations appear to be relatively minor and should not present any serious problems in the course of the data analysis. A subsequent normality check, performed in AMOS 3.62 (Arbuckle, 1997, p238), revealed a significant departure from multivariate normality²⁴. In general, however, large sample sizes, tend to diminish the detrimental effects of non-normality (Hair et al., 1998, p71). Maximum likelihood parameter estimates have been found to be rather robust against this kind of violation, provided that sample size exceeds about 100 observations (Steenkamp and van Trijp, 1991; Boomsma, 1982; Gerbing and Anderson, 1985). Also with regard to MANOVA analyses, violations of the assumption of multivariate normality have little impact with larger sample sizes (Hair et al., 1998, p349).

Thus, a total of 777 cases were retained. The characteristics of the respondents in the final sample are presented in the following paragraph.

²³ A normal probability plot compares the cumulative distribution of actual data values with the cumulative distribution of a normal distribution. The line representing the actual data distribution should follow the diagonal closely in order to be able to assume a normal distribution (Hair et al., 1998, p71). In a detrended normal plot the deviations from this straight diagonal line are plotted. In case of a normal distribution, the points should cluster around a horizontal line, through 0, and there should be no pattern (Norusis, 1993, p189).

²⁴ Multivariate normality assumes that the joint effect of multiple variables is normally distributed.

6.4. RESPONDENTS

Tables 6-4 and 6-5 give an overview of the demographic and socio-economic characteristics of the retained 777 participants. The final sample includes a little bit less males than females (respectively 46.5% versus 53.5%). Note that considerably more males suffered from colour vision deficiency. Among the three preconceived age categories, for both men and women fairly equal numbers of respondents were obtained.

Table 6-4: Respondents according to age and gender (n=777)

Gender	Age			Total
	18-30	30-45	45-60	
Male	137 17.7%	116 15.0%	107 13.8%	360 46.5%
Female	153 19.7%	140 18.1%	122 15.7%	415 53.5%
Total	290 37.4%	256 33.0%	229 29.5%	775 100.0%

Moreover, a fairly representative sample was obtained with regard to household size, the number of kids in the households and respondents' occupation, education level and household income.

Table 6-5: Demographic and socio-economic characteristics of respondents (n=777)

Household Size:		%
Mean: 3.26 Std. Dev.: 1.44		
1		10.8
2		23.1
3		19.2
4		30.8
5+		16.1
Number of Kids in Household:		%
Mean: 1.45 Std. Dev.: 1.35		
0		32.0
1		19.4
2		30.7
3+		17.9
Occupation:		%
Full-Time Employed		61.2
Part-Time Employed		11.5
Unemployed / Housewife / Retired		6.3
Student		21.0
Level of Education:		%
Junior High School Diploma or less		5.7
Technical or Professional Education		15.6
General High School Diploma		24.9
Short Type Higher Education		18.3
Long Type Higher Education		6.1
University		29.5
Net Average Monthly Household Income:		%
< 30.000 BEF		6.9
30.000 - 45.000 BEF		11.2
45.000 - 60.000 BEF		20.3
60.000 - 75.000 BEF		14.7
75.000 - 95.000 BEF		11.0
95.000 - 115.000 BEF		14.7
115.000 - 135.000 BEF		9.3
> 135.000 BEF		11.9

Table 6-6 gives an overview of the number of respondents obtained in each condition.

Table 6-6: Number of respondents in each condition (n=777)

Hue	Value	Saturation		Total
		low saturation	high saturation	777
Purple-Blue	dark	24	28	52
	light	27	29	56
		51	57	108
Blue	dark	24	24	48
	light	21	15	36
		45	39	84
Blue-Green	dark	27	26	53
	light	27	29	56
		54	55	109
Green	dark	22	18	40
	light	29	22	51
		51	40	91
Green-Yellow	dark	25	24	49
	light	25	27	52
		50	51	101
Yellow	dark	23	21	44
	light	22	24	46
		45	45	90
Yellow-Red	dark	25	30	55
	light	28	23	51
		53	53	106
Red	dark	25	21	46
	light	20	22	42
		45	43	88

6.5. CONSTRUCT VALIDATION

As the validity of constructs is a necessary condition for theory development and testing, it forms a foundation for scientific progress in marketing (Steenkamp & van Trijp, 1991).

Evaluating the *unidimensionality* of a construct ensures that the questionnaire items cover the same content domain. It can be defined as the ‘existence of one construct underlying a set of items’ (Steenkamp and van Trijp, 1991, p286) and has been recognized as ‘*one of the most critical and basic assumptions of measurement theory*’ (Hattie 1985, p135; Steenkamp and van Trijp, 1991). *Within-method convergent validity* or internal consistency involves ‘the extent to which multiple applications of the same method are in agreement’ and *reliability* refers to ‘the degree to which measures are free from random error’ (Steenkamp and Van Trijp, 1991, p289).

The dimensionality and validity of the PAD-emotion scale and the approach-avoidance scale will be investigated conscientiously in the following paragraphs. Covariance structure modelling provides substantial advantages over traditional methods, such as coefficient alpha²⁵, exploratory factor analysis and bivariate correlations, to assess the criteria for construct validity (Steenkamp and Van Trijp, 1991). For this reason AMOS²⁶ 3.62 (Arbuckle) will be used to validate the different constructs used in this study and in order to purify the measures. Not only the uni-dimensionality of the constructs will be tested this way, but also their within-method convergent validity or internal consistency and reliability...

²⁵ Cronbach’s alpha, which is based on the internal consistency of the items in a scale, is one of the most commonly used reliability coefficients (Norusis, 1994, p147)

²⁶ AMOS is an SPSS program for structural equation modelling.

6.5.1. CONSTRUCT VALIDATION OF THE PAD EMOTION SCALE

6.5.1.1. Exploratory Factor Analysis

According to previous research (Mehrabian and Russell, 1974; Russell and Mehrabian, 1977; Valdez and Mehrabian, 1994) the six pleasure items, the six arousal items and the six dominance items are expected to indicate three underlying dimensions. In order to test the theoretical structure of the measurement instrument, a maximum likelihood confirmatory factor analysis is conducted using AMOS 3.62 (Arbuckle, 1997) on the 18-item, three-factor PAD scale proposed by Mehrabian and Russell (1974). This yielded however unacceptable goodness of fit scores ($\chi^2=1046.513$, $df=132$, $p<.001$, $\chi^2/df=7.928$)²⁷.

In order to explore the uni-dimensionality of the pleasure, arousal and dominance constructs, Principal Component Factor Analyses with Varimax rotations were conducted on the items measuring the respective constructs. This suggested that in fact two separate dimensions underlie the arousal construct, which may explain the ambiguous results regarding this construct reached by previous researchers (Donovan et al., 1994; Van Kenhove and Desrumaux, 1997; see Gröppel-Klein and Baun, 2001). With regard to the dominance construct, results are rather ambiguous. The pleasure construct, on the contrary, appears to be measured very well. The six items clearly underlie one pleasure construct, explaining 66.7% of the variance (Cronbach's $\alpha = .8970$). The factor scores are presented in table 6-7.

²⁷ The overall fit of the model is an indication of the fit between the calculated variance-covariance matrix and the real variance-covariance matrix. A good model shows no significant difference ($p\text{-value}>0.05$) or for larger samples has a chi-square/d.f. <5 .

Table 6-7: Principle Component Factor loadings with Varimax rotated solution

PLEASURE			
Items	Labels	(Cronbach's $\alpha = .8970$)	
P1	depressed – contented	.776	
P2	unhappy - happy	.808	
P3	unsatisfied - satisfied	.889	
P4	annoyed - pleased	.815	
P5	bored - relaxed	.826	
P6	despairing - hopeful	.778	
		66.623 % of the variance explained	
AROUSAL			
	2-factor solution	(Cronbach's $\alpha = .5902$)	(Pearson corr. = .457, p<.001)
A1	relaxed - stimulated	.611	
A2	calm - excited	.740	
A4	dull - jittery	.673	
A6	unaroused - aroused	.651	
A3	sluggish - frenzied		.851
A5	sleepy – wide-awake		.845
		30.029 % of the variance explained	24.362 % of the variance explained
DOMINANCE			
	1-factor solution	(Cronbach's $\alpha = .5834$)	
D1	controlled – controlling	.756	
D2	influenced – influential	.385	
D3	cared for – in control	.493	
D4	awed – important	.608	
D5	submissive - dominant	.440	
D6	guided – autonomous	.675	
		33.029 % of the variance explained	
	2-factor solution	(Cronbach's $\alpha = .5602$)	(Cronbach's $\alpha = .4238$)
D1	controlled – controlling	.763	
D2	influenced – influential	.789	
D6	guided – autonomous	.551	
D3	cared for – in control		.600
D4	awed – important		.578
D5	submissive - dominant		.758
		26.940 % of the variance explained	26.438 % of the variance explained

With regard to the arousal construct, not one, but two factors are extracted with Eigenvalues exceeding unity, explaining together 54% of the variance (or respectively 30% and 24%). Also the Scree plot (presented in figure 6-2), representing the total variance associated with each factor (Cattell, 1966), suggests at least two factors²⁸.

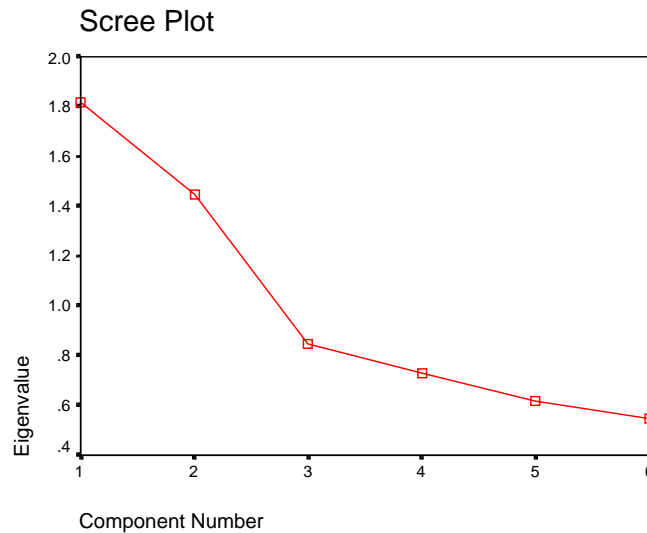


Figure 6-2: Scree plot arousal construct

With regard to this two-factor solution, all items met the cut-off values and could clearly be ascribed to one of the factors. Each item had a minimum factor-loading of .60 and no loading higher than .15 on the other factor. However, the corrected item-total correlations were all unacceptably low (ranging from .33 to .45). The cut-off level for this criterion, opted for by several researchers (Green, Tull and Albaum, 1988; Tabachnik and Fidell, 1989) is .50. Nevertheless, the reliability of the respective dimensions appears adequate (Cronbach's $\alpha = .59$ for the first factor and Pearson correlation = .457, $p < .000$ for the second factor²⁹). The factor scores are presented in table 6-7. The presence of two dimensions underlying the arousal construct has been demonstrated and rationalized in previous research (Walters, Apter and Svebak, 1982; Thayer, 1986; Gorn et al., 1997).

²⁸ Experimental evidence demonstrates that the true number of factors, is indicated by the component number at which the Scree (i.e. the gradual trailing off of the total variance associated with each subsequent factor) begins (Norusis, 1994).

²⁹ Because the second factor is composed of only two items, the correlation between the items is ascertained.

Reversal theory, a phenomenological theory originally proposed by Smith and Apter, 1975 (Apter, 1979, 1982), suggests that instead of one single curve (optimal arousal theory) there are two hypothetical curves relating arousal to hedonic tone, as presented in figure 6-3.

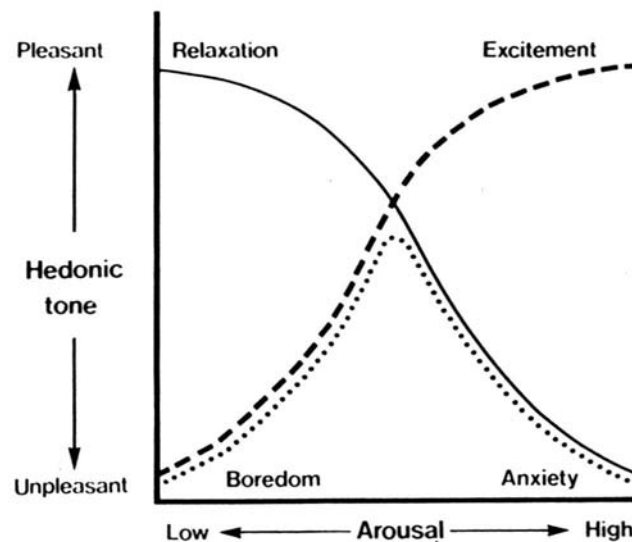


Figure 6-3: Reversal theory:
two hypothetical curves relating arousal to hedonic tone

Source: Walters, Apter and Svebak, 1982, p195.

In contrast to optimal arousal theorists (Hebb & Thompson, 1954; Hebb, 1955; Fiske and Maddi, 1961), who assume that there is only one arousal system with a single optimal point (i.e. “homeostasis”), the theory of psychological reversals (Apter, 1981) argues that there are two systems, each with its own optimal point (i.e. “bistability”). According to this theory, there are consequently two optimal points or “preferred levels” of arousal positioned towards opposite ends of the arousal dimension (i.e. “reversals”). Thus, one system is an “arousal avoiding system” and the other is an “arousal seeking system”. Only one is preferred at a given moment “being the preferred level of the arousal system that is operative at that moment” (Walters, Apter and Svebak, 1982). According to reversal theory, it is possible at any level of arousal to switch from the curve representing one of these systems to the other curve. Low arousal preference has been found to be associated with seriousness and planning orientation (characterizing a “telic state”) and high arousal preference is associated with playfulness and spontaneity (characterizing a “paratelic state”).

The system of emotions proposed by Wundt (1896) actually incorporates three bipolar dimensions: ‘unpleasant-pleasant’, ‘quiet-excited’ and ‘relaxed-tense’.

In a retailing context, the PAD-arousal construct has been shown to be rather ambiguous (e.g. Donovan et al., 1994; Van Kenhove and Desrumaux, 1997; see Gröppel-Klein and Baun, 2001). Claiming that ‘excitement’ represents a pervasively positive reaction in a retail setting, Babin and Attaway (2000) see no reason to include a separate arousal dimension in their study. Also Gröppel-Klein (1998) argues that ‘arousal’ and ‘pleasure’ seem to converge in a retail setting, as ‘positive activation’ appears to be implicitly registered in the arousal construct. Nevertheless, empirical studies by Bost (1987) and Gröppel (1991) reveal that consumers in a retail setting can also experience a pleasant state of low arousal (i.e. relaxation). Thus, too much arousal can, also at the point-of-sale, be experienced as hectic and unpleasant. For this reason, Gröppel-Klein (1998) recommends not to neglect the emotional dimension of “relaxation” experienced in the shopping environment in further studies.

Consistent with such operationalization of arousal, the first dimension (relaxation-tension) appears to be negatively related with pleasure (Pearson correlation = $-.732$, $p < .001$), while the second dimension (boredom-excitement) appears to be positively related with pleasure (Pearson correlation = $.578$, $p < .001$). The scatterplot in figure 6-4 demonstrates the relation between the two distinct arousal dimensions, ‘tension’ and ‘excitement’ and the pleasure dimension. Note that the two arousal dimensions do not seem to be correlated at all (Pearson correlation = $.001$).³⁰

³⁰ These correlations were based on the in Lisrel 8.5 (Jöreskog and Sörbom, 1993; du Toit et al., 1999, p250) calculated latent variable scores of the purified factors (see further).

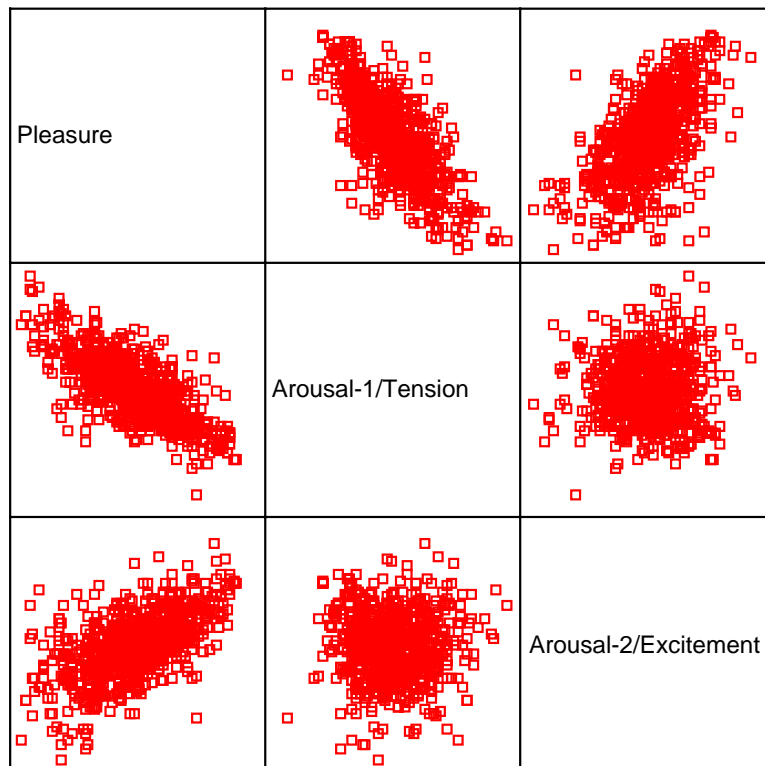


Figure 6-4: Matrix scatterplot revealing the correlations between the two distinct arousal factors and pleasure

With regard to the dominance construct, also two factors seem to underlie the measurement instrument, instead of only one. By means of Principle Component Factor Analysis with Varimax Rotation, two factors are extracted with Eigenvalues exceeding unity, explaining together 53% of the variance (or respectively 27% and 26%). The Scree plot (presented in figure 6-5), representing the total variance associated with each factor (Cattell, 1966), also suggests a two-factor solution.

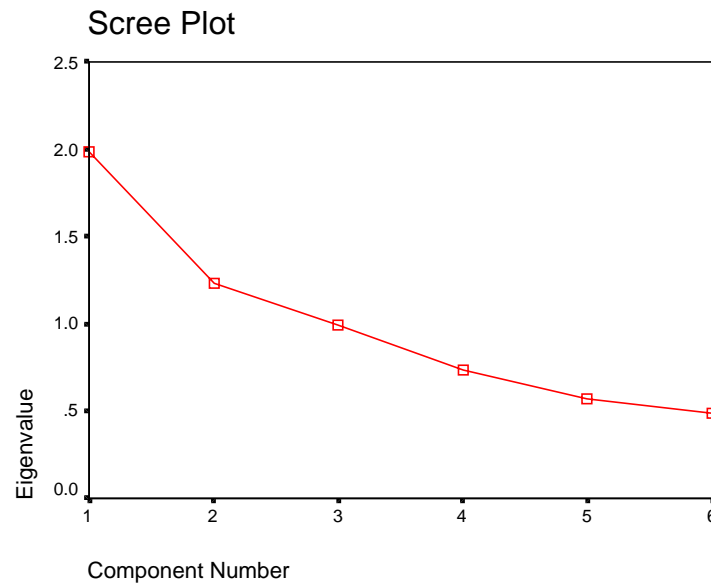


Figure 6-5: Scree plot dominance construct

In fact, a one factor solution can explain only 33 % of the total variance. Moreover, in this case, three items appear to have factor-loadings below .50. Also for this construct the corrected item-total correlations were almost all unacceptably³¹ low (ranging from .19 to .51). The reliability is not high either (Cronbach's $\alpha = .58$).

With regard to the possible two-factor solution, all items could rather clearly be ascribed to one of the two factors. Each item had a minimum factor-loading of .55 and no loading higher than .40 on the other factor. The corrected item-total correlations were all unacceptably low (ranging from .20 to .47). The reliability of the respective dimensions also appears to be very low (Cronbach's $\alpha = .56$ and .42 respectively).

³¹ The cut-off level for this criterion, opted for by several researchers is .50 (Green, Tull and Albaum, 1988; Tabachnik and Fidell, 1989).

The factor scores of both the one- and two-factor solutions are presented in table 6-7.

Because of the low reliability of the two-factor solution and the lack of a theoretical framework to support such a multi-dimensional dominance construct, this two-factor solution will be disregarded and a one-factor solution will be pursued. Nevertheless, in that case, deleting item d2 appears to be called for, because of the low factor loading. This also slightly improves the reliability. Cronbach's α for the five remaining items is .60, which is, however, still rather low.

6.5.1.2. Uni-Dimensionality

A maximum likelihood confirmatory factor analysis using AMOS 3.62 (Arbuckle), conducted on each of the constructs separately indeed reveals that there appear to be two separate non-related arousal dimensions within the arousal construct. The pleasure construct on the other hand clearly is uni-dimensional. As far as the dominance construct is concerned, the one-dimensional solution performs best and appears to be highly reliable³².

In order to test the proposed theoretical structure of the measurement instrument, a maximum likelihood confirmatory factor analysis is conducted on the 17 remaining items, using AMOS 3.62 (Arbuckle, 1997). On the basis of the exploratory factor analyses four correlated underlying dimensions are assumed: pleasure, tension, excitement and dominance.

First of all, three items (a6, d3 and d5) obviously have to be eliminated because of extremely low standardized regression weights (<.40). This way a satisfactory overall fit of the model is

³² Correlating three pairs of error-terms (error d3–d6; error d4–d5 and error d3–d5) resulted in excellent goodness of fit scores ($\chi^2=.22$, $df=2$, $p=0.896$, $\chi^2/df=.11$). Error-terms can be correlated when several observed variables, which are supposed to be indicators of one latent construct have some systematic error (i.e. they measure something in common, somewhat different from the latent construct they are supposed to measure). Detailed discussions on correlating errors are given by Cote, Netemeyer and Bentler in a recent methodological issue of the *Journal of Consumer Psychology* (2001, p87-89). In fact, it seems justified to correlate error-terms in this particular case, because we assume that the dominance 'state' emotion scale also captures some dominance 'trait', a personality characteristic (see Mehrabian, 1996). The standardized regression weights for the 5 remaining items (remember that item d2 was removed on the basis of the exploratory factor analysis) are all significant (critical ratio > 1.96).

achieved ($\chi^2=278.767$, $df=71$, $\chi^2/df=3.926$, $p=0.000$)³³. Nevertheless, because large standardized residuals³⁴ point to possible multidimensionality (Steenkamp and Van Trijp, 1991), these were carefully examined. 5 standardized residuals were detected exceeding the |2.58| norm. Dropping the corresponding items (p6 and a1) (Jöreskog and Sörbom, 1989), a very satisfactory four-factor model was obtained. Overall goodness of fit measures are presented in table 6-8. Acceptable values for a good fit (Marsh and Hovecar, 1985; Bentler, 1990, Bagozzi and Baumgartner, 1994; Sharma, 1996; Baumgartner and Homburg, 1996), are provided in the first column of this table. With this solution no standardized residuals exceed the |2.58| norm. Overall, the fit indices show a very good fit for the resulting four-factor model. The obtained model is shown in figure 6-6.

³³ It has to be added that the chi square test is highly dependent on the sample size, and that its hypothesis of an exact reproduction of the sample covariance matrix by the implied covariance matrix of the model is often considered to be overly rigid. Models that fit the data well, often have to be rejected on the basis of the chi square value (Bollen and Long, 1993; Bagozzi and Baumgartner, 1994).

³⁴ Standardized residuals are the residuals from the observed and reproduced covariance matrix divided by their asymptotic standard errors, and values exceeding |2.58| indicate misspecification (Jöreskog and Sörbom, 1988).

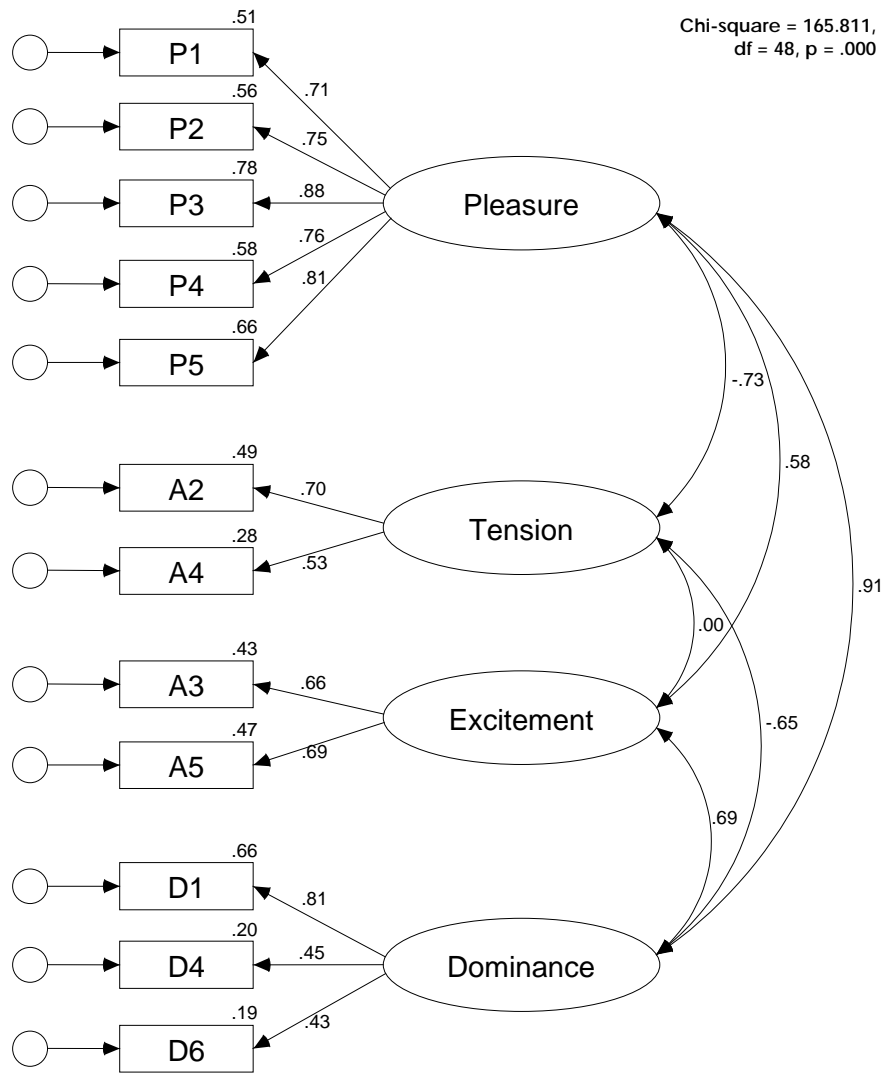


Figure 6-6: Path coefficients of the four-correlated factor PAD emotion construct in our sample³⁵

Goodness-of-fit indices	Acceptable values	4-correlated factor model
χ^2 , (df)	Small	165.811, (48)
p-value	>.05	0.000
χ^2/df	<5	3.454
Goodness-of-fit index (GFI)	>.90	0.965
Adjusted Goodness-of-fit index (AGFI)	>.80	0.943
Tucker and Lewis non-normed fit index (TLI)	>.90	0.957
Benler's normed Comparative Fit Index (CFI)	>.90	0.969
Root mean squared error of approximation (RMSEA)	<.08	0.056
Standardized residuals > 2.58	No	No
Factor regression coefficients > .50	Yes	10 out of 12

Table 6-8: Goodness of fit measures for the four correlated factor structure in the PAD scale (several items were dropped)

³⁵ The exact items referred to, can be retrieved on p 300 where the full scale is presented.

6.5.1.3. Within-Method Convergent Validity

According to Steenkamp and Van Trijp (1991, p289) ‘within-method convergent validity’ deals with ‘the extent to which multiple applications of the same method are in agreement’ (Steenkamp and Van Trijp, 1991, p289). They claim that this should be tested before reliability of the measurement instrument is assessed. Provided that the overall fit of the model is acceptable, they argue that a condition for within-method convergent validity is that the factor regression coefficients on a particular item are statistically significant (weak condition) and substantial (stronger condition). With respect to the latter criterion, it has been suggested by Hildebrandt (1987) that the correlation between the item and the construct should exceed .50. In case of the adapted four-factor PAD-emotion scale in this study, almost all of the factor regression coefficients exceed the .50 norm. However, the standardized regression weights of two dominance items score slightly lower. Nevertheless, all factor regression coefficients were highly significant (critical ratio’s >11)³⁶.

6.5.1.4. Reliability

Reliability refers to ‘the degree to which measures are free from random error’ (Steenkamp and Van Trijp, 1991, p289) and should be estimated only provided that within-method convergent validity is achieved (Steenkamp and Van Trijp, 1991; see also Bagozzi, 1981b; Bagozzi et al., 1990). With regard to the reliability of the individual items, Bagozzi and Baumgartner (1994) suggest that the lower acceptable bound of the squared correlation between the item and the construct is 0.4. Two dominance items (d4 and d6) and one tension item (a4) score somewhat lower on this criterion. To assess the reliability of the respective dimensions, the composite reliabilities were ascertained, as well as the average variances extracted³⁷ (Bagozzi, 1980; Bagozzi and Yi, 1988; Fornell and Larcker, 1981; Steenkamp and van Trijp, 1991; Baumgartner and Homburg, 1996; Bagozzi and Baumgartner, 1994). The ‘pleasure’ factor proved to be very reliable with a composite reliability of .89 and an average variance extracted of .62. ‘Tension’ scores considerably lower, with a composite reliability of

³⁶ In order for a regression weight to reach statistical significance at the .05 level, its critical ratio should exceed |1.96| (see Arbuckle, 1997, p292).

³⁷ For a scale to possess good reliability, its composite reliability should be between 0.60 and 0.80 and the average variance extracted at least 0.50 (Bagozzi and Yi, 1988).

only .55. The average variance extracted reached only .38. Because only two items were retained to assess this factor, also Pearson's correlation coefficient is checked, which, nevertheless, appears to be highly significant ($r=.368$, $p<.001$). The composite reliability of 'excitement' reaches .62, with an average variance extracted of .45. We verified Pearson's correlation coefficient in this case too, as only two items are included here as well. This proved also to be highly significant ($r=.452$, $p<.001$). Finally the composite reliability for the 'dominance' construct amounts to .58, which is also rather low. The average variance extracted reached only .35. We can conclude that some random error is captured by our measures, in addition to what we intended to measure. Whereas the pleasure factor scores extremely well with regard to its reliability, the other factors score somewhat lower, but still almost meet the minimum criteria of .60 (Bagozzi and Yi, 1988), which is rather satisfactory considering the low number of items retained to capture the underlying constructs.

6.5.1.5. Discussion

Overall, the goodness of fit indices show a good fit for the resulting four-factor model. The uni-dimensionality, within-method convergent validity and reliability of the underlying pleasure, tension, excitement and dominance constructs prove to be adequate. However, we note that dominance does not score very well with regard to reliability and that the standardized regression weights of two dominance items do not score high either. Moreover, the 'dominance' dimension appears to be extremely highly correlated with the 'pleasure' dimension ($r = .91$). In order to test whether 'pleasure' and 'dominance' do not involve in fact one and the same dimension, we will investigate the discriminant validity of the dominance construct. According to Fornell and Larcker (1981) a scale possesses discriminant validity if the average variance extracted by the underlying construct is larger than the shared variance (i.e. the squared intercorrelation) with other latent constructs. Since the squared correlation among pleasure and dominance (.83) exceeds the variance extracted in both the pleasure and dominance scales (respectively .62 and .35), the discriminant validity of the dominance construct is rather questionable. An additional, less stringent, analysis of discriminant validity (Steenkamp and van Trijp, 1991) consists of examining whether applying an additional restriction of perfect correlation between the two dimensions does not result in a better fit. This can be examined by determining the difference between the χ^2 of the nested model (i.e. the more restricted model with the constraint of perfect correlation between

pleasure and dominance) and the χ^2 of the initial model (allowing for free correlation) and dividing this result by the difference in the degrees of freedom between the two models (Sharma, 1996). This test³⁸ $[(180.56 - 165.81) / (49-48) = 14.75 > 3.84 (\chi^2_{0.95, 1df})]$ reveals that the additional constraint of perfect correlation between the pleasure and dominance dimensions is not justified. The model assuming free correlation between the two factors fitted the data significantly better than the model constraining the correlation to one. Therefore, pleasure and dominance prove to be two highly correlated but separate factors³⁹.

Still, because of the low within-method convergent validity and reliability, the question remains whether or not the 'dominance' dimension should be dropped altogether. In line with Russell and Pratt's (1980) conceptualisation that the 'dominance' dimension is not applicable in environments calling for an affective response, we could consider ignoring the 'dominance' dimension, as several researchers have done in the past (e.g., Van Kenhove and Desrumaux, 1997, Sherman et al., 1997). However, several other researchers in the retailing context, have referred to the importance of the all too often ignored 'dominance' dimension (Gröppel-Klein, 1998; Foxall, 2000). Foxall (1997) proposes that the role of 'dominance' may depend on the type of consumer setting investigated. This may be responsible for the failure of past studies to find a role for 'dominance'. In the same vein, Turley and Milliman (2000) also note that the importance of the 'dominance' dimension may be context specific, depending on the independent store environmental variables investigated. Since the specific effects of colour on the 'dominance' dimension have been demonstrated (Valdez and Mehrabian, 1994), it seems appropriate to retain the construct. For these theoretical reasons and because the adapted 4-factor model appears to have an adequate overall fit, it was decided to retain the 'dominance' dimension for further analyses. Although it has to be noted that results concerning the 'dominance' dimension should be interpreted with caution.

³⁸ Discriminant validity among these constructs was tested in Lisrel 8.5 (Jöreskog and Sörbom, 2001).

³⁹ This procedure for identifying discriminant validity was also followed by Babin, Darden and Babin, 1998.

6.5.2. CONSTRUCT VALIDATION OF THE APPROACH – AVOIDANCE SCALE

6.5.2.1. Exploratory Factor Analysis

The original approach–avoidance intentions scale, introduced to the study of environmental psychology by Mehrabian and Russell (1974), was adapted to the retailing context by Donovan and Rossiter (1982). Since there appears to be some inconsistency in the literature with regard to the conceptualisation of the approach-avoidance construct (see chapter 2), both exploratory and confirmatory factor analyses will be conducted on the 8-item retail-specific approach-avoidance scale proposed by Donovan and Rossiter (1982).

In order to explore the underlying factor structure of the eight items, measuring approach-avoidance intentions, first a Principal Component Factor Analysis with Varimax rotation was performed. This way, two factors are extracted with Eigenvalues exceeding unity, explaining 67.57% of the variance (40.35% and 26.97% respectively for F1 (approach) and F2 (avoidance)).

The Scree plot (presented in figure 6-7), representing the total variance associated with each factor (Cattell, 1966), also clearly suggests a two-factor solution.

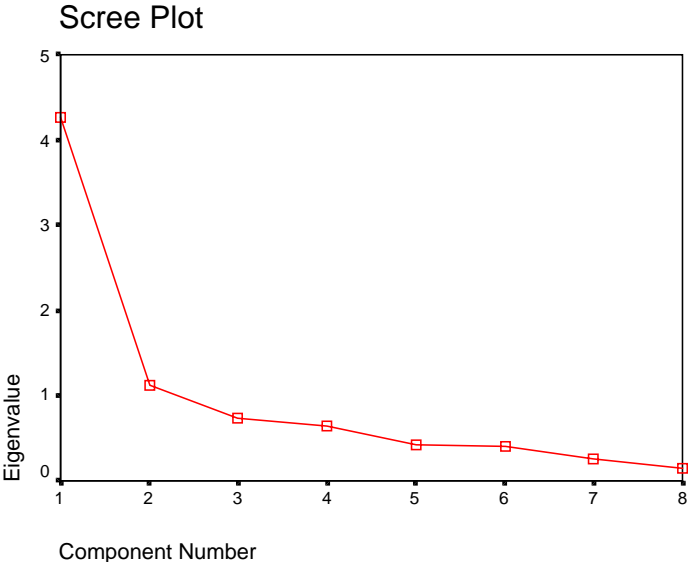


Figure 6-7: Scree plot approach-avoidance construct

All items could clearly be ascribed to one of these two factors. Each item had a minimum factor-loading of .65 and no loading higher than .4 on the other factor. The corrected item-total correlations were all high, except for the reversed 'affiliation' item (Apav3) and the retail-specific 'money spending' item (Apav8), for which the item-total correlations amounted respectively to .43 and .49. Although the cut-off level for this criterion, opted for by several researchers (Green, Tull and Albaum, 1988; Tabachnik and Fidell, 1989) is .50, both items were provisionally retained. The factor scores are presented in table 6-9.

The resulting factors clearly reveal two separate approach and avoidance dimensions with high coefficient alphas, pointing to a high internal validity of the factors. Recently, Foxall (1990, 1997; Foxall and Greenley, 2000) also suggested that approach and avoidance make up two separate underlying dimensions of the approach-avoidance construct. Referring to Alhadeff (1982), Foxall argues that consumer behaviour in any given situation can be explained as the outcome of two opposing learning histories, with the strength of approach being a function of the individual's learning history with respect to prior approach behaviour and their consequences, while the strength of avoidance/escape constitutes a function of the individual's learning history with prior avoidance/escape and their consequences (Foxall, 1997, p514, Foxall and Greenley, 2000). Therefore, he resumes that approach and avoidance cannot be represented psychometrically by a single continuum from escape/avoidance to approach. Moreover, pleasure, arousal and dominance have been found to exert independent influences upon approach and avoidance responses (Foxall, 1997; Foxall and Greenley, 2000).

Table 6-9: Principle Component Factor loadings with Varimax rotated solution

APPROACH-AVOIDANCE			
Items	Labels	Factorloading mean	Approach
			Avoidance
			0.772
			Cronbach's $\alpha = 0.874$
			0.748
			Cronbach's $\alpha = 0.707$
Apav 1	I like to spend much time browsing in this store (Time)	.843	
Apav4	This is a place in which I feel friendly and talkative to store personnel who happens to be near me (Affiliation)	.654	
Apav5	I like this store environment (Affect)	.792	
Apav6	I enjoy shopping in this store (Affect)	.854	
Apav8	This is the sort of place where I might end up spending more money than I originally set out to spend (Spending)	.716	
Apav2	I want to avoid looking around or explore this store (Time - Reversed)		.730
Apav3	This is a place where I try to avoid other people, and avoid to talk with them (Affiliation - Reversed)		.805
Apav7	I would avoid ever having to return to this store (Affect - Reversed)		.710
Explained variance: 67.32%			40.35%
			26.97%

6.5.2.2. Uni-Dimensionality

Because traditional approach–avoidance studies (Mehrabian and Russell, 1974; Russell and Mehrabian, 1976, 1978; Donovan and Rossiter, 1982; Bellizzi and Hite, 1992; Van Kenhove and Desrumaux, 1997, Matilla and Wirtz, 2001) have always considered approach and avoidance to be the opposite poles in a uni-dimensional approach-avoidance construct, we will submit the 8-item approach-avoidance scale to a maximum likelihood confirmatory factor analysis, performed in AMOS 3.62 (Arbuckle, 1997). This yielded however

unacceptable goodness of fit scores ($\chi^2=332.528$, $df=20$, $p<.001$, $\chi^2/df=16.626$). Five standardized residuals, with values exceeding $|2.58|$, were detected. Because large standardized residuals point to possible multidimensionality (Steenkamp and Van Trijp, 1991), these were carefully examined. The pattern of standardized residuals was informative for re-specification⁴⁰. Clearly three items could be identified, which are responsible for the unacceptable fit of the initial one-factor model. The originally reversed-scored items Apav3, Apav7 and Apav2 appear to constitute a separate ‘avoidance’ dimension, conform to the second factor extracted by the exploratory Principal Component factor analysis with Varimax rotation.

Thus, two dimensions appear to underlie approach and avoidance responses in our study. A separate approach dimension, containing 5 high loading items, and an avoidance dimension, consisting of 3 high loading items, could be revealed. In order to determine whether this two-factor solution is tenable, a maximum likelihood confirmatory factor analysis was undertaken on the re-specified model. This yielded however still unacceptable goodness of fit scores ($\chi^2=134.834$, $df=19$, $p<.001$, $\chi^2/df=7.097$). One standardized residual was detected exceeding $|2.58|$. Dropping an item (Apav4) pertaining to this ‘offending’ residual⁴¹ (Jöreskog and Sörbom, 1989) resulted in a satisfactory two-factor model. Overall goodness of fit measures are provided in table 6-10. With this solution no standardized residuals exceed $|2.58|$. Overall, the goodness of fit indices show a good fit for the resulting two-factor model. The obtained model is shown in figure 6-8.

⁴⁰ A subset of items could be detected with large positive residuals among each other (representing underfitting) and negative, although small, standardized residuals with most of the other items pertaining to the original factor, which may suggest that the subset constitutes a separate factor (see Steenkamp and van Trijp, 1991, p287).

⁴¹ If no clear pattern indicating misspecification emerges, as in this case, Steenkamp and van Trijp (1991) suggest it is best to delete the defective item.

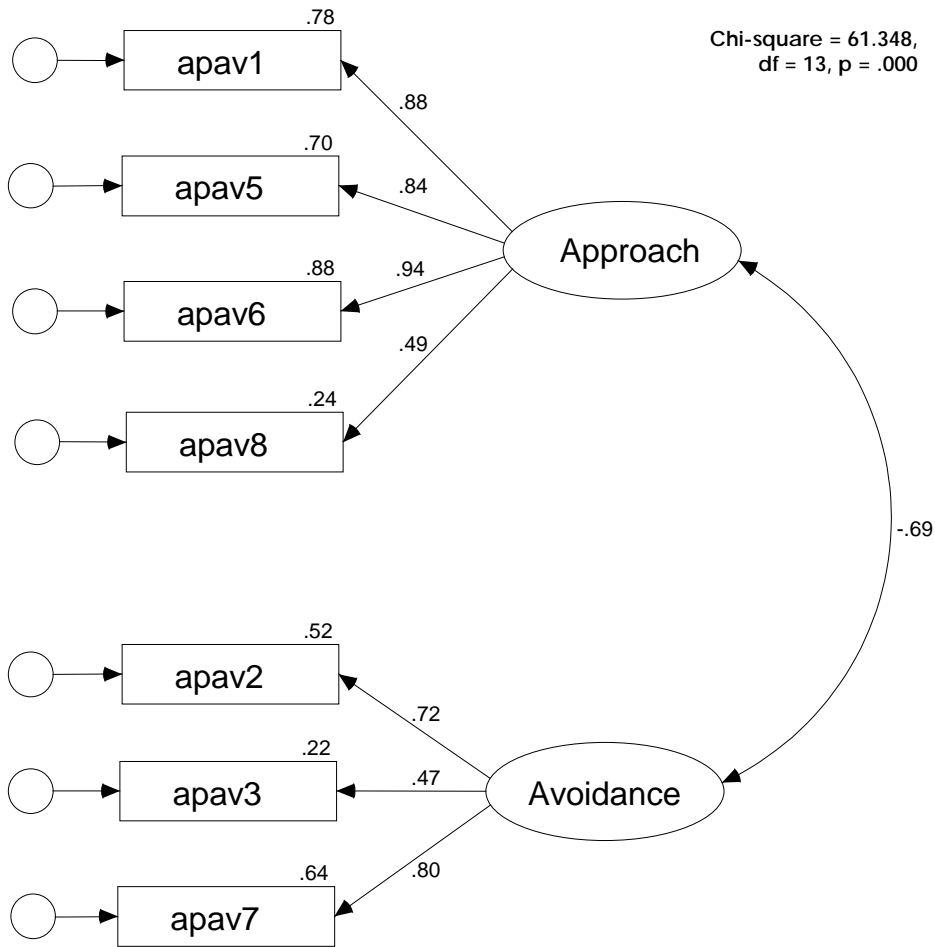


Figure 6-8: Path coefficients in the two-correlated-factor model underlying the Approach-Avoidance construct in our sample

Goodness-of-fit indices	Acceptable values	2-correlated factor model
χ^2 , (df)	Small	61.348, (13)
p-value	>.05	0.000
χ^2/df	<5	4.719
Goodness-of-fit index (GFI)	>.90	0.978
Adjusted Goodness-of-fit index (AGFI)	>.80	0.953
Tucker and Lewis non-normed fit index (TLI)	>.90	0.971
Benler's normed Comparative Fit Index (CFI)	>.90	0.982
Root mean squared error of approximation (RMSEA)	<.08	0.069
Standardized residuals > 2.58	No	No
Factor regression coefficients > .50	Yes	5 out of 7

Table 6-10: Goodness of fit measures for the two correlated factor structure of the 7-item approach-avoidance scale (item apav 4 was dropped)

6.5.2.3. Within-Method Convergent Validity

Considering that the overall fit of the model is satisfactory, we verify whether the factor regression coefficients are statistically significant and substantial (Steenkamp and van Trijp, 1991; Hildebrandt, 1987). In case of the two-dimensional approach-avoidance scale in this study, standardized regression weights appear to be high and almost all exceed the .50 norm. Only two standardized regression weights score slightly lower, but almost achieve the norm: .47 and .49. Moreover, all factor regression coefficients were highly significant (critical ratio's >11.45)⁴².

6.5.2.4. Reliability

As within-method convergent validity appears to be adequate, reliability can be ascertained (Steenkamp and Van Trijp, 1991; see also Bagozzi, 1981b; Bagozzi et al., 1990). As far as the individual items are concerned, one approach item (apav8) and one avoidance item (apav3) do not appear to be very reliable. The squared correlations, between these items and the constructs they are supposed to capture (respectively approach and avoidance), do not meet the minimum criterion of 0.4 proposed by Bagozzi and Baumgartner (1994). To assess the reliability of the respective dimensions, the composite reliabilities were ascertained, as well as the average variances extracted⁴³ (Bagozzi, 1980; Bagozzi and Yi, 1988; Fornell and Larcker, 1981; Steenkamp and van Trijp, 1991; Baumgartner and Homburg, 1996; Bagozzi and Baumgartner, 1994). The approach dimension proved to be very reliable with a composite reliability of .88 and an average variance extracted of .65. Also for the avoidance dimension an adequate composite reliability was obtained: .71. The average variance extracted reached .46. We can conclude that the approach/avoidance measure was highly reliable, with the composite reliabilities of the approach and avoidance factors both well exceeding the minimum criteria of .60 (Bagozzi and Yi, 1988). The average variance extracted of the avoidance construct was slightly lower than the .50 criterion proposed by Bagozzi and Yi (1988).

⁴² In order for a regression weight to reach statistical significance at the .05 level, its critical ratio should exceed |1.96| (see Arbuckle, 1997, p292).

⁴³ For a scale to possess good reliability, its composite reliability should be between 0.60 and 0.80 and the average variance extracted at least 0.50 (Bagozzi and Yi, 1988).

6.5.2.5. Discussion

Overall, the goodness of fit indices show a good fit for the resulting two-factor model. The uni-dimensionality, within-method convergent validity and reliability of the underlying approach and avoidance constructs prove to be satisfactory. However, the ‘avoidance’ dimension appears to be rather highly correlated with the ‘approach’ dimension ($r = -.69$). In order to test whether ‘approach’ and ‘avoidance’ do not involve in fact two opposite poles of one and the same dimension, as traditionally suggested, their discriminant validity was investigated (cfr. Babin, Darden and Babin, 1998). The squared correlation among approach and avoidance (.48) slightly exceeds the variance extracted in the avoidance scale (.46), but not the average variance extracted in the approach scale (.65)⁴⁴. An additional, less stringent, analysis of discriminant validity⁴⁵ (Steenkamp and van Trijp, 1991) $[(267.02 - 61.35) / (14 - 13) = 205.67 > 3.84 (\chi^2_{0.95}, 1df)]$ reveals that the additional constraint of perfect correlation between the ‘approach’ and ‘avoidance’ dimensions is not justified. The model assuming free correlation between the two factors fitted the data significantly better than the model constraining the correlation to one. Therefore, ‘approach’ and ‘avoidance’ prove to be two correlated but separate factors, as suggested by Foxall (1990, 1997; Foxall and Greenley, 2000).

Discriminant validity of ‘approach’ and ‘avoidance’ was also examined with regard to the ‘pleasure’, ‘tension’, ‘excitement’ and ‘dominance’ constructs⁴⁶. Correlations between each of the constructs proved all to be significantly different from unity.

⁴⁴ A scale is presumed to possess discriminant validity if the average variance extracted by the underlying construct is larger than the shared variance (i.e. the squared intercorrelation) with other latent constructs (Fornell and Larcker, 1981).

⁴⁵ Examined was whether applying an additional restriction of perfect correlation between the two dimensions does not result in a better fit. This was done by determining the difference between the χ^2 of the nested model (i.e. the more restricted model with the constraint of perfect correlation between ‘approach’ and ‘avoidance’) and the χ^2 of the initial model (allowing for free correlation) and dividing this result by the difference in the degrees of freedom between the two models (Sharma, 1996). This test was performed in Lisrel 8.5 (Jöreskog and Sörbom, 2001).

⁴⁶ Discriminant validity among these constructs was also tested in Lisrel 8.5 (Jöreskog and Sörbom, 2001).

6.6. STORE-COLOUR-EVOKED EMOTIONS

6.6.1. INTRODUCING MOOD AS A COVARIATE

It is clear that assessments of feeling states within a store environment will reflect feeling states brought to the environment, as well as those induced by the environment (Dawson et al., 1990; Swinyard, 1993; Mano, 1999). No doubt, emotions measured in the store will include some combination of both. Therefore Donovan et al. (1994) suggests that future studies should measure emotions prior to entering the store, as well as some time after entering the store. For this reason, we would like to take into account the pre-existing mood states of the participants in the current empirical study. We acknowledge that respondents' general pre-existing moods at the time of questioning, can significantly affect how they will respond to the store colour (Walters, Apter and Svebak, 1982; Ziems and Christman, 1998). Indeed, Ziems and Christman (1998) found mood to have an effect on affective reactions to colour. They induced participants' moods by having them listen to happy versus sad music and instructing them to think happy versus sad thoughts. Thus, induced mood was shown to affect the speed with which colours, differing on the arousal dimension, could be discriminated. Nevertheless, as consumers' moods are difficult to manipulate and as they are not the main focus of our study, we will try to control for them by including general mood as a covariate⁴⁷ in the analyses.

Pre-existing mood was measured by a short mood inventory (Peterson and Sauber, 1983) before exposure to the stimulus. The uni-dimensionality of the mood-scale was assessed conducting a maximum likelihood confirmatory factor analysis in AMOS 3.62 (Arbuckle, 1997). A satisfactory fit was obtained when the error-terms of the reversed-scored items are allowed to correlate⁴⁸ ($\chi^2=0.401$, $df=1$, $\chi^2/df=0.401$, $p=0.527$). One regression weight (mood

⁴⁷ Metric covariates are typically included in an experimental design to remove extraneous influences from the dependent variable, thus increasing the within-group variance (Hair et al., 1998, p346).

⁴⁸ It seems justified to correlate error-terms in this particular case, because we suspect a potential method effect. In fact, a major controversy actually concerns the bi-polarity of the mood construct (Babin et al., 1998). Several researchers have however imputed the independence of a positive and a negative mood dimension to an artifact of method (Russell and Carroll, 1999). As the scale to measure pre-existing mood, used in this study, was intended to be bi-polar (Peterson and Sauber, 1983), we assume it is justified to correlate the error terms of the originally reversed scored items. Nevertheless, we acknowledge that our decision may be subject to debate (detailed discussions on the bi-polarity controversy, which appears to be central to the psychology of affect, can be found in Russell and Carroll, 1999 and Babin et al., 1998). Detailed discussions on correlating

3) scored slightly lower (.39), but remained significant (critical ratio=9.025). As with this solution none of the standardised residuals exceed the |2.58| norm and a satisfactory composite reliability of .73 was obtained, it was decided to retain the four items of the original scale. Scores for the latent mood variable are computed in LISREL 8.5 and used as a covariate in the further analyses. Thus, by measuring the potentially confounding pre-existing mood variable, we can control statistically its effect on the dependent variables (Cook and Campbell, 1979).

6.6.2. HYPOTHESES TESTING: MULTIVARIATE ANALYSIS OF VARIANCE (MANCOVA)

In order to test a first set of hypotheses (H1-H9), concerning the emotions elicited by store colour, a three-way (8 x 2 x 2) multivariate analysis of variance⁴⁹ (MANOVA) was performed in SPSS 10, with pleasure, tension, excitement and dominance as the dependent variables and *hue* (eight categories: Purple-Blue, Blue, Blue-Green, Green, Green-Yellow, Yellow, Yellow-Red and Red), *saturation level* (high/low) and *value* (high/low) as fixed factors. Pre-existing mood was included in the analysis as a covariate (i.e. MANCOVA) (see Tacq, 1997, p346).

Thus, this analysis will test more specifically whether there are significant differences between the ‘centroids’ or vectors of multiple means of the emotions (i.e. pleasure, tension, excitement and dominance) elicited by (1) store colour hue, (2) store colour brightness and (3) store colour saturation.

But first let us take a look at the basic assumptions for this analysis: the dependent variables are required to have a multivariate normal distribution with the same variance-covariance matrix in each group.

errors are given by Cote, Netemeyer and Bentler in a recent methodological issue of the Journal of Consumer Psychology (2001, p87-89).

⁴⁹ Multivariate analysis of variance (MANOVA) is an extension of univariate analysis of variance (ANOVA), which can accommodate more than one dependent variable and is particularly useful when used in conjunction with an experimental design, in which the independent variable is manipulated in order to examine its effect on the dependent variables (Hair et al., 1998, p326-327). Although ANOVA tests can be computed separately for each of the dependent variables, this approach ignores the interrelation among them, and thus the possibility that some composite (linear combination) of the dependent variables may provide evidence of an overall group difference, that may not be detected otherwise. Moreover, conducting a series of separate ANOVA tests would fail to provide control of our effective overall experiment-wide Type 1 error rate (Hair et al., 1998, p339).

With regard to the normality assumption, we refer to section 6.3., where this supposition has already been examined. While it is apparent that multivariate normality is not achieved, it has been demonstrated that such a violation has little impact for multivariate analyses of variance when larger sample sizes are analysed (Hair et al., 1998, p349). Because we have a sufficiently large sample, this violation should not pose any problems for our analyses.

Secondly, the assumption of homoscedasticity (an equal dispersion in each cell) must be examined before starting with the analyses. Moreover, since we are dealing with dependent variables, which are mutually associated, the co-variations among them should not differ too much per cell either (Tacq, 1997, p354). Box's M test is used to examine this homogeneity of within-variations and co-variations. It tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups. Box's M reaches a significance level of .049 for the eight hue-categories; for the two brightness levels Box's M attained a p-value of .794 and for the two saturation levels, eventually, a significance level of .683 is obtained. For saturation and brightness levels these p-values are well above the postulated α of .05. With regard to the hue categories, the significance level also almost reaches the required level⁵⁰. Because the observed covariance matrices of the dependent variables do not appear to be very different across the groups, we can accept the assumption of homoscedasticity.

As the violation of one of the basic assumptions (i.e. multivariate normality) is not expected to cause any real problems because of the sufficient sample size, we can go ahead and conduct the MANCOVA analysis. The results of this analysis are presented next.

Wilks' lambda⁵¹ reveals significant main effects of store colour hue ($p=.028$) and store colour value ($p=.017$) on the emotions elicited, but not of store colour saturation ($p=.101$). Nevertheless, a significant two-way (hue x saturation) interaction effect seems to exist ($p=.026$), as well as a significant three-way (hue x value x saturation) interaction effect ($p=.031$).

⁵⁰ Note that Box's M is very sensitive to departures from normality (Norusis, 1994, p72).

⁵¹ Wilks' lambda is a rather robust criterion to assess multivariate differences across groups, which is relatively immune to violations of the assumptions underlying MANOVA (especially for larger sample sizes) and yet maintains high power (Hair et al., 1998, p351).

As expected, the respondents' pre-existing mood (the covariate introduced to the model) also proved to have a highly significant effect on the emotions experienced after exposure to the stimulus (Wilks' lambda, $p < .001$), thus revealing clearly the necessity to control for this intervening variable. Although a participant's mood did not seem to significantly affect his/her perceived tension (Pearson's $r = -.037$, $p = .357$), mood did appear to be significantly related to experienced pleasure (Pearson's $r = .100$, $p = .010$), excitement (Pearson's $r = .142$, $p < .001$) and dominance (Pearson's $r = .142$, $p < .001$). As a consequence, in all subsequent analyses, respondents' pre-existing general state of mind or mood will be controlled for.

With regard to the power⁵² of the experiment, we assumed that the large sample size would be adequate to detect rather small true differences. Retrospectively, satisfactory average observed power-levels were obtained, in general well exceeding the suggested .80 norm⁵³.

In the following paragraphs we will take a closer look at the individual hypotheses with regard to the effects of store colour hue, saturation and brightness on experienced feelings of pleasure, tension, excitement and dominance. Table 6-11 gives a comprehensive overview of the findings.

⁵² The power of an experiment refers to the probability of rejecting the null hypothesis when it is false and depends on the magnitude of the true differences and the sample size (Norusis, 1994, p41; Cohen, 1977).

⁵³ With regard to the effects of colour saturation and the value x saturation interaction, smaller power-levels (.61 and .10 respectively) were observed. However, the latter probably only reflects the low actual effect-size (partial-Eta-squared for the value x saturation interaction amounted to a mere .001). For clear discussions on observed power and effect sizes, we refer to Trochim, 2002, Becker, 1999 and the following anonymous website: <http://www.linguistics.ucla.edu/faciliti/facilities/statistics/power.htm>.

Table 6-11: Main and interaction effects of store colour wavelength, saturation and value on elicited emotions

										MAIN EFFECTS			INTERACTION EFFECTS																			
										Colour Wavelength			Colour Value			Colour Saturation		Hue x Value	Hue x Saturation	Value x Saturation	Hue x Saturation x Value											
										PB	B	BG	G	GY	Y	YR	R	p	Low	High	p	Low	High	p	p	p	p	p				
EMOTIONS																																
Pleasure										5	1 ^a	6	4	8 ^a	2	3	7	.037	-.074	.075	.037	.034	-.033	ns	ns	ns	ns	ns	ns	ns	ns	
Tension										5	8 ^b	6	7	1 ^b	4	3	2	.047	.081	-.081	.024	-.076	.077	.033	ns	ns	ns	ns	ns	ns	ns	
Excitement										7	5	4	6	3	2	1	8	ns	-.026	.010	ns	-.010	-.006	ns	ns	.010	ns	ns	.019	ns		
Dominance										6	1	4	5	8	3	2	7	ns	-.040	.034	ns	.035	-.040	ns	ns	ns	ns	ns	ns	ns	ns	ns
WILK'S LAMBDA										.028			.017			ns		ns	.026		ns	.031										

Results from a MANCOVA analysis, including pre-existing mood as a covariate (Wilk's lambda, $p < .001$).
 With regard to colour wavelength average rankings are given, from 1 (highest scoring) to 8 (lowest scoring).
^a Means scores are significantly different (post-hoc Bonferroni, $p = .028$)
^b Means scores are significantly different (post-hoc Bonferroni, $p = .012$)

6.6.3. STORE COLOUR-EVOKED PLEASURE

6.6.3.1. Store Colour Hue

H1: *A negative U-shaped relationship was hypothesized between store-colour wavelength and store-elicited pleasure, with the stores with extreme long wavelength colours (red) expected to be judged less pleasant than the stores with extreme short wavelength colours (blue) and the mid-wavelength colours (green-yellow) at the bottom of the U, being judged least pleasant.*

Since, with regard to elicited pleasure, independence⁵⁴ was reached in the factorial design among hue, value and saturation, the main effects could be interpreted directly (Hair et al., 1998, p344). Store-colour-evoked pleasure was in fact found to differ significantly among the different hue categories ($p=.037$). The average pleasure elicited by the various hues is represented in figure 6-9. The hues are arranged according to increasing wavelengths. In contrast to expectations, however, no clear pattern seems to emerge in the pleasure evoked by short to long wavelength hues. Post-hoc comparisons among the hues showed only the difference in elicited pleasure between blue and green-yellow to be significant (Bonferroni, $p=.028$). This difference was in the hypothesized direction, with blue being the store-colour eliciting most pleasure and green-yellow evoking least pleasure (respective standardized average pleasure ratings were .219 versus -.263). The extreme long wavelength-colour red also scored rather low with regard to elicited pleasure (the standardized pleasure rating for red averaged -.142). In contrast, other long-wavelength hues, yellow and yellow-red, were judged to be very pleasant. According to increasing pleasure, hues can be ranged as follows:

Green-Yellow / Red / Blue-Green / Purple-Blue / Green / Yellow-Red / Yellow / Blue.

Average pleasure-scores are given in table 6-12.

⁵⁴ Independence in factorial design means that the effect of one treatment is the same for each level of the other treatment(s) (Hair et al., 1998, p344).

Estimated Marginal Means of Pleasure

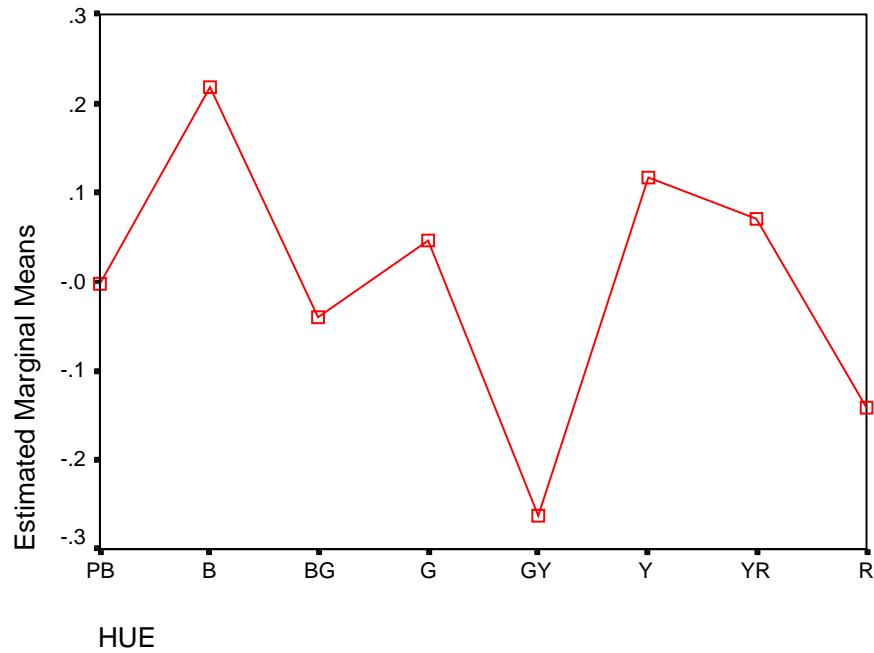


Figure 6-9: Average pleasure elicited by the various store-colour-hues

Pleasure	
Hue	Average score
B	.219
Y	.117
YR	.070
G	.045
PB	-.003
BG	-.039
R	-.142
GY	-.263

Table 6-12: Average pleasure elicited by the various store-colour-hues⁵⁵

⁵⁵ Vertical lines indicate homogeneous sub-groups obtained post-hoc with Duncan's multiple-range test. Note that Duncan's multiple range test is less conservative than Bonferonni's post-hoc comparisons with respect to type I errors and has therefore more power, consequently identifying more group differences among the hues (Hair et al., 1998, p356).

6.6.3.2. Store Colour Brightness

H2: *Store colour value is expected to have a positive effect on store-elicited pleasure, with higher value coloured or brighter stores expected to be judged more pleasant than the lower value coloured or darker stores.*

As hypothesized, the value or brightness of the colour in the store interior does appear to have a significant impact on pleasurable feelings. Our findings indeed confirm that brighter coloured stores evoke more pleasant feelings than darker coloured stores (respective average pleasure scores of .075 versus -.074; $p=.037$), as demonstrated in figure 6-10.

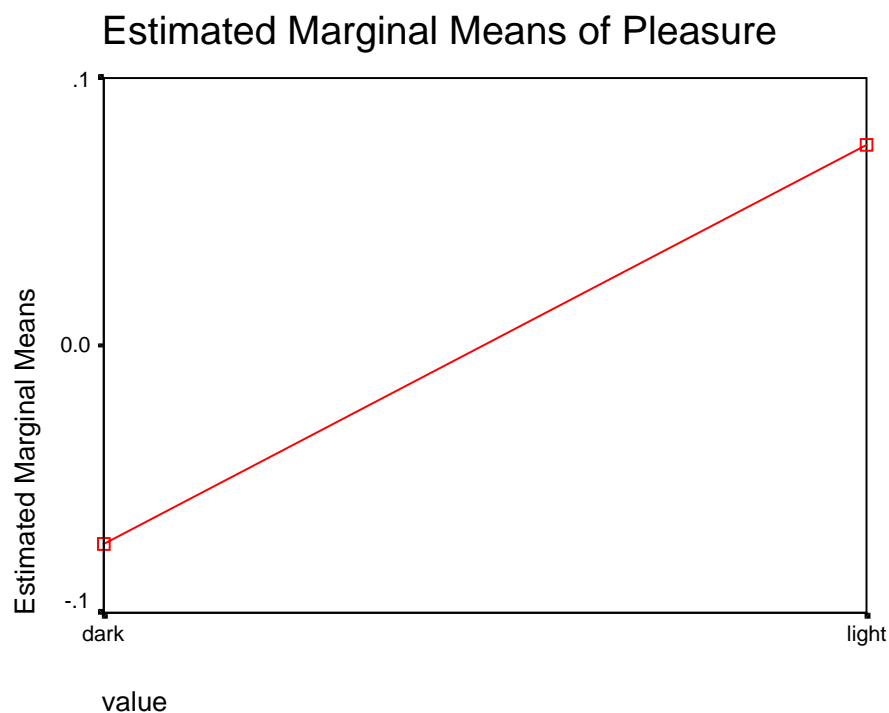


Figure 6-10: Average pleasure elicited by light and dark colours

Although this hypothesis generally appears to be true, a small (insignificant) interaction can be revealed between store colour hue and store-colour brightness, as demonstrated in figure 6-11. Whereas generally brighter coloured stores are rated more pleasant than darker coloured stores, the opposite seems to be true for yellow and for purple-blue. Note however, that this interaction effect was not significant.

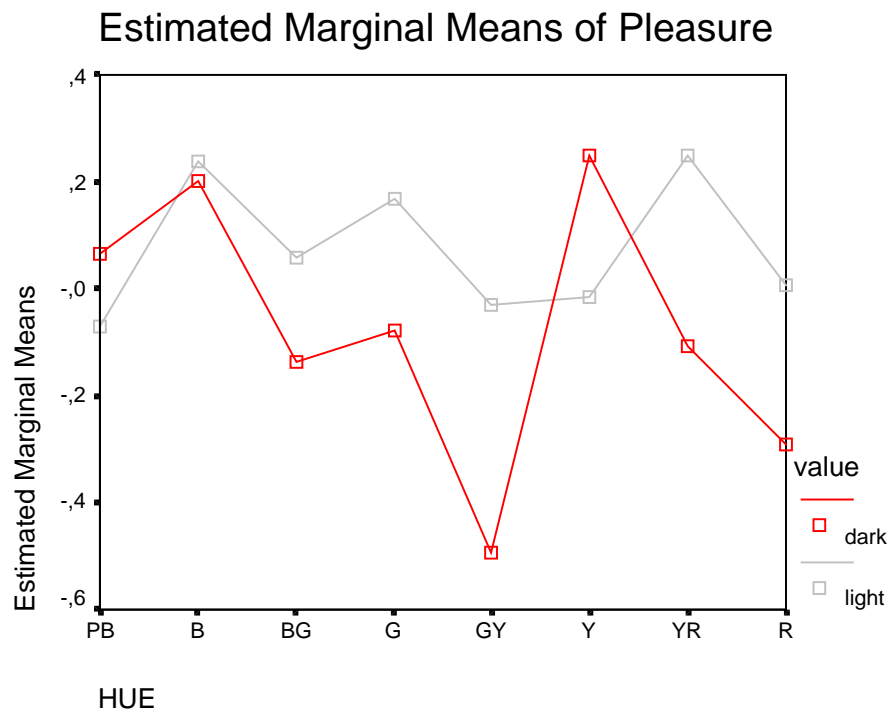


Figure 6-11: Average pleasure elicited by light and dark tints of the various store-colour-hues

6.6.3.3. Store Colour Saturation

H3: *Store colour saturation is expected to have a positive effect on store-elicited pleasure, with more saturated coloured stores expected to be judged more pleasant than the less saturated coloured stores.*

From our findings, saturation appears, on the contrary, to have a slightly negative impact on feelings of pleasure (figure 6-12), with more saturated coloured store interiors being judged a little bit less pleasant (-.033 for highly saturated coloured stores versus .034 for less saturated coloured stores). Although the effect is not in the hypothesized direction, it is not significant either.

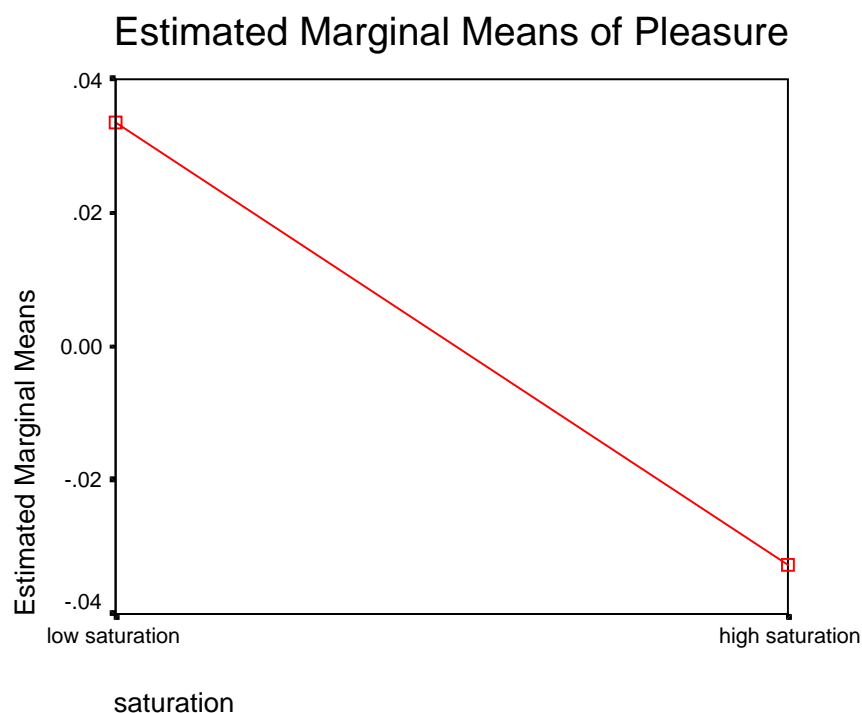


Figure 6-12: Average pleasure elicited by saturated and unsaturated store-colours

When we take a closer look at the matter (figure 6-13), we see that actually there is a hue-saturation interaction, which is however not significant either. In general more saturated colours seem to elicit less intensive feelings of pleasure, although there are some exceptions. For green-yellow, for example, the opposite applies.

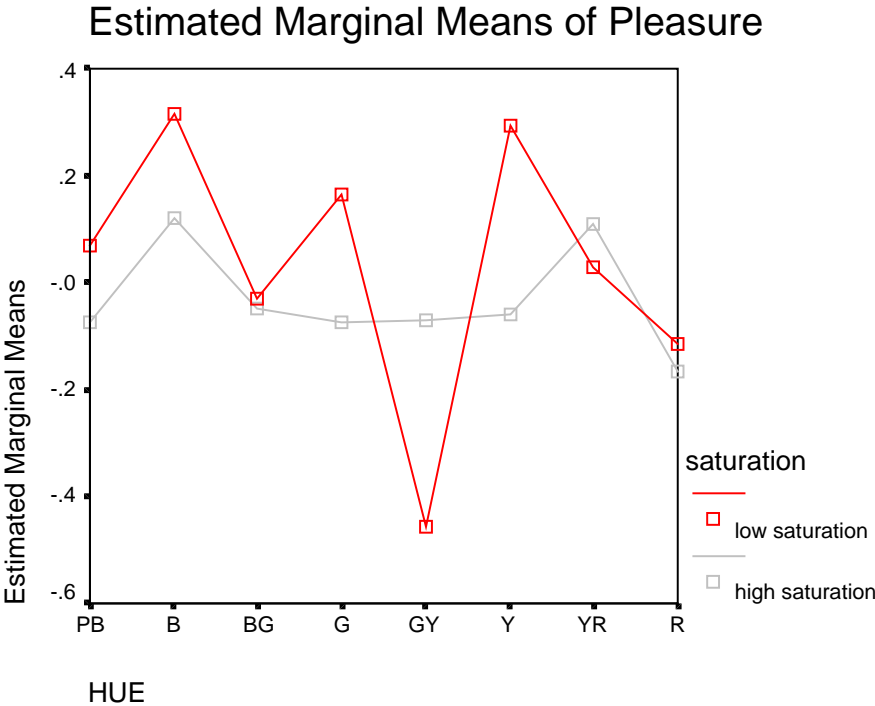


Figure 6-13: Average pleasure elicited by saturated and unsaturated tints of the various store-colour-hues

6.6.4. STORE COLOUR-EVOKED AROUSAL

6.6.4.1. Tension and Excitement: A Two-dimensional View of Arousal

As discussed in paragraph 6.5.1., the arousal construct was found to be composed of two separate un-correlated arousal dimensions. A first dimension (relaxation-tension) appeared to be negatively related with pleasure, while a second dimension (boredom-excitement) was found to be positively related with pleasure. Such a two-dimensional view of arousal has also been demonstrated and rationalized in previous research (Walters, Apter and Svebak, 1982; Thayer, 1986; Gorn et al., 1997). As no separate hypotheses have been formulated with regard to these distinct arousal dimensions, the general hypotheses on the arousal elicited by store colour hue, brightness and saturation were tested with regard to each arousal dimension. For each hypothesis we will first present the findings for the negatively valenced tension dimension. Subsequently the results with regard to the positively valenced excitement dimension will be discussed.

6.6.4.2. Store Colour Hue

H4: *A positive U-shaped relationship is hypothesized between store-colour wavelength and store-induced arousal, with the stores with extreme long wavelength colours (red) expected to be judged more arousing than the stores with extreme short wavelength colours (blue) and the mid-wavelength colours (green-yellow) at the bottom of the U, being judged least arousing.*

Tension

With regard to tension, independence was reached among hue, value and saturation in the factorial design. Therefore the main effects could be interpreted directly. In fact, among the different hue categories a significant difference could be revealed in store-colour-evoked tension ($p=.047$). The average tension elicited by the various hues is represented in figure 6-14.

The hues are arranged according to increasing wavelengths. In contrast to expectations, however, again no clear pattern seems to emerge in the tension evoked by short to long wavelength hues. Post-hoc comparisons among the hues showed only a significant difference in elicited tension between blue and green-yellow (Bonferroni, $p=.012$). This difference was, however, not in the hypothesized direction. Contrary to expectations, the blue-coloured store environment appeared to cause less tension than the green-yellow-coloured interior (standardized average tension scores were $-.272$ versus $.240$, respectively). The mid-wavelength colour green-yellow actually appeared to be the most tense colour (which is in accordance with findings by Valdez and Mehrabian, 1994), followed by red. In contrast, blue, green, blue-green and purple-blue seemed to be, as hypothesized, more relaxing colours. Yellow does not appear to cause tension either.

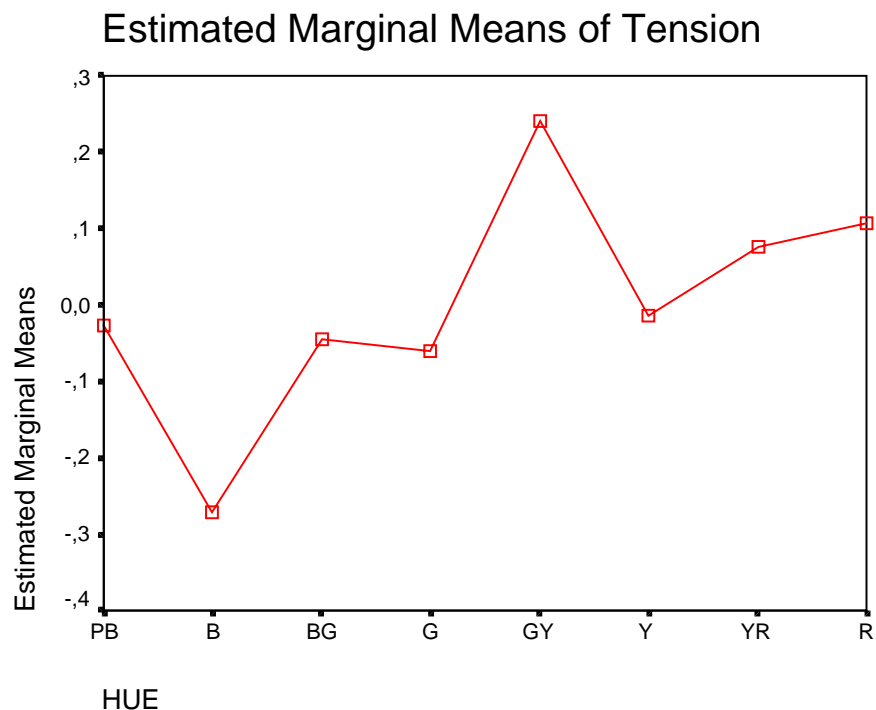


Figure 6-14: Average tension elicited by the various store-colour-hues

According to increasing tension, hues can be ranged as follows:

Blue / Green / Blue-Green / Purple-Blue / Yellow / Yellow-Red / Red / Green-Yellow.

Average tension-scores are given in table 6-13.

Tension	
Hue	Average score
GY	.240
R	.106
YR	.076
Y	-.014
PB	-.028
BG	-.045
G	-.061
B	-.272

Table 6-13: Average tension elicited by the various store-colour-hues

Excitement

With regard to the excitement elicited by store colours, the interpretation of the results is more complex. Actually, in this case no independence was achieved between hue, brightness and saturation effects. Instead, complex interaction effects were found. None of the main effects appeared to be significant. Nevertheless, a plot of the mean excitement scores for store colour hue is presented here anyway (figure 6-15). However the reader should keep in mind that this is an oversimplification of the facts, since the interaction-effects are not represented here.

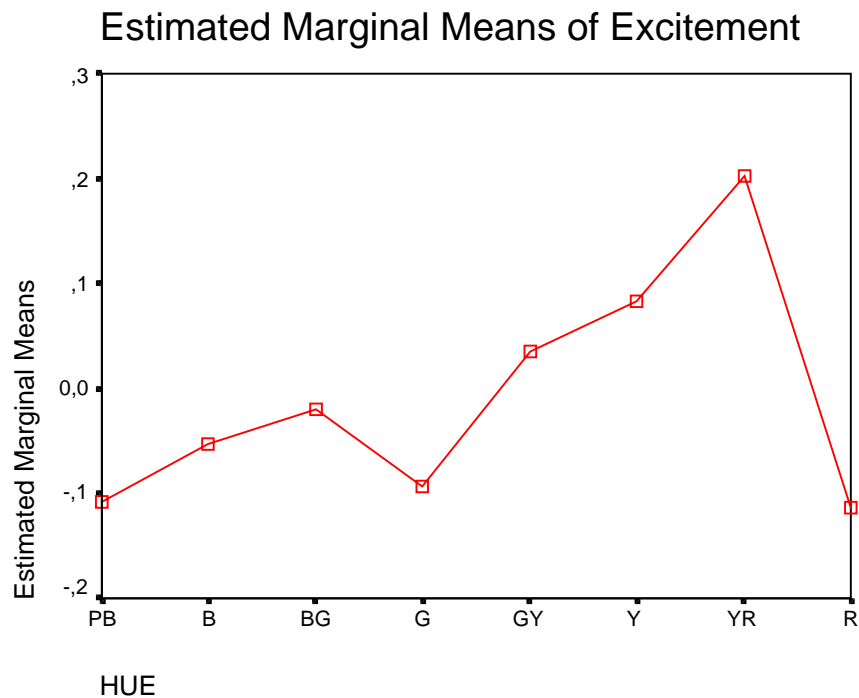


Figure 6-15: Average excitement elicited by the various store-colour-hues

According to increasing excitement, hues can be ranged as follows (note however that the differences among the hues are insignificant):

Red / Purple-Blue/ Green/ Blue / Blue-Green / Green-Yellow / Yellow / Yellow-Red

Average excitement-scores are given in table 6-14.

Excitement	
Hue	Average score
YR	.202
Y	.083
GY	.036
BG	-.019
B	-.052
G	-.092
PB	-.107
R	-.113

Table 6-14: Average excitement elicited by the various store-colour-hues⁵⁶

Yellow-red turned out to be the most exciting colour. Ignoring the colours green and red, an upward trend can be revealed in elicited excitement, going from short to long-wavelength hues. Thus, with the exception of green and red, the warmer the store-colour, the more excitement it appears to elicit.

In figure 6-16 the joint effects of store-colour-hue on the two orthogonal dimensions of arousal, excitement and tension, are comprehensively illustrated. Note, for instance, for red that, although it is conceived as a rather tense colour, on the other hand it is perceived to be rather boring. Yellow-red, in contrast, appears to evoke excitement as well as tension. Blue is found to be very relaxing, but a little bit boring. Whereas yellow and purple-blue evoke approximately the same small amount of relaxation, yellow is still perceived as rather exciting, whereas purple-blue appears to elicit feelings of boredom.

⁵⁶ Vertical lines indicate homogeneous sub-groups obtained post-hoc with Duncan's less conservative multiple-range test.

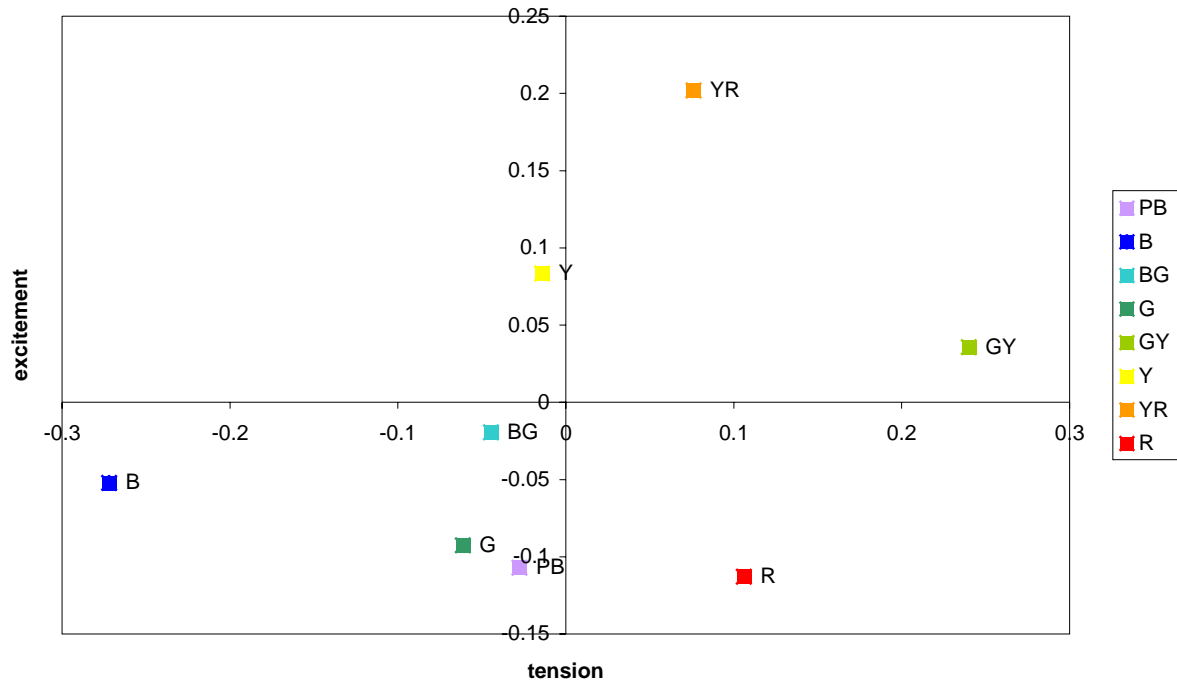


Figure 6-16: Store-colour-hue evoked tension and excitement

In fact, in this diagram, the bottom-left to top-right diagonal can be considered as a main arousal axis, onto which, for each colour, a perpendicular line can be dropped, in order to determine the colour's general arousal score. In the same vein, the bottom-right to top-left diagonal approximates a valence or pleasure axis. Thus, disregarding the valence or feelings of pleasure involved, yellow and red can be conceived as approximately equally arousing. Nevertheless, the feelings of arousal elicited by a yellow-coloured store interior appear to be more pleasant than those evoked by a red-coloured retail environment.

6.6.4.3. Store Colour Brightness

H5: *Store colour value is expected to have a negative effect on store-induced arousal, with higher value coloured or brighter stores expected to be judged less arousing than the lower value coloured or darker stores.*

Tension

As hypothesized, the value or brightness of the colour in the store interior appears to have a significant impact on experienced tension. Our findings indeed confirm that brighter coloured stores evoke less tension than darker coloured stores (respective average tension scores of -.081 versus 0.81; $p=.024$), as demonstrated in figure 6-17.

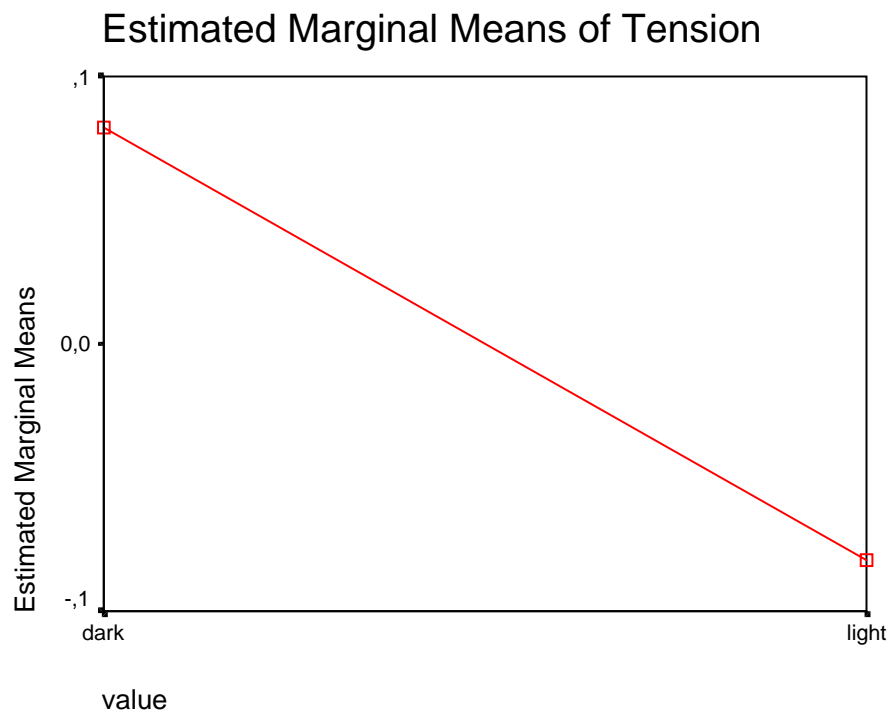


Figure 6-17: Average tension elicited by dark and light store-colours

Although this hypothesis generally appears to hold, a small (insignificant) interaction can be revealed between store colour hue and store-colour brightness, as demonstrated in figure 6-18.

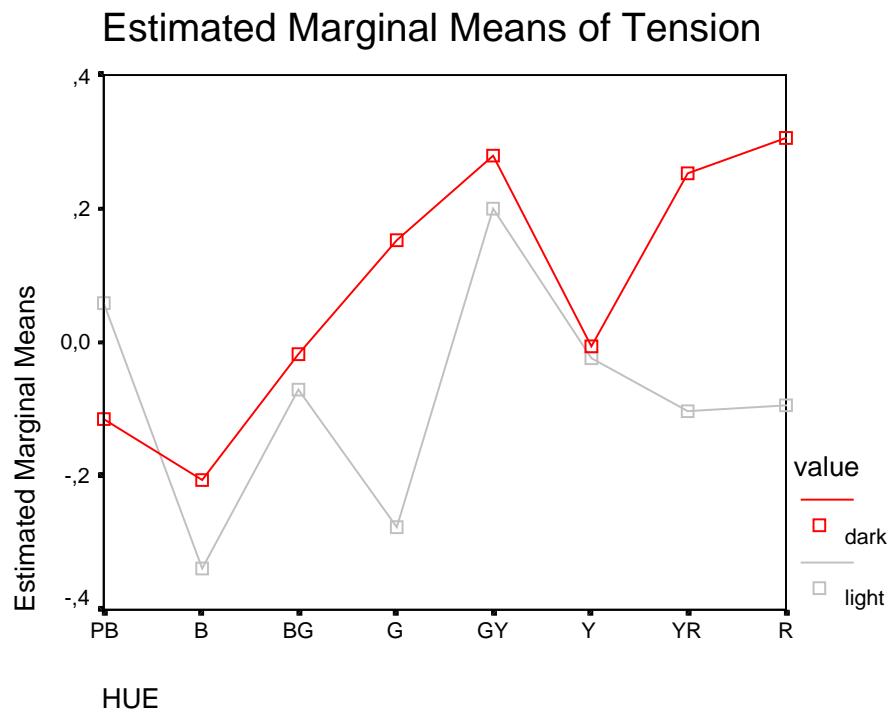


Figure 6-18: Average tension elicited by light and dark tints of the various store-colour-hues

Whereas generally darker coloured stores appear to be rated more tense than brighter coloured stores, the opposite seems to be true for purple-blue. With regard to yellow no difference can be found in elicited tension between bright and dark tones. The finding, that darker coloured store interiors are experienced as more tense than brighter coloured stores is apparently most pronounced for the colours green, yellow-red and red. For blue, blue-green and green-yellow, the difference in elicited tension among bright coloured and dark coloured store environments is much smaller. Note however, that this 'hue x value' interaction effect was not found to be significant.

Excitement

Although brighter coloured stores appear to elicit less tension (or more relaxation), they also appear to generate a little more excitement (figure 6-19), which was not hypothesized. However, this effect appeared to be insignificant.

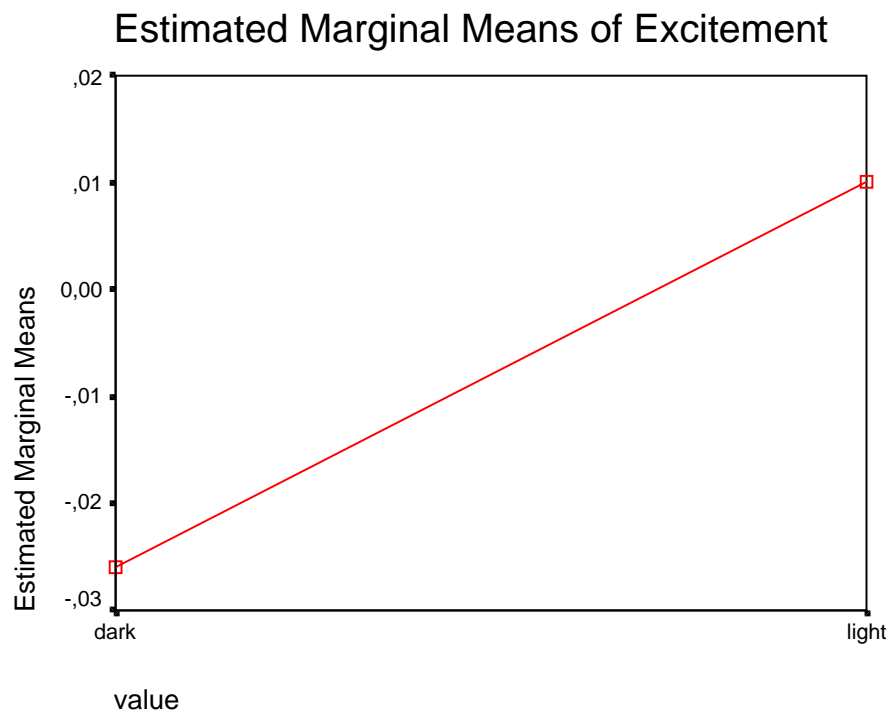


Figure 6-19: Average excitement elicited by dark and light store-colours

Although the 'hue x saturation' interaction was also found to be insignificant, the plot in figure 6-20 reveals some interesting contrasts. Whereas, in general, brighter coloured stores seemed to elicit a little more excitement (remember that this effect turned out not to be significant), the opposite appeared to be true for yellow. Moreover, for blue, green and red, no such effect could be discovered.

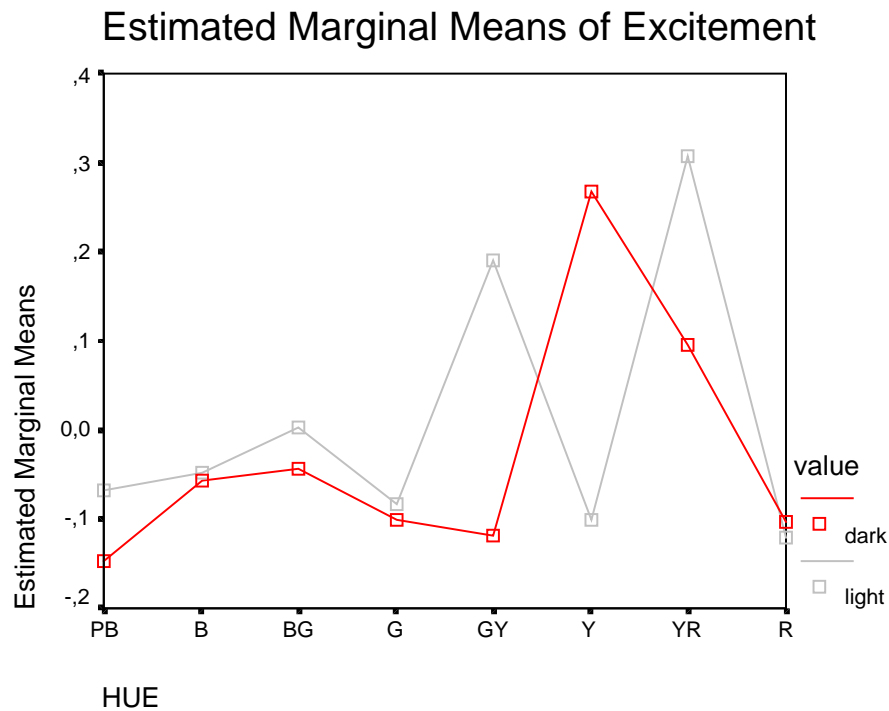


Figure 6-20: Average excitement elicited by light and dark tints of the various store-colour-hues

In fact a complex ‘hue x saturation x value’ interaction effect appeared to be significant, as will be demonstrated later on.

Discussion

Thus far, the results obtained, regarding the effects of store colour value on elicited feelings of tension and excitement, are conform to the findings by Gorn et al. (1997) in an advertising context. Although their study was confined to only two hues (red and blue), they also found that brighter colours, when used as a peripheral cue in advertising, elicited more feelings of relaxation (and thus less tension) than darker colours on the one hand, but found, on the other hand, no effect of value on excitement. We found generally the same to be true for a wider range of colours applied in a store interior.

6.6.4.4. Store Colour Saturation

H6: *Store colour saturation is expected to have a positive effect on store-induced arousal, with more saturated coloured stores expected to be judged more arousing than the less saturated coloured stores.*

Tension

From our findings, saturation appears indeed to have a significant impact on experienced tension, with more saturated coloured store interiors being judged more tense (average experienced tension of .077 for highly saturated coloured stores versus -.076 for less saturated coloured stores, $p=.033$) as demonstrated in figure 6-21.

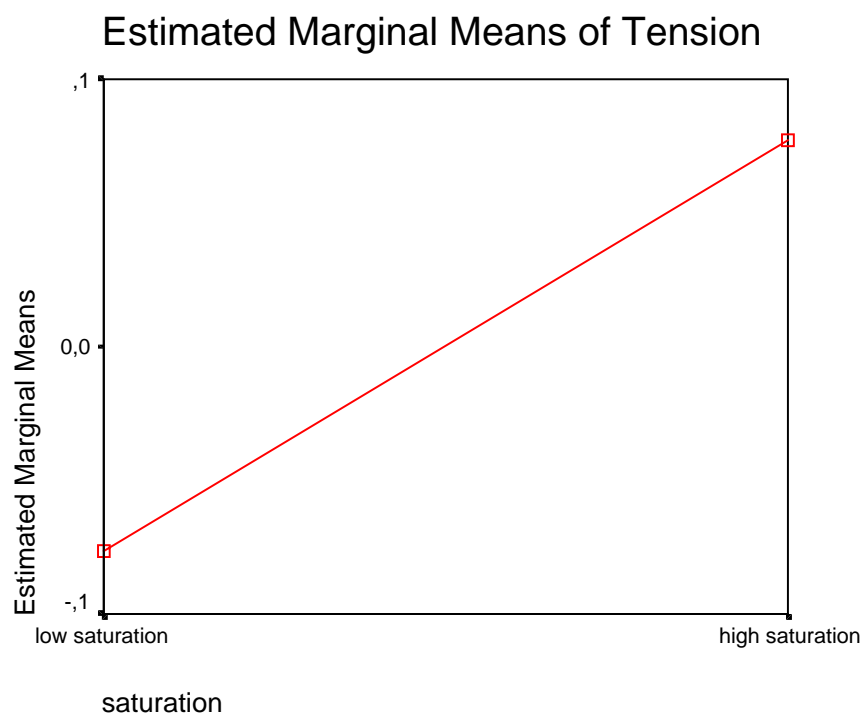


Figure 6-21: Average tension elicited by saturated and unsaturated store-colours

However, when we take a closer look at the matter (figure 6-22), we see that actually there is a ‘hue x saturation’ interaction, which is, nevertheless, not significant. In general, more saturated colours seem to elicit more tension, although there are some exceptions. Green-yellow is again a notable exception, as well as blue-green and red. For blue, no effect of saturation is apparent, while for green, yellow and yellow-red, in contrast, it is very pronounced.

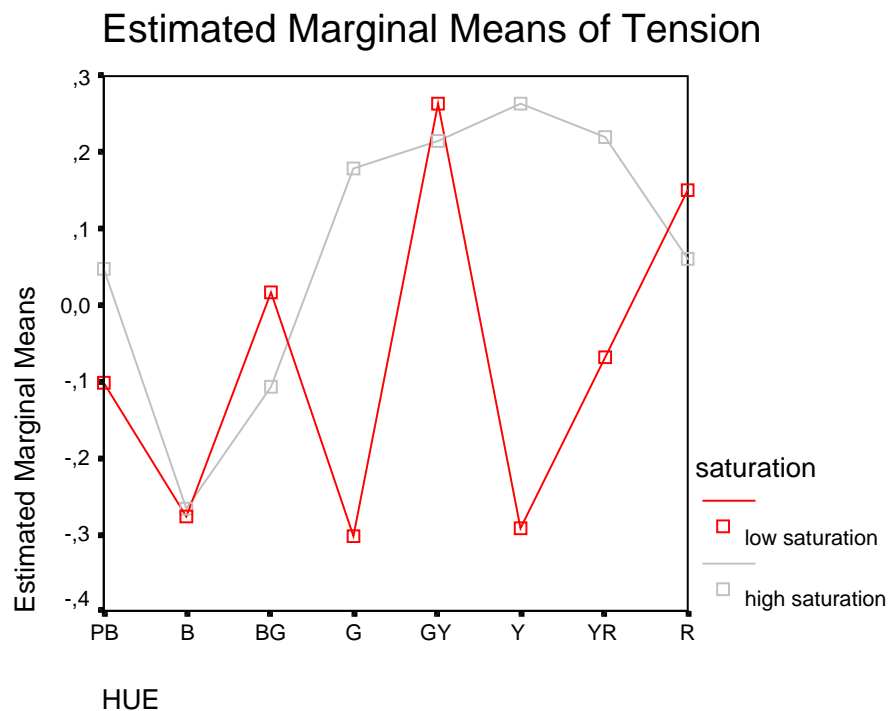


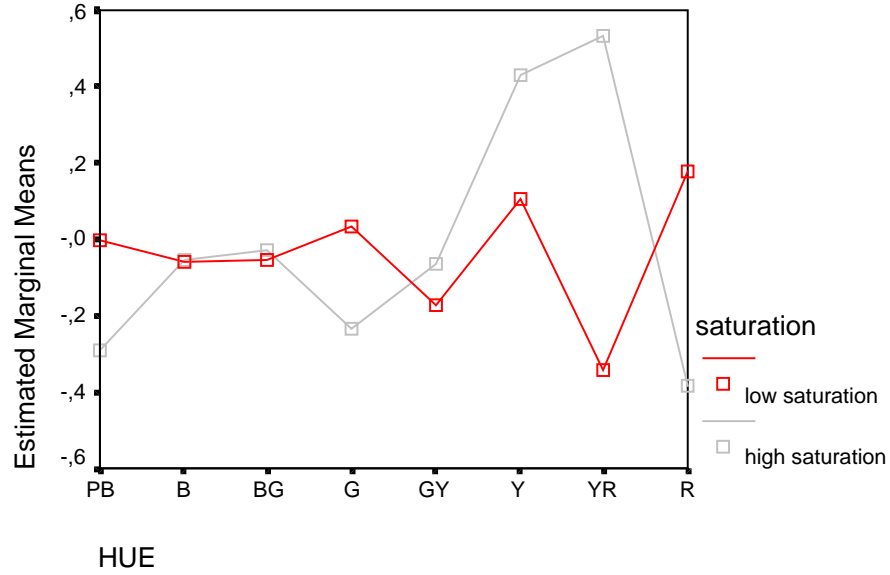
Figure 6-22: Average tension elicited by saturated and unsaturated tones of the various store-colour-hues

Excitement

With regard to store-colour-evoked excitement, none of the main effects were found to be significant. Instead, complex significant interaction effects could be revealed. In fact a significant ‘hue x saturation’ interaction-effect ($p=.010$), as well as a significant ‘hue x saturation x value’ interaction-effect ($p=.019$), appeared to be present. In figures 6-23, 6-24 and 6-25 these complex interactions are demonstrated. As in this case no general interpretation of the effects can be given, the effects for each hue will be discussed separately.

Estimated Marginal Means of Excitement

At value = dark



Estimated Marginal Means of Excitement

At value = light

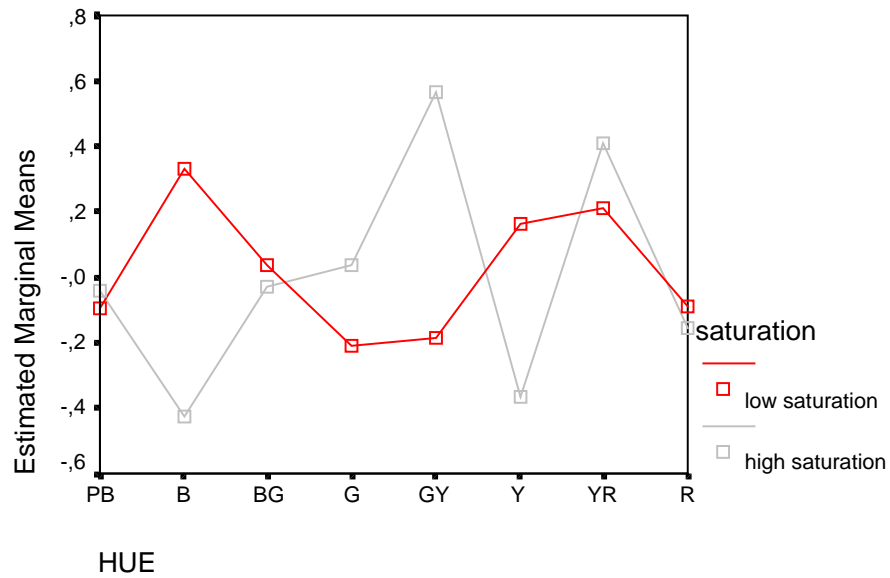
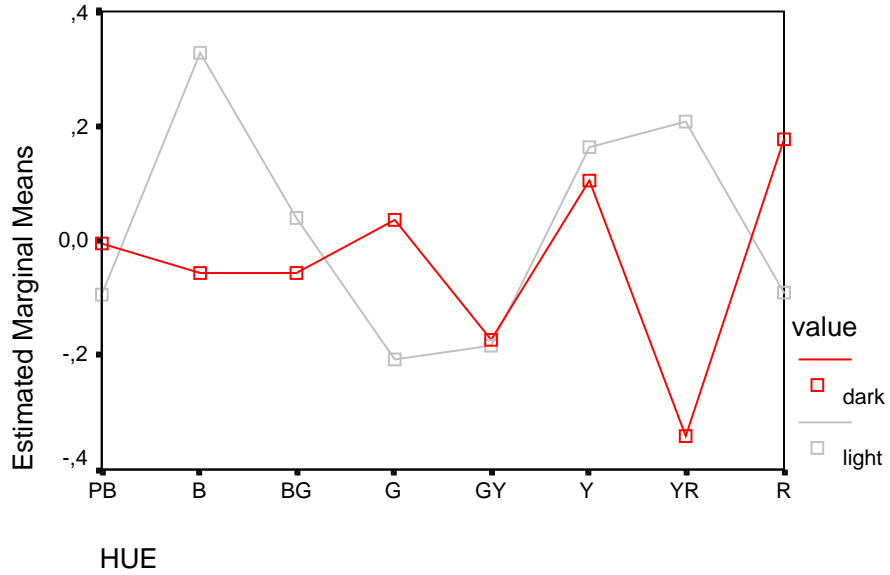


Figure 6-23: Average excitement elicited by saturated and unsaturated tones of the various store-colour-hues, respectively for dark tints (top) and for bright tints (bottom), demonstrating a complex 'hue x saturation x value' interaction.

Estimated Marginal Means of Excitement

At saturation = low saturation



Estimated Marginal Means of Excitement

At saturation = high saturation

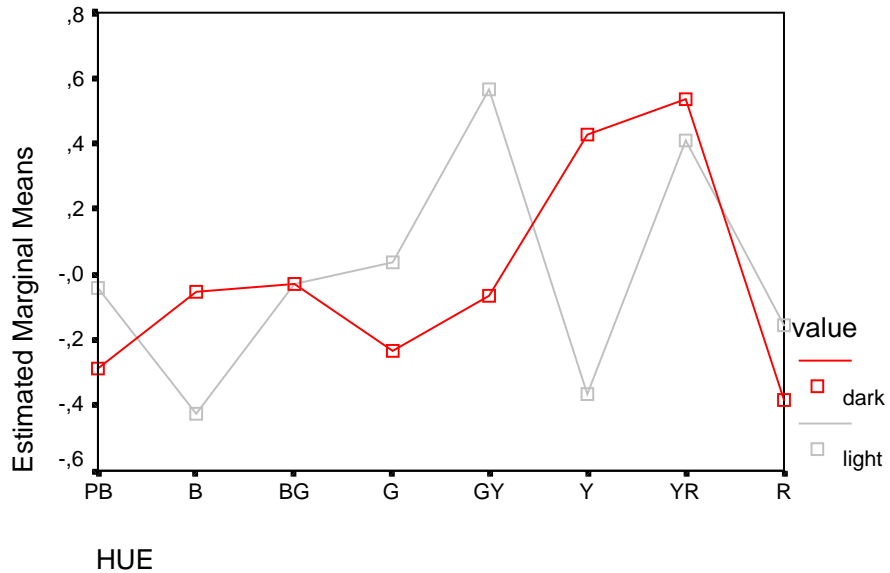


Figure 6-24: Average excitement elicited by light and dark tints of the various store-colour-hues, respectively for unsaturated tones (top) and for saturated tones (bottom), demonstrating a complex 'hue x saturation x value' interaction.

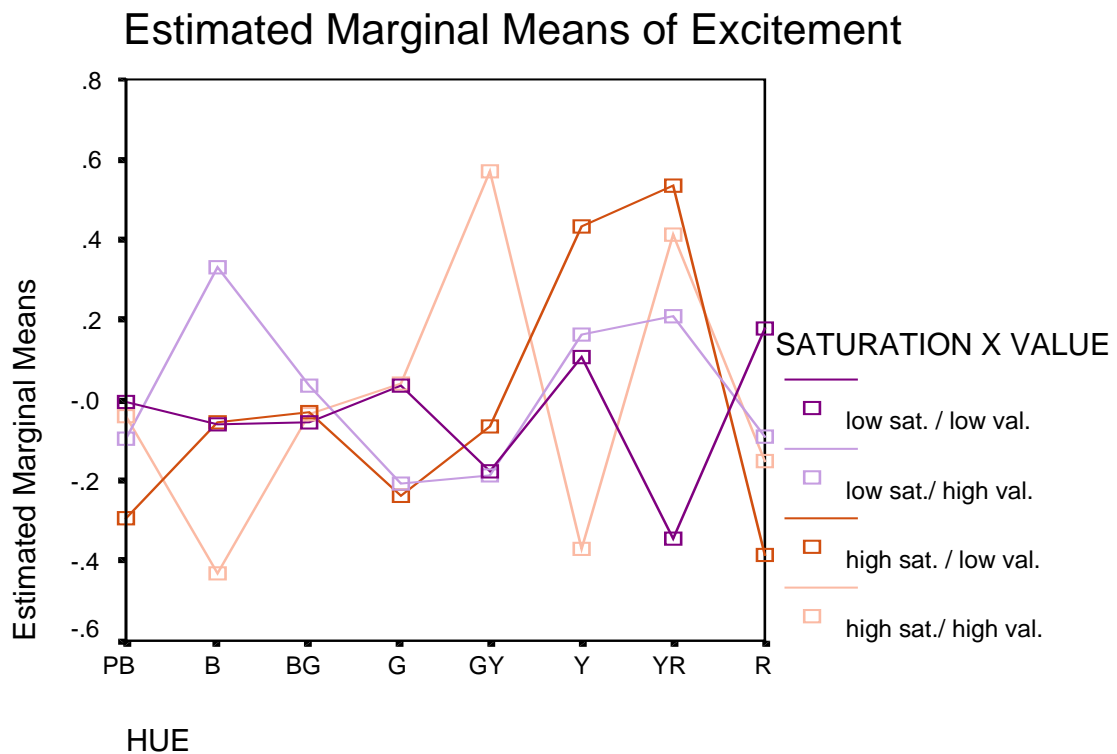


Figure 6-25: Comprehensive illustration of the complex 'hue x saturation x value' interactions.

Purple-Blue:

The darker and more saturated Purple-Blue coloured store appeared to elicit a little more boredom than the other Purple-Blue tints, which seemed to score pretty similar with regard to evoked excitement.

Blue:

With regard to Blue, there seems to be no difference in elicited excitement between the saturated and unsaturated tones when dark tints are involved. The unsaturated light coloured blue store interior elicited more excitement, whereas the saturated light coloured blue environment evoked less excitement than the dark coloured designs.

Blue-Green:

With regard to blue-green, there seems to be no difference in elicited excitement between saturated and unsaturated tones or dark and light tints.

Green:

For Green, low-saturated/low-value and high-saturated/high-value tones elicit the same amount of excitement. The same is true for low-saturated/high-value and high-saturated/low-value greens, which can both be considered as a little more boring.

Green-Yellow:

Highly saturated, bright (high value) Green-Yellow was found to elicit the most excitement of all the tints. The level of excitement elicited by this particular Green-Yellow tone was also considerably higher than for the other Green-Yellows, which were generally perceived as more boring.

Yellow:

With regard to Yellow, there seems to be no difference in elicited excitement between the dark and bright tints for the unsaturated tones. In contrast, the dark, highly saturated yellow store interior elicited more excitement, whereas the bright (high value), highly saturated yellow environment appeared to evoke less excitement than the unsaturated yellow coloured store designs.

Yellow-Red:

Dark, unsaturated yellow-red, applied to the store interior, appeared to be rather boring, while the following tones were able to elicit more excitement (in order of increasing evoked excitement): high-value/low-saturation yellow-red, high-value/high-saturation yellow-red and, ultimately, dark, highly saturated yellow-red, which elicited a considerable amount of excitement.

Red:

With regard to Red, there seems to be no difference in elicited excitement between the saturated and unsaturated tones when bright (high value) tints are concerned. The less saturated dark coloured red store interior elicited more excitement, whereas the more saturated dark coloured red environment evoked less excitement than the bright coloured red store designs.

From these hue-by-hue results, it should be clear that no generalizations can be drawn with regard to the excitement elicited by store-colour saturation and brightness.

Discussion

The results obtained, regarding the effects of store colour saturation on elicited feelings of tension and excitement, are not conform to the findings by Gorn et al. (1997) in an advertising context. For red and blue hues, used as a peripheral cue in advertising, they found that more saturation elicited more feelings of excitement, but not less relaxation. In contrast, in a retailing context, for the eight hues investigated, we found in general more saturation to cause more tension (and thus in fact less relaxation). Nevertheless, when we consider only blue and red hues, we cannot find a significant effect of colour saturation on elicited tension, as illustrated in figure 6-26. From the interaction results discussed earlier, we cannot say much in general with regard to the excitement elicited by store-colour saturation. In fact, when we consider only red and blue coloured store interiors, we could say that more saturation actually appears to evoke less excitement (see figure 6-26), which is exactly opposite to Gorn's (1997) findings.

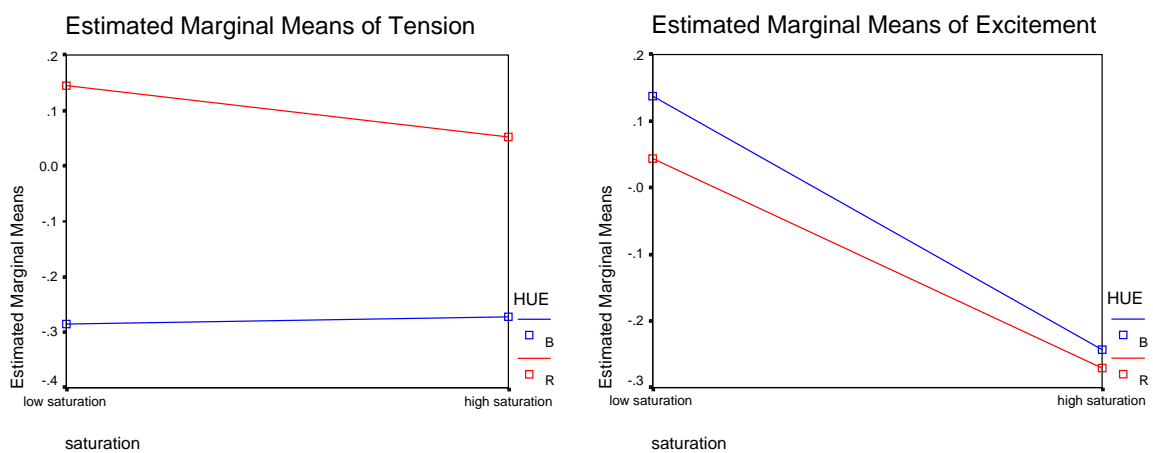


Figure 6-26: Store-colour-saturation-evoked tension and excitement (for red and blue hues)

These results reveal the importance of including many colour-hues in experimental designs testing saturation and brightness effects. Otherwise very misleading results can be obtained. Generalizations on the basis of findings with regard to only two hues (which are common in colour research) are odious.

6.6.5. STORE COLOUR-EVOKED DOMINANCE

From the results of the MANCOVA analysis, we could not reveal any significant effects of store-colour hue, brightness nor saturation on feelings of dominance. Consequently, none of the hypothesized effects with regard to store-colour-evoked dominance could be supported. As our results turned out not to be significant, we will not pursue to present our findings with regard to the individual hypotheses on the specific effects of store colour hue, saturation and brightness on feelings of dominance in further detail.

In subsequent analyses, the latent dominance variable will be omitted, as it does not seem to be impacted significantly by store-colour⁵⁷.

⁵⁷ Note that the dominance construct did not turn out to be very reliably measured, as demonstrated in the paragraph on construct validation. Moreover, because of the high correlation ($r = .91$) with the pleasure construct, the discriminant validity of the dominance construct could also be questioned (Fornell and Larcker, 1981) and multicollinearity generally decreases statistical efficiency (Hair et al., 1998).

6.6.6. MODERATING EFFECTS

In this section we will investigate whether there are any moderating effects of age and gender regarding the relationships between store-colour and the emotions elicited. Our aim is to determine, more specifically, whether age or gender affect these relationships or, in other words, whether store colours elicit different emotions in males than in females or in younger than in middle-aged or older consumers.

Before starting with the analyses, the assumption of homoscedasticity is examined. Box's M reaches a satisfactory significance level of .147 for the three age-categories, demonstrating homogeneity of within-variations and co-variations among the age groups. Nevertheless, for the gender groups a significance level of only .013 is obtained. Fortunately, a violation of the assumption of homoscedasticity has minimal impact if the groups are of approximately equal size⁵⁸ (Hair et al., 1998, p348). Moreover, Wilk's lambda is a rather robust criterion to assess multivariate differences across groups and is relatively immune for violations of the assumptions underlying MANOVA, especially for larger sample sizes (Hair et al., 1998, p351). Thus, although the observed covariance matrices of the gender groups appear to differ to some degree, we feel we can go ahead and proceed with the analyses conscientiously.

6.6.6.1. Testing for the moderating effect of gender

First, it was verified whether males and females react differently to store colour. To investigate whether there is such a moderating effect of gender on the emotions elicited by store colours, a MANOVA analysis was conducted on the full-factorial model, including the gender-factor. Wilks' lambda reveals neither a significant ($p < .05$) main nor significant interaction effects of gender on store-colour-evoked emotions in general. Nevertheless, the univariate statistics reveal a significant hue by gender interaction ($p = .026$) with respect to store-colour-evoked tension, suggesting that different store-colour-hues appear to elicit a different amount of tension in males than in females, which is demonstrated in figure 6-27.

⁵⁸ The sampling design was actually set up to attain equal sample sizes among age and gender groups. Nevertheless, a significant proportion of the male participants turned out to suffer to some degree from colour vision deficiency. Although this should not be surprising, it was not anticipated when setting up the sampling-quota for each condition. As the female group size ($N=417$) divided by the some smaller male group size ($N=360$) still amounts to only 1.16, which is smaller than the suggested 1.5 norm, we should not expect any problems in this regard.

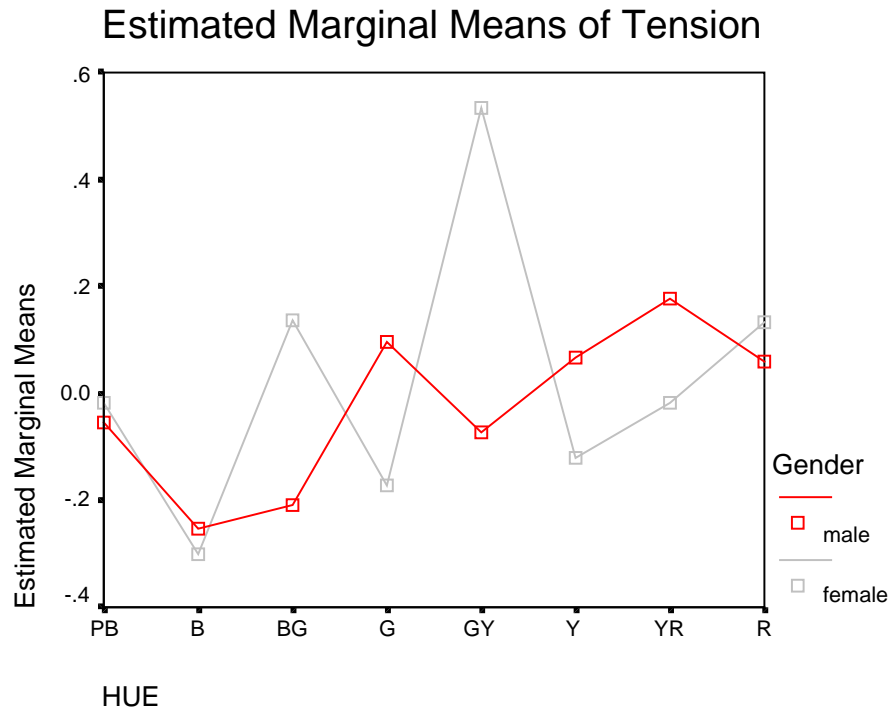


Figure 6-27: Store-colour-hue-evoked tension for males and females

Whereas purple-blue, blue and red seem to elicit about the same amount of tension in males and females, for the other hues considerable differences can be discerned. In fact, applied to a store-environment, the hues blue-green and green-yellow appear to elicit more tension in females than in males. On the other hand, green, yellow and yellow-red seem to evoke a little more tension in males than in females. Average tension-scores for males and females are given in table 6-15. These results suggest that the gender of the target audience should not be ignored in store-colour decision-making.

Tension		
Average scores	Male	Female
GY .240	YR .178	GY .534
R .106	G .095	BG .138
YR .076	Y .065	R .134
Y -.014	R .060	PB -.016
PB -.028	PB -.056	YR -.018
BG -.045	GY -.073	Y -.120
G -.061	BG -.211	G -.171
B -.272	B -.254	B -.302

Table 6-15: Average tension elicited by the various store-colour-hues among males and females

6.6.6.2. Testing for the moderating effect of age

To determine whether store colours elicit different emotions in younger, middle-aged or older consumers, a MANOVA analysis is conducted on the full-factorial model, including the age factor. Wilks' lambda reveals no significant main or interaction effects of age on store-colour-evoked emotions either. Nevertheless, taking a look at the univariate statistics, we find that age does affect experienced excitement significantly, as demonstrated in figure 6-28.

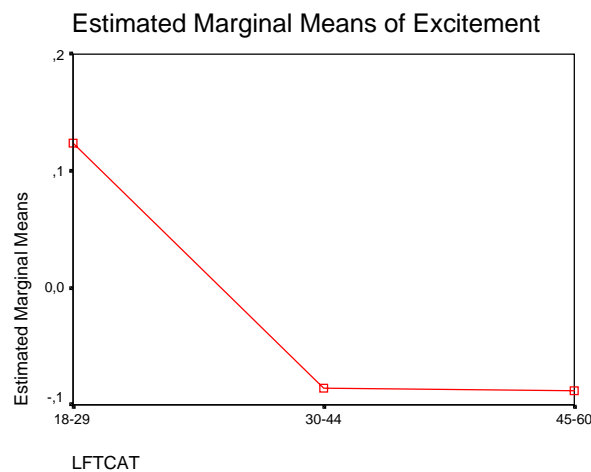


Figure 6-28: Store-colour-evoked excitement among different age-groups

Younger respondents appear to experience more excitement than middle-aged and older respondents (respective excitement scores of .123 versus -.086 and -.088, $p=.020$). More specifically, we can identify a significant hue by age interaction with regard to elicited excitement ($p=.038$). Figure 6-29 clearly illustrates this rather complex interaction effect. Although, generally store-colours elicited higher amounts of excitement in younger respondents, the opposite appears to be true for blue, blue-green and green-yellow, which actually seem to elicit most excitement in the oldest age-category. Average excitement-scores are given per age-category in table 6-16. In fact, no obvious pattern seems to emerge from the obtained results, suggesting that for each hue different conclusions should be drawn. This points to the importance of considering the target-age-group when making store-colour decisions.

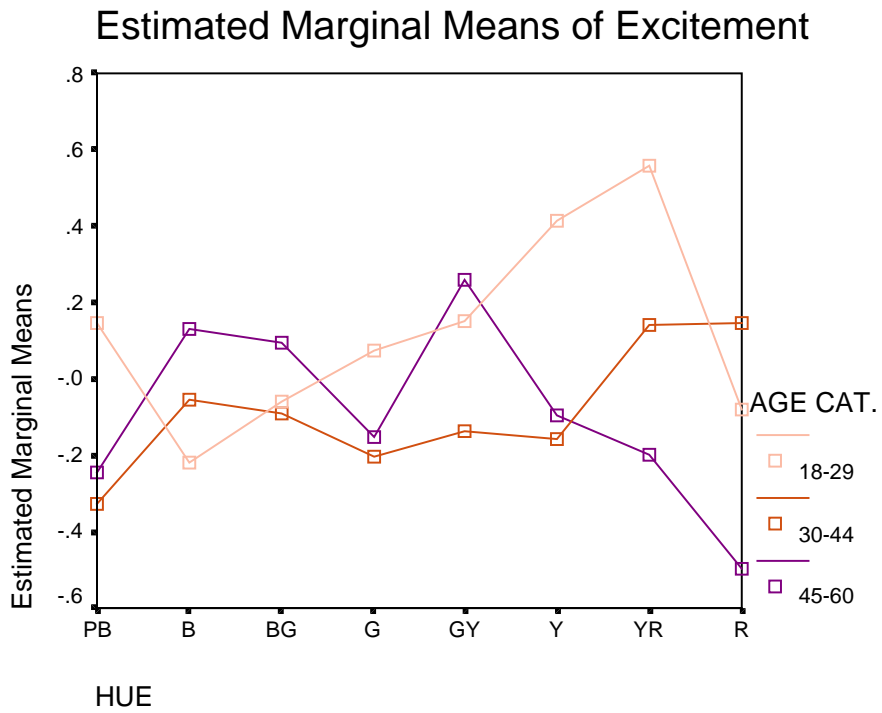


Figure 6-29: Store-colour-hue-evoked excitement among different age-groups

Excitement			
Average scores	18-29	30-44	45-46
YR .202	YR .558	R .144	GY .257
Y .083	Y .416	YR .140	B .129
GY .036	GY .154	B -.055	BG .095
BG -.019	PB .144	BG -.090	Y -.094
B -.052	G .072	GY -.138	G -.151
G -.092	BG -.057	Y -.158	YR -.199
PB -.107	R -.080	G -.205	PB -.245
R -.113	B -.218	PB -.326	R -.497

Table 6-16: Average excitement elicited by the various store-colour-hues by age-group

6.7. STORE-COLOUR-EVOKED EMOTIONS AS DETERMINANTS OF APPROACH/AVOIDANCE BEHAVIOURS

6.7.1. HYPOTHESIS TESTING: STRUCTURAL EQUATION MODELING

Structural Equation Modelling was deemed ideally suited to analyse our data with regard to the next set of hypotheses, because this multivariate data analysis technique enables the researcher (1) to deal with multiple relationships simultaneously in a statistically efficient way and (2) to assess these relationships comprehensively, transitioning from exploratory to confirmatory analysis (Hair et al., 1998, p578). More specifically, we will be using the statistical package ‘AMOS 3.62’ (Arbuckle) to test the second part of relationships in the hypothesized model, proposed earlier.

Nevertheless, because of the rather high correlations among the pleasure construct on the one hand, and the arousal constructs (tension and excitement) on the other hand, the analyses will be performed in two parts. First the hypotheses will be tested with regard to the pleasure construct and subsequently the analyses will be performed with regard to the two arousal constructs (which are not correlated among themselves). As dominance did not appear to be significantly impacted by store colour, relationships regarding this dimension were not examined any further.

The inter-correlations among the latent constructs⁵⁹ are tabulated in table 6-17. Note that pre-existing mood was controlled for in this and subsequent analyses according to procedures recommended by Draper and Smith (1980) and Green (1978). By regressing the mean composite mood scores on the composite as well as on the individual emotion and approach-avoidance items and using the resulting standardized residuals as respective indicators, the effects of pre-existing mood could be completely partialled out.

⁵⁹ Intercorrelations among latent constructs (Φ matrix from confirmatory factor analysis) are corrected for attenuation due to measurement error. Latent construct scores were calculated in Lisrel 8.5 (Jöreskog and Sörbom, 1993; du Toit et al., 1999, p250).

Table 6-17 : Construct Correlations

	STORE-COLOUR-EVOKED EMOTIONS			BEHAVIOUR	
	Pleasure	Tension	Excitement	Approach	Avoidance
EMOTIONS					
Pleasure	1.000			.771*** p=.000	-.644*** p=.000
Tension	-.732*** p=.000	1.000		-.391*** p=.000	.376*** p=.000
Excitement	.573*** p=.000	n.s.	1.000	.431*** p=.000	-.323*** p=.000
BEHAVIOUR					
Approach	.771*** p=.000	-.391*** p=.000	.431*** p=.000	1.000	
Avoidance	-.644*** p=.000	.376*** p=.000	-.323*** p=.000	-.695***	1.000

Pearson's correlation coefficients.

Pre-existing mood was controlled for.

*** Correlation is significant at the 0.01 level (2-tailed)

6.7.2. PLEASURE AS A DETERMINANT OF APPROACH/AVOIDANCE BEHAVIOURS

H10: *Approach intentions towards a store*

are positively related with the pleasure elicited by the store.

H11: *Avoidance intentions towards a store*

are negatively related with the pleasure elicited by the store.

Table 6-18 displays the overall fit statistics resulting from testing the pleasure-part of the model. Overall, the fit indices show that the model fits the data quite well. The individual standardized path estimates are shown in figure 6-30. The results suggest a significantly positive path between store-colour-evoked pleasure and approach intentions towards the store (.79) and a significantly negative path between elicited in-store pleasure and avoidance responses (-.68). Thus our findings provide strong support for the proposed hypotheses.

Chi-square = 237.836,
df = 52, p = .000

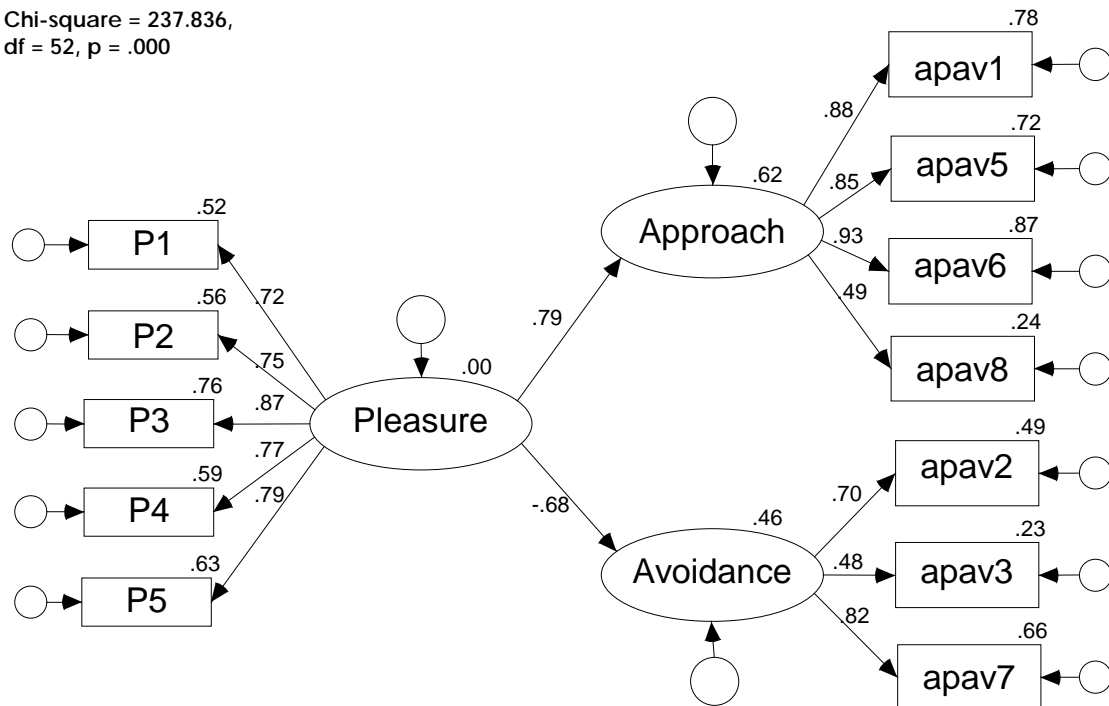


Figure 6-30: Empirical test of hypothesized model (pleasure)

Goodness-of-fit indices	Acceptable values	Model
χ^2 , (df)	Small	237.836, (52)
p-value	>.05	0.000
χ^2/df	<5	4.574
Goodness-of-fit index (GFI)	>.90	0.953
Adjusted Goodness-of-fit index (AGFI)	>.80	0.929
Tucker and Lewis non-normed fit index (TLI)	>.90	0.956
Benler's normed Comparative Fit Index (CFI)	>.90	0.966
Root mean squared error of approximation (RMSEA)	<.08	0.068

Table 6-18: Goodness of fit measures for the hypothesized model (pleasure)

6.7.3. AROUSAL AS A DETERMINANT OF APPROACH/AVOIDANCE BEHAVIOURS

H12: *Approach intentions towards a store*

are positively related with the arousal induced by the store (for pleasant stores).

H13: *Avoidance intentions towards a store*

are not (or negatively) related with the arousal induced by the store.

As discussed in paragraph 6.5.1., in this study, two separate, un-correlated dimensions were found to underlie the arousal construct⁶⁰. The first dimension (relaxation-tension) appeared to be negatively related with pleasure, while the second dimension (boredom-excitement) was found to be positively related with pleasure. Nevertheless, as we had anticipated a uni-dimensional arousal construct, no separate hypotheses have been formulated with regard to these distinct arousal dimensions. Yet, when an environmental psychology approach is applied in a retailing context, sometimes a pleasure-arousal interaction effect is hypothesized, in the sense that for pleasant environments a positive relation is expected between store-elicited arousal and approach, whereas in unpleasant environments this relation is supposed to be negative. A test of this interaction effect can be accommodated in our hypotheses, when we expect the tension dimension to have inverse effects to the excitement dimension. Therefore, we propose that approach intentions towards a store are positively related with the excitement induced by the store, but negatively with the store-elicited tension. With regard to avoidance, we expect no or inverse effects.

Table 6-19 displays the overall fit statistics, resulting from testing this arousal-part of the model. Overall, the fit indices show that the model fits the data quite well. The individual standardized path estimates are shown in figure 6-31. The results suggest a significantly positive path between store-colour-evoked excitement and approach intentions towards the store (.47) and a significantly negative path between elicited tension and approach (-.69). With regard to avoidance, a negative effect was detected for excitement (-.38) and a positive one for tension (.72). Thus, our findings provide strong support for the proposed interaction effect. Not only with regard to approach intentions significant paths could be identified from

⁶⁰ Such a two-dimensional view of arousal has also been demonstrated and rationalized in previous research (Walters, Apter and Svebak, 1982; Thayer, 1986; Gorn et al., 1997).

store-elicited feelings of tension and excitement, but also for avoidance reverse effects could be revealed.

Chi-square = 164.287,
df = 40, p = .000

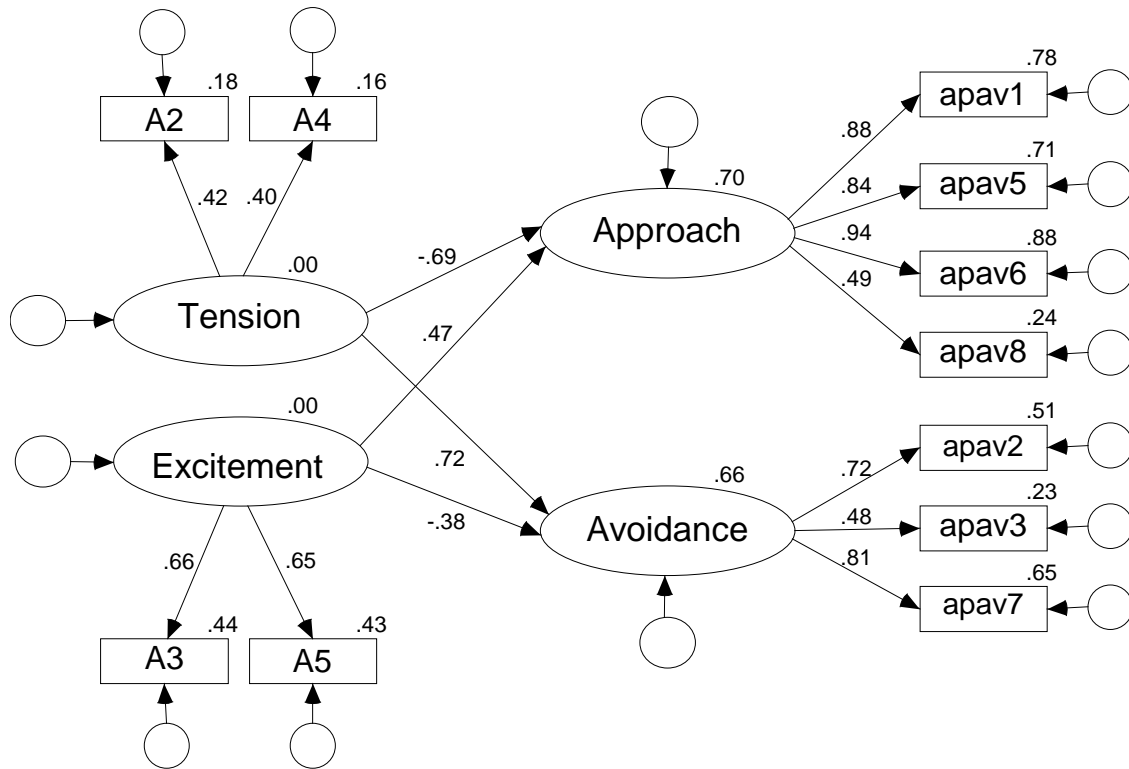


Figure 6-31: Empirical test of hypothesized model (arousal)

Goodness-of-fit indices	Acceptable values	Model
χ^2 , (df)	Small	164.287, (40)
p-value	>.05	0.000
χ^2/df	<5	4.107
Goodness-of-fit index (GFI)	>.90	0.962
Adjusted Goodness-of-fit index (AGFI)	>.80	0.938
Tucker and Lewis non-normed fit index (TLI)	>.90	0.946
Benler's normed Comparative Fit Index (CFI)	>.90	0.961
Root mean squared error of approximation (RMSEA)	<.08	0.063

Table 6-19: Goodness of fit measures for the hypothesized model (arousal)

6.7.4. OVERVIEW

Our findings support the presumption that in-store induced emotions can induce approach and avoidance responses. Approach intentions towards the store appear to be positively affected by store-colour-evoked pleasure and excitement and negatively by feelings of tension. Store-colour-evoked tension, on the other hand, appears to induce avoidance responses, which also seem to increase when less pleasure and less excitement are experienced. An overview of all individual standardized path estimates is given in table 6-20. Note that the relatively high standardized regression weights may be due to some common-method variance.

Total Sample N=777		Parameter Estimates: Total Sample		
<i>Path to:</i>	<i>Path from:</i>			
	Pleasure	Tension	Excitement	
Approach	.79	-.69	.47	
Avoidance	-.68	.72	.38	

Table 6-20: Store-colour-evoked emotions: parameter estimates

As the path –coefficients with regard to approach and avoidance intentions appear to be very similar, only pointing in opposite directions, critical ratio’s for differences in both parameters were verified. As these proved to exceed the critical ratio of 1.96, ($crdiff_{\text{approach-avoidance}}=19.801$ for pleasure, 8.856 for tension and 8.554 for excitement), it is deemed worthwhile holding on to both related, but separate constructs. A comprehensive overview of the respective hypotheses tested and results obtained is rendered in table 6-21.

Path		Hypothesis	Coefficient	Conclusion
H10	Pleasure → Approach	+	.79	Supported
H11	Pleasure → Avoidance	-	-.68	Supported
H12a	Tension → Approach	-	-.69	Supported
H13a	Tension → Avoidance	+	.72	Supported
H12b	Excitement → Approach	+	.47	Supported
H13b	Excitement → Avoidance	-	-.38	Supported

Table 6-21: Store-colour-evoked emotions: Summary of hypotheses and results

6.7.5. MODERATING EFFECTS

In this section we will investigate whether there are any moderating effects of age and gender. Our purpose is to determine, more specifically, whether the relationships found, between the emotions elicited by store-interior-colour and approach and avoidance responses towards the store, are affected by consumers' age and/or gender. This will be tested using the multigroup-procedure in AMOS 3.62 (Arbuckle, 1997).

Up until now, we have always reported standardized coefficients, because these closely approximate effect sizes, which are particularly useful for interpretation. Nevertheless, whereas standardized coefficients are useful for determining relative importance, they are sample specific and not comparable across samples (Hair et al., 1998, p614). As in the current analyses, we are not interested in the actual size of the parameters, but in group-comparisons, we will convert to the un-standardized solutions in this section.

6.7.5.1. Testing for the moderating effect of gender

The research question of interest at this point is whether a consumer's gender moderates the relationship between store-colour-evoked emotions and subsequent approach and avoidance intentions. Thus far, the path coefficients in the structural models have been calculated for both genders together. We now run the structural equation model for both groups separately, in order to be able to determine whether there are any significant differences in the path coefficients between both groups. Overall, the fit indices show that the models fit the data from the two groups quite well. Goodness of fit measures for both groups are presented in table 6-22 and the results are illustrated in figure 6-32. Table 6-23 gives the parameter estimates by gender.

We can subsequently compare a new model, in which all paths are constrained to be equal across male and female sub-samples, with the original model for which these constraints are set free (i.e. in this case the paths for males and females are allowed to vary). Thus, this new model is actually nested in the original one (i.e. it simply is a more restricted version of the initial model).

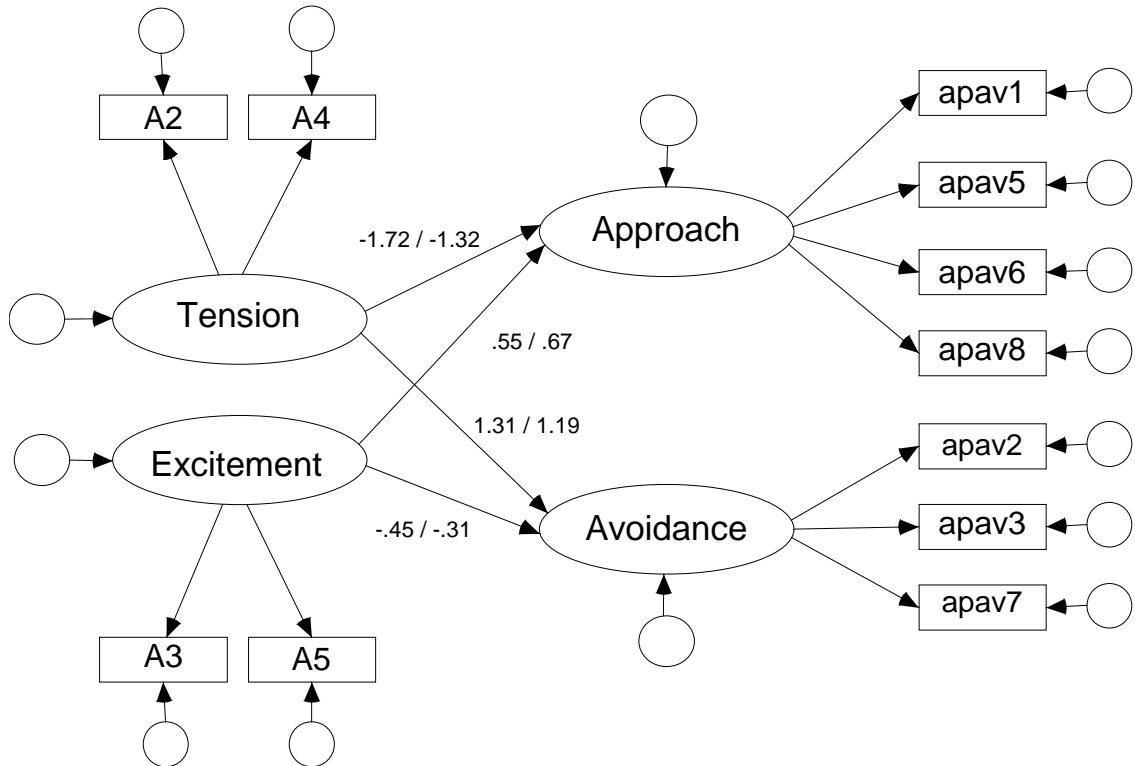
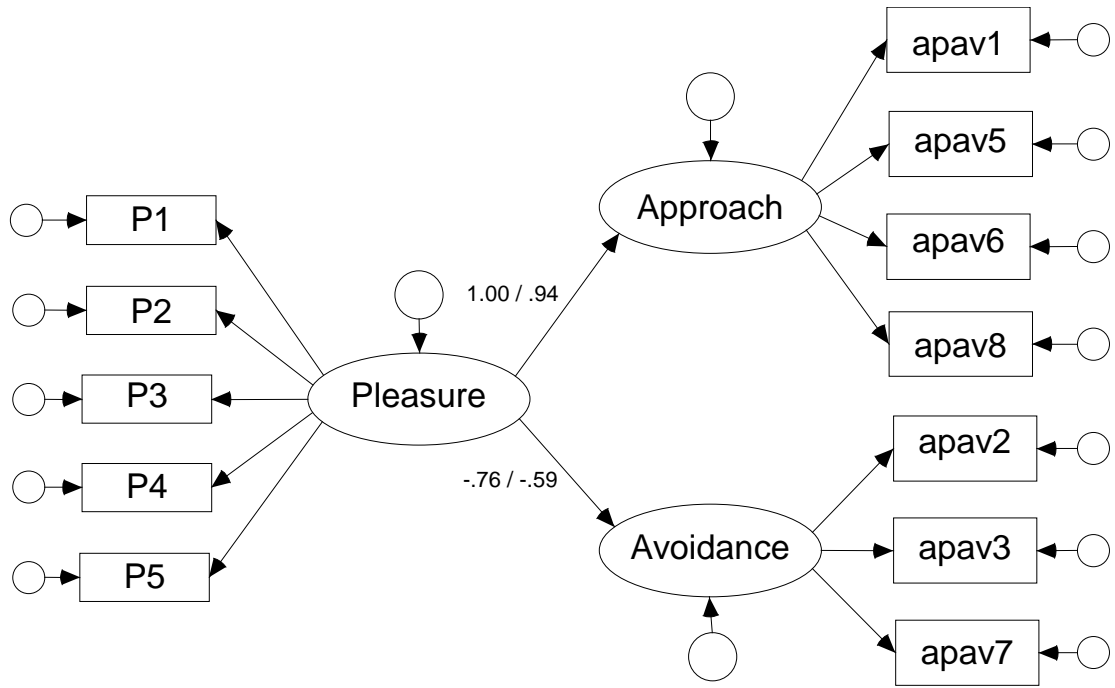


Figure 6-32: Path coefficients for males versus females (male/female)

Goodness-of-fit indices	Acceptable values	Pleasure Model		Arousal Model	
		Males	Females	Males	Females
χ^2 , (df)	Small	300.536, (104)		225.291, (80)	
p-value	>.05	.000		.000	
χ^2/df	<5	2.890		2.816	
Goodness-of-fit index (GFI)	>.90	.941		.950	
Adjusted Goodness-of-fit index (AGFI)	>.80	.912		.917	
Tucker and Lewis non-normed fit index (TLI)	>.90	.954		.938	
Benler's normed Comparative Fit Index (CFI)	>.90	.964		.955	
Root mean squared error of approximation (RMSEA)	<.08	.049		.048	

Table 6-22: Goodness of fit measures for the hypothesized models for male and female sub-samples

Male N=360		Parameter Estimates by Gender		
Path to:		Path from:		
		Pleasure	Tension	Excitement
Approach		1.00	-1.72	.55
	Avoidance	-.76	1.31	-.45
Female N=417		Path from:		
Path to:		Pleasure	Tension	Excitement
Approach		.94	-1.32	.67
	Avoidance	-.59	1.19	-.31

Table 6-23: Unstandardized regression weights for gender

In order to test whether it is justified to hold on to this constrained model or whether we should rather use separate models for males and females, we have to compare both models, which can be done by determining the difference between the χ^2 of the nested model (i.e. the more restricted model with the constraint of equal paths for males and females) and the χ^2 of the initial model (allowing for discrepancies in path coefficients) and dividing this result by the difference in the degrees of freedom between the two models (Sharma, 1996).

With regard to the impact of store-colour-evoked pleasure, this test $[(303.476 - 300.536) / (102-104) = 2.94 < 5.99 (\chi^2_{0.95}, 2df)]$ reveals that the constraint of equal path coefficients for males and females is justified. The model assuming equal effects for gender did not fit the data significantly worse, than the model allowing for differences. Therefore, this simpler model is preferred and we can conclude that there are no significant differences for men and women in the relationships between store-colour-evoked pleasure and approach or avoidance intentions.

For the effect of store-colour-evoked arousal (i.e. tension and excitement) on approach and avoidance intentions, no significant difference can be detected between the sexes either $[(232.006 - 225.291) / (84-80) = 6.715 < 9.49 (\chi^2_{0.95}, 4df)]$.

Therefore, we can conclude that no significant differences can be revealed between males and females in the relationships between store-colour-elicited emotions and subsequent approach and avoidance intentions.

6.7.5.2. Testing for a moderating effect of age

In order to examine whether the relationships between store-colour-evoked emotions and subsequent approach and avoidance intentions are moderated by the consumer's age, we run the structural equation models again, this time for the three age-categories (18-29, 30-44 and 45-60) separately.

Goodness-of-fit indices	Acceptable values	Pleasure Model			Arousal Model		
		Young	Middle	Old	Young	Middle	Old
χ^2 , (df)	Small	415.626, (156)			253.670, (120)		
p-value	>.05	.000			.000		
χ^2/df	<5	2.664			2.114		
Goodness-of-fit index (GFI)	>.90	.920			.945		
Adjusted Goodness-of-fit index (AGFI)	>.80	.880			.909		
Tucker and Lewis non-normed fit index (TLI)	>.90	.940			.943		
Benler's normed Comparative Fit Index (CFI)	>.90	.953			.959		
Root mean squared error of approximation (RMSEA)	<.08	.046			.038		

Table 6-24: Goodness of fit measures for the hypothesized models for the different age sub-samples

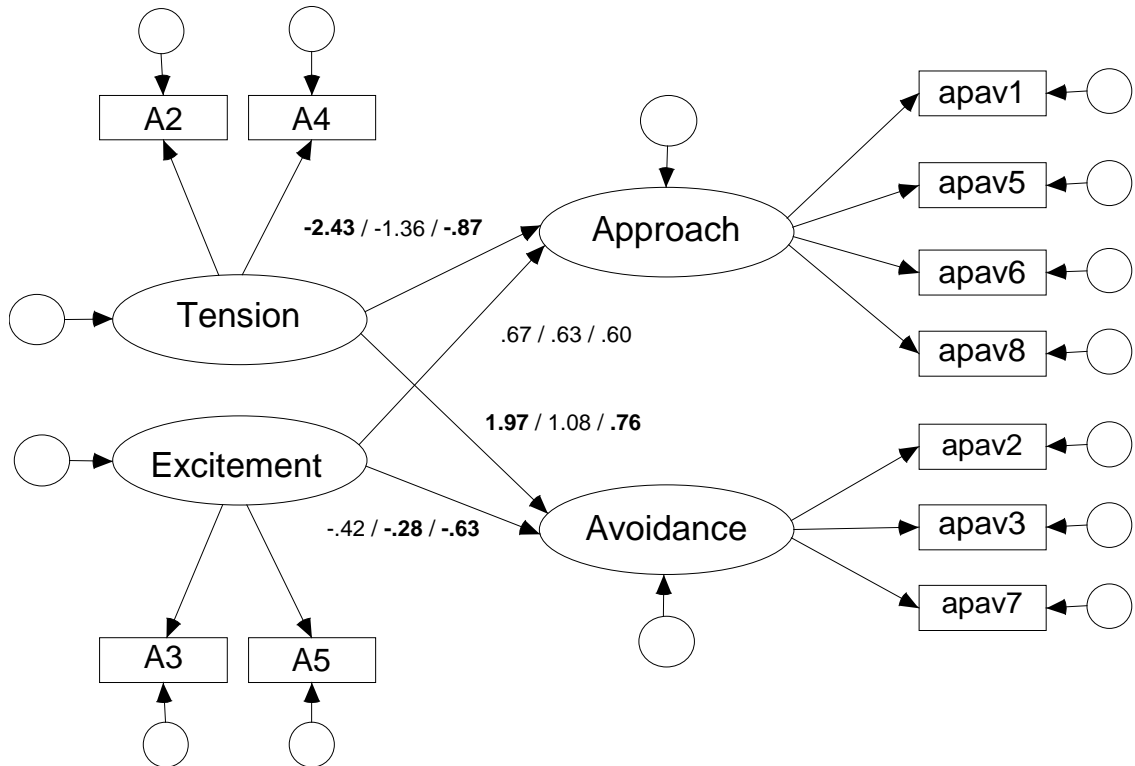
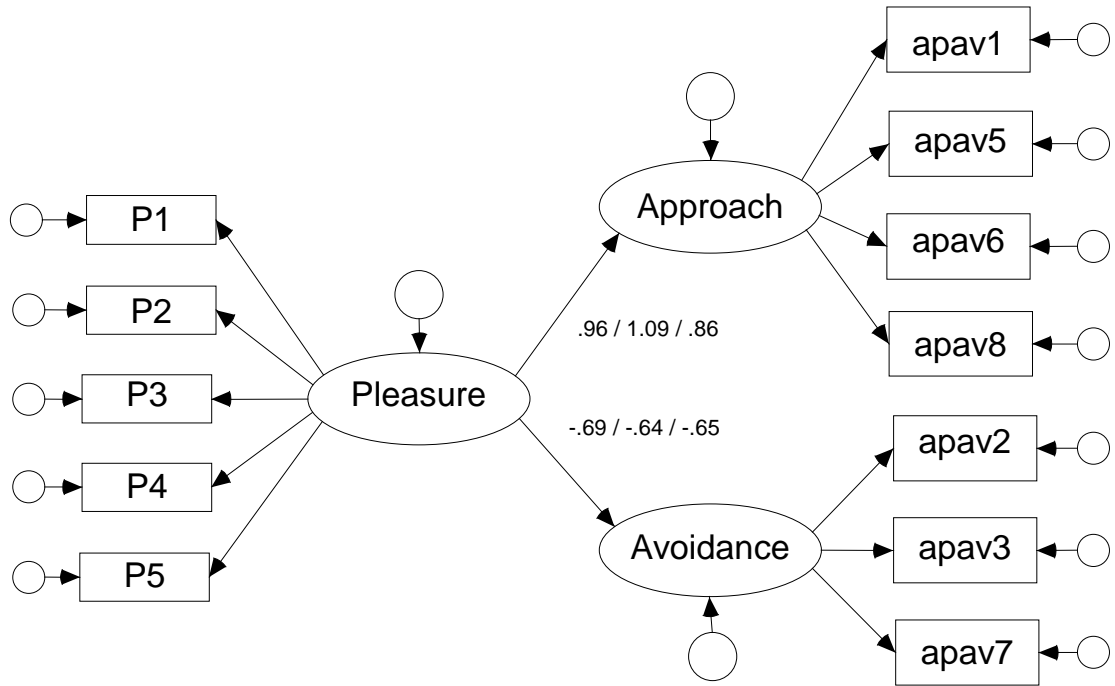


Figure 6-33: Unstandardized path coefficients for age-groups (younger18-29/middle 30-44/older 45-60)

Overall, the fit indices show that the models fit the data from the three age groups quite well. Goodness of fit measures for the three groups are presented in table 6-24 and the results are illustrated in figure 6-33. Table 6-25 gives the parameter estimates by age-group.

Younger (18-29) N=290			
Parameter Estimates by Age group			
<i>Path to:</i>	<i>Path from:</i>		
	Pleasure	Tension	Excitement
Approach	.96	-2.43 ^a	.67
Avoidance	-.69	1.97 ^b	-.42
Middle (30-44) N=256			
<i>Path to:</i>	<i>Path from:</i>		
	Pleasure	Tension	Excitement
Approach	1.09	-1.36	.63
Avoidance	-.64	1.08	-.28 ^c
Older (45-60) N=229			
<i>Path to:</i>	<i>Path from:</i>		
	Pleasure	Tension	Excitement
Approach	.86	-.87 ^a	.60
Avoidance	-.65	.76 ^b	-.63 ^c

^a Critical ratio for differences between parameters = 2.323

^b Critical ratio for differences between parameters = -2.163

^c Critical ratio for differences between parameters = -2.032

Table 6-25: Unstandardized regression weights for age-groups

To determine whether there are any significant differences in the path coefficients between the age-groups, we can again compare the more restricted model, in which all paths are constrained to be equal across age-group sub-samples, with our initial model for which these constraints are set free (i.e. in this case the paths are allowed to vary between the age-groups).

With regard to the impact of store-colour-evoked pleasure, this test $[(419.980 - 415.626) / (160-156) = 4.354 < 9.49 (\chi^2_{0.95}, 4df)]$ reveals that the constraint of equal path coefficients for the three age-groups is also justified. Because the model assuming equal effects among the

three age-groups, did not fit the data significantly worse than the model allowing for differences, this simpler model is preferred over the more complex one. We can conclude that there are no significant differences in the relationships between store-colour-evoked pleasure and approach or avoidance intentions among younger, middle-aged and older respondents.

For the effect of store-colour-evoked arousal (i.e. tension and excitement) on approach and avoidance intentions, no significant differences can be detected between the age-groups either $[(268.963 - 253.670) / (128-120) = 15.293 < 15.51 (\chi^2_{0.95}, 8df)]$. However, as in this case significance was almost reached, we also closely examined the individual parameter estimates. By a rough inspection, the regression paths appear relatively similar among the age categories, with the exception of the tension-approach and the tension-avoidance paths, which seem to differ considerably between young and older respondents. In fact, these paths appear to be stronger among the young sub-sample. When calculating the critical ratio's for differences between parameters, we discover in fact three parameters that differ significantly between particular subgroups. Besides the two already mentioned differences, the regression-path between excitement and avoidance also appears to differ significantly among older and middle-aged respondents (-.63 versus -.28, critical ratio=-2.032). Comparing the fully constrained model, with another model in which these three (out of the twelve) path coefficients are released, suggests that the latter model is significantly better $[(268.963 - 253.670) / (128-125) = 9.552 > 7.81 (\chi^2_{0.95}, 3df)]$. Thus, for older respondents (aged between 45-60), the relations between store-colour evoked tension and subsequent approach and avoidance intentions seem weaker than those for the younger age-group, while the relation between store-colour-evoked boredom (i.e. the opposite pole of excitement) and avoidance appears to be stronger, especially with regard to the middle-age-group.

Nevertheless, in general we can conclude that the differences, among the different age-groups, in the relationships between store-colour-elicited emotions and subsequent approach and avoidance intentions are not very significant.

6.8. TESTING MEDIATION

In the previous sections we demonstrated that store interior colour can affect feelings of pleasure, excitement, but also tension. Moreover, we showed that the emotions elicited by store colour are significantly related to approach and avoidance intentions towards the store.

Tables 6-26 and 6-27 provide a comprehensive summary of these research findings:

Path	Hypothesis	p	Conclusion
H1 Hue → Pleasure	- U	.037*	Partially Supported*
H2 Brightness → Pleasure	+	.037	Supported
H3 Saturation → Pleasure	+	n.s.	Not Supported
H4a Hue → Tension	+ U	.047*	Partially Supported*
H5a Brightness → Tension	-	.024	Supported
H6a Saturation → Tension	+	.033	Supported
H4b Hue → Excitement	+U	n.s.**	Partially Supported**
H5b Brightness → Excitement	-	n.s.**	Partially Supported**
H6b Saturation → Excitement	+	n.s.**	Partially Supported**
H7 Hue → Dominance	U ⁻¹	n.s.	Not Supported
H8 Brightness → Dominance	-	n.s.	Not Supported
H9 Saturation → Dominance	+	n.s.	Not Supported

* Significant hue effects could be discerned, yet, no apparent pattern seemed to emerge.

** Significant complex hue x saturation and hue x saturation x value interaction effects could be revealed (p=.01 and p=.019 respectively), although no clear pattern was apparent.

Table 6-26: Store-colour-evoked emotions:
Summary of hypotheses and results

Path	Hypothesis	Coefficient	Conclusion
H10 Pleasure → Approach	+	.79	Supported
H11 Pleasure → Avoidance	-	-.68	Supported
H12a Tension → Approach	-	-.69	Supported
H13a Tension → Avoidance	+	.72	Supported
H12b Excitement → Approach	+	.47	Supported
H13b Excitement → Avoidance	-	-.38	Supported

Table 6-27: Effects of Store-colour-evoked emotions on approach/avoidance intentions:
Summary of hypotheses and results

What we are interested in at this point is whether it is reasonable to assume that there is mediation. We want to establish whether store-colour-elicited emotions act as a ‘mediator’, representing the general mechanism through which store-colour (the focal independent variable) is able to influence approach/avoidance intentions towards the store (the dependent variable of interest) (see Baron and Kenny, 1986).

According to Baron and Kenny (1986), “*in general, a given variable may be said to function as a mediator to the extent that it accounts for the relation between the predictor and the criterion*”. The procedure for testing mediation, outlined by Baron and Kenny (1986) will be followed next to determine whether there is mediation in our model. This procedure will be explained on the basis of the illustration in figure 6-34, which diagrams the basic causal chain involved in mediation. In this model two causal paths lead to the outcome variable, one direct from the independent variable (path c) and one from the mediator (path b), which is in turn affected by the independent variable (path a).

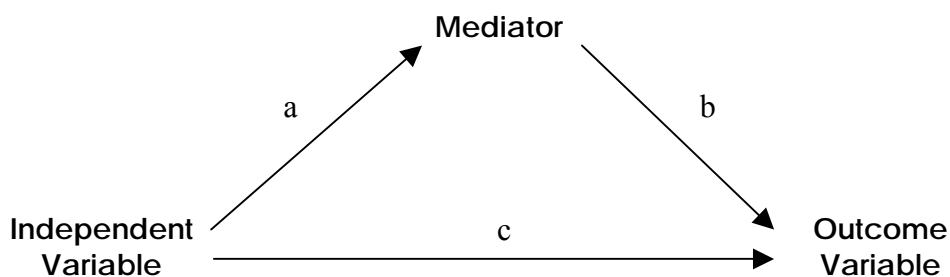


Figure 6-34: Path-diagram of mediational model

To test for mediation, three regression equations should be estimated and separate coefficients for each equation should be estimated and tested (Baron and Kenny, 1986):

- (1) Path a: the mediator should be regressed on the independent variable
- (2) Path c: the dependent variable should be regressed on the independent variable
- (3) Path b and path c': the dependent variable should be regressed on both the independent variable and the mediator.

Mediation is established when:

- (1) Path a is significant, i.e. the independent variable has impact on the mediator in the first equation.
- (2) Path c is significant, i.e. the independent variable has impact on the outcome variable in the second equation.
- (3) Path b is significant, i.e. the mediator has impact on the outcome variable in the third equation.
- (4) If the first three conditions hold, path coefficient c' from the third equation should be less than path coefficient c from the second equation, or zero in case of perfect mediation.

Baron and Kenny (1986) suggest to use the multiple indicator approach and estimate mediation paths by latent variable structural modeling. By means of this technique all the relevant paths can be directly tested and measurement error is taken into account. They argue that although structural modeling techniques were developed for the analysis of non-experimental data, the experimental context actually strengthens their use.

Nevertheless, due to the nature of this study, the independent variable we are interested in, store colour, is composed of three dimensions: store colour hue, brightness and saturation, which were manipulated according to a three-way (8x2x2) factorial design. Thus, the colour variable cannot be incorporated in a testable mediational model. As a consequence, instead we chose to include a single item, capturing '*store-interior colour appreciation*', which was included in the questionnaire in a series of questions pertaining to judgements of several aspects of the store interior. The item was measured on a 7-point Likert-type scale, with scores ranging from -3 "very ugly colours" to +3 "very pretty colours". The use of a single item is deemed acceptable in this case, since in mediator-oriented research, we are more interested in the mechanism than in the exogeneous variable itself.

In figures 6-35, 6-36 and 6-37 the direct and respective pleasure-, tension- and excitement-mediated effects of store-colour-appreciation on approach-avoidance intentions are represented.

Figure 6-35: Direct and pleasure-mediated effects of store-colour-appreciation on approach/avoidance intentions

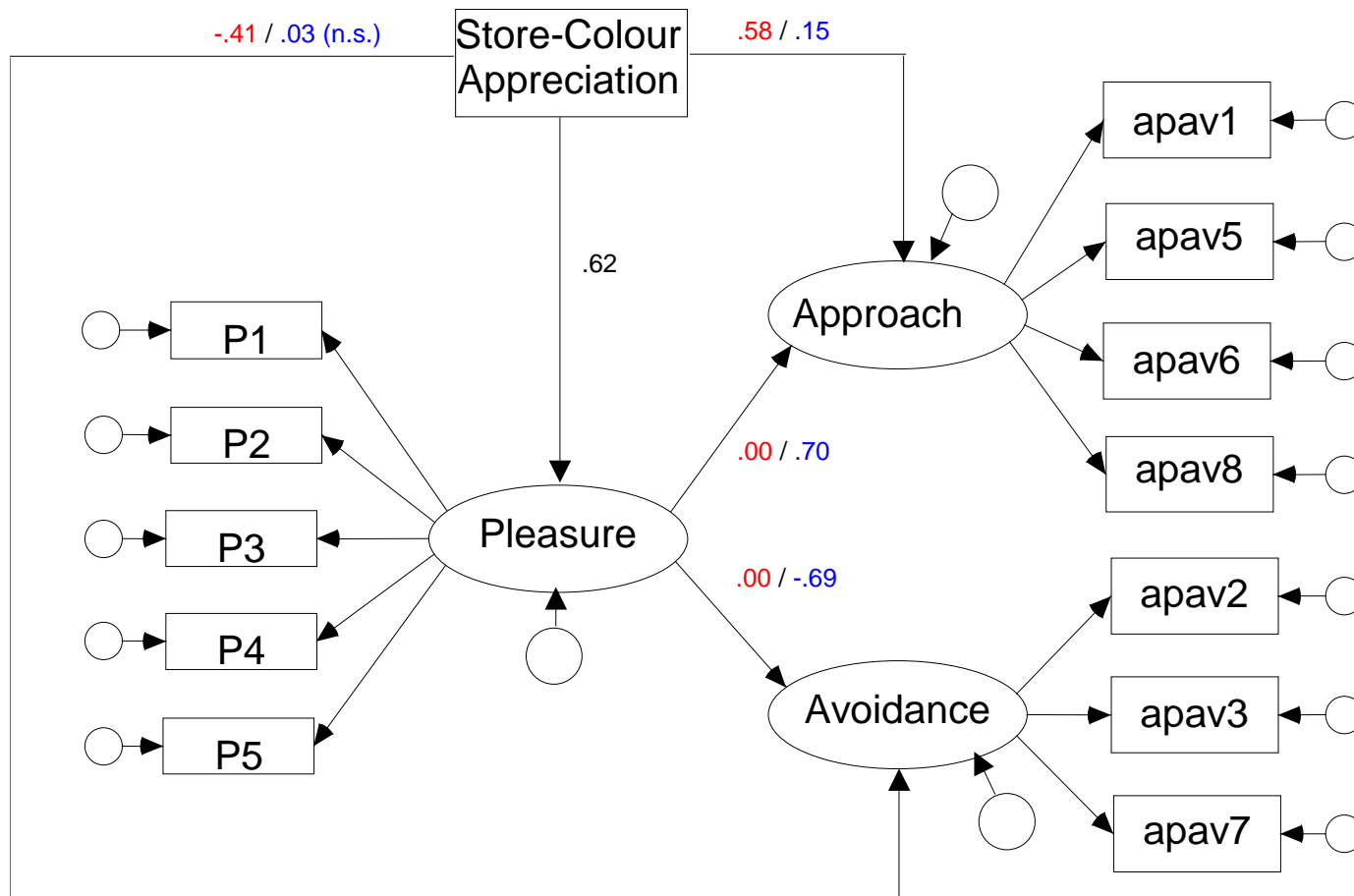


Figure 6-36: Direct and tension-mediated effects of store-colour-appreciation on approach/avoidance intentions

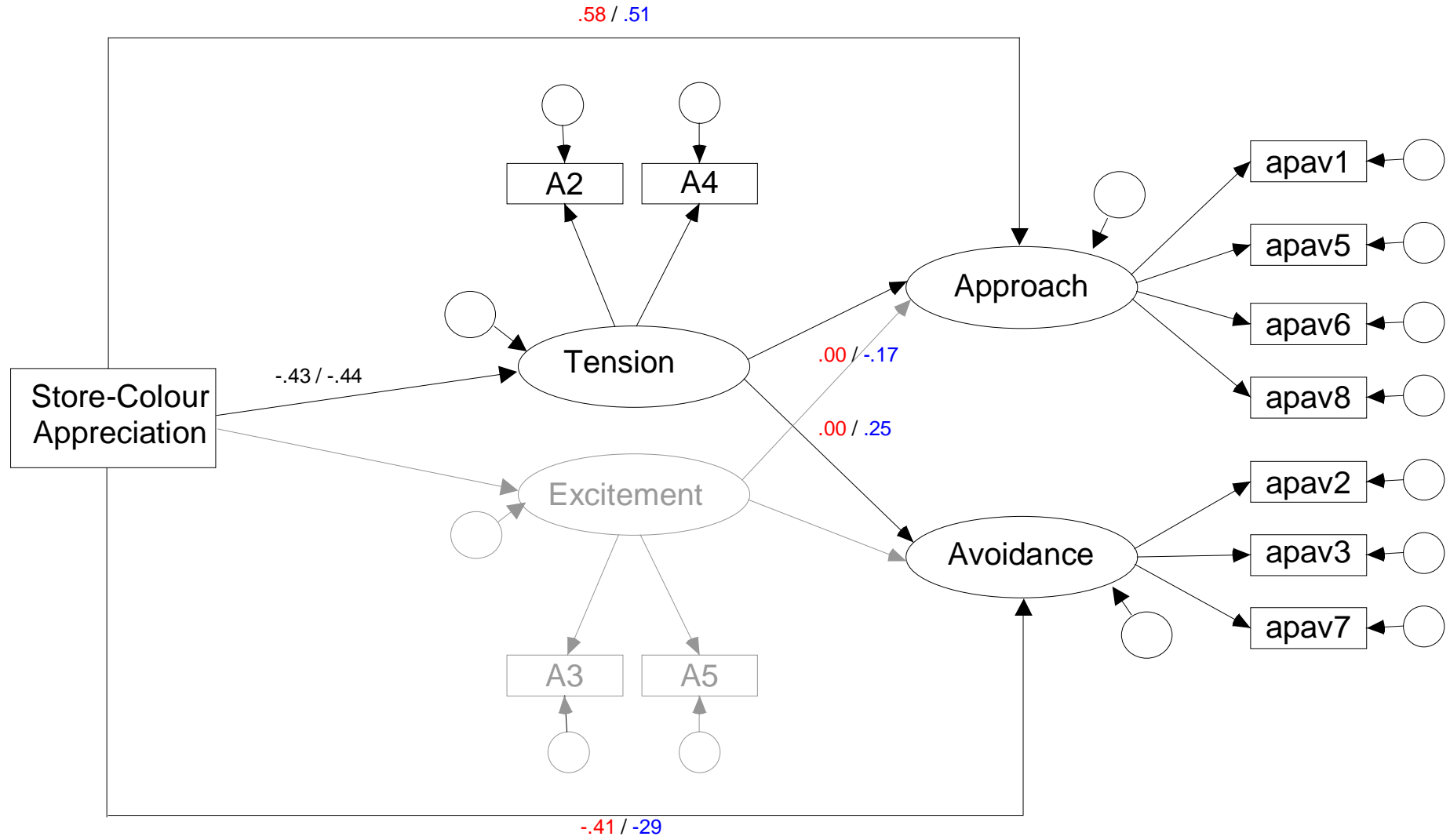
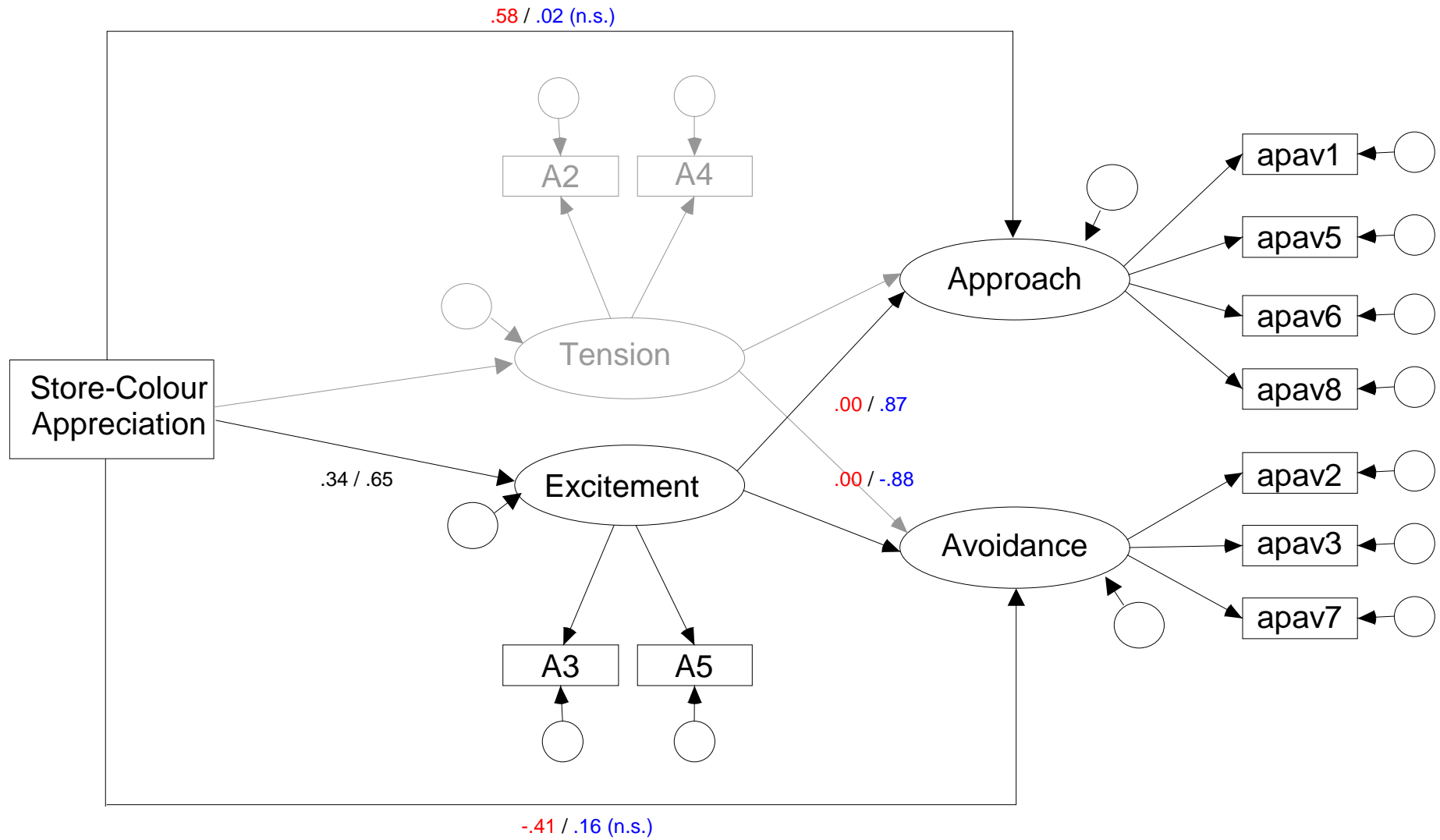


Figure 6-37: Direct and excitement-mediated effects of store-colour-appreciation on approach/avoidance intentions



A first investigation concerned whether the necessary conditions for mediation were fulfilled. This was checked respectively for pleasure, tension and excitement. To begin with, store-colour-appreciation was found to affect these potential mediating emotions significantly. Moreover, store-colour-appreciation also had a significant impact on both, approach and avoidance responses. Finally, the store-colour-evoked emotions of pleasure, tension and excitement were each found to be significantly related to approach and avoidance intentions, as was proved earlier. As these necessary conditions appear to hold, the path coefficients can be examined further.

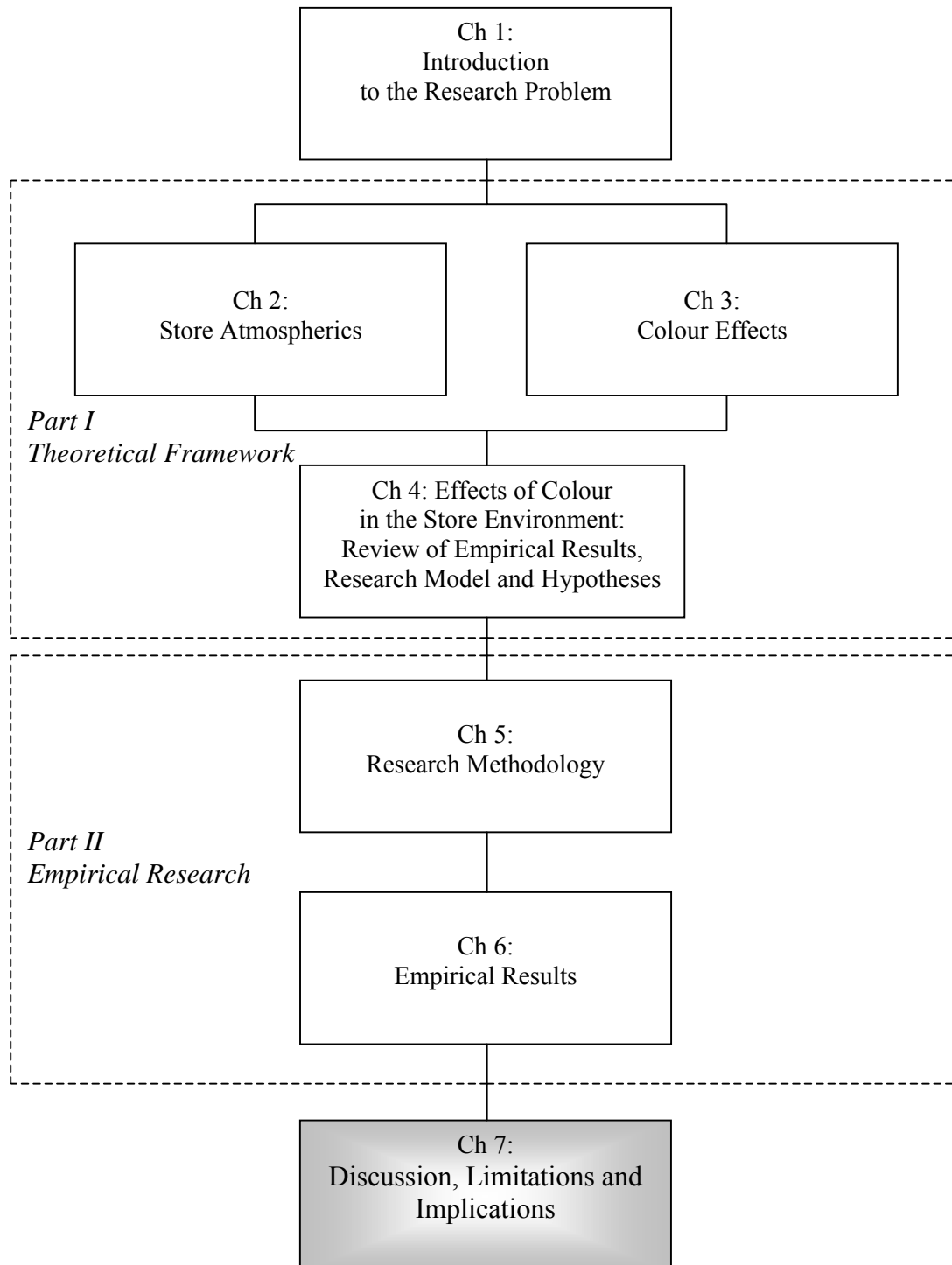
From a rough inspection of these coefficients, it is obvious that the direct paths from store-colour-appreciation to approach and avoidance responses strongly diminish when respectively pleasure and excitement are controlled (compare the blue with the red coefficients). Running the mediated and un-mediated models together in AMOS, gives us the possibility to test whether this decrease in path coefficients is significant, which appeared to be true in both cases of pleasure and excitement ($crdiff > 5$). The direct effects of store-colour-appreciation become insignificant when the emotions of pleasure and excitement are introduced in the model, which clearly illustrates their mediational role. Only in the case of pleasure, the direct colour-appreciation – approach path remained significant, but was nevertheless also strongly reduced. Here, no full mediation was reached, but a significant direct effect remains.

With regard to tension, we could not reveal a significant mediating effect, in that, although the path-coefficients seem to diminish slightly, the differences are not significant ($crdiff < 1.96$). However, according to Lehman (2001, p91), treating mediation as a yes-no question leaves out a lot of information. He suggests a more continuous measure, which concentrates on the size of the effects. Lehman's (2001) simple index of mediation $[(c-c')/c]$ amounts to $[(.58-.51)/.58 = .12]$ for the colour-appreciation – approach relationship and $[(.41-.29)/.41 = .29]$ for the colour-appreciation – avoidance relationship, indicating some small amount of mediation anyway.

Therefore, we can conclude that it is reasonable to assume that approach-avoidance responses to store-colours are, at least partially, mediated by the emotions they evoke. This is particularly true for store-colour-evoked feelings of pleasure and excitement.

Chapter 7

*Discussion,
Limitations and Implications*



CHAPTER STRUCTURE

Chapter 7: Discussion, Limitations and Implications

- 7.1. Introduction
- 7.2. Overview of the Results
- 7.3. Implications
 - 7.3.1. Theoretical Implications
 - 7.3.2. Managerial Implications
 - 7.3.3. Consumer Implications
- 7.4. Limitations
- 7.5. Directions for Further Research

7.1. INTRODUCTION

In this final chapter the results of the current study and its limitations will be discussed and directions for further research will be suggested. First, an overview of the results is presented in section 7.2. Then, in section 7.3., the implications of the findings are assessed. In this section, theoretical, managerial as well as consumer implications are provided. Subsequently, section 7.4. outlines the limitations of this study and finally in section 7.5. suggestions for further research are proposed.

7.2. OVERVIEW OF THE RESULTS

After data screening and screening for colour blindness, responses of 777 participants were retained for further analyses.

Before testing the actual hypotheses, strong efforts were made to enhance the validity and reliability of the constructs included in this study. A careful validation of the underlying constructs of both the PAD-emotion scale and the approach-avoidance scale was performed, assessing conscientiously the uni-dimensionality, within-method convergent validity and reliability of the respective scales.

Although the six pleasure items, the six arousal items and the six dominance items were expected to indicate three underlying dimensions in the PAD emotion scale, the scale turned out to be composed of four underlying constructs. In fact two separate unrelated arousal dimensions emerged: ‘tension’, which appeared to be negatively related to pleasure, and ‘excitement’, which appeared to be positively related to pleasure. After the deletion of several items, maximum likelihood confirmatory factor analysis of the resulting four-factor model attained very satisfactory goodness-of-fit scores. Whereas the pleasure factor appeared to score extremely well with regard to its reliability, the other factors scored somewhat lower. Although dominance scored actually rather weak with regard to within-method convergent validity and reliability, the construct was originally retained, because the potential role of dominance has been noted to be context specific (Turley and Milliman, 2000) and colour has been demonstrated to affect this dimension (e.g. Valdez and Mehrabian, 1994; Osgood et al., 1957; Adams and Osgood, 1973; Sivik, 1974a). The pleasure, tension, excitement and dominance factors also appeared to be highly correlated, but still, discriminant validity among them was achieved. Mehrabian (1998, p6) has indicated high correlations between the respective PAD dimensions not to be unusual, when stimuli represent only “*limited realms of affective experience*”, which apparently seems to be the case when only colour is manipulated (see also Valdez and Mehrabian, 1994).

Traditionally, in a retailing context approach and avoidance have always been considered to be the opposite poles of a uni-dimensional approach-avoidance construct (Donovan and Rossiter, 1982; Bellizzi and Hite, 1992; Van Kenhove and Desrumaux, 1997; Matilla and Wirtz, 2001). Nevertheless, in this study, both exploratory as well as confirmatory factor analyses clearly revealed two related but separate underlying approach and avoidance

dimensions, each demonstrating high internal validity. This finding is in line with Foxall's (1990, 1997, Foxall and Greenley, 2000) conceptualization that approach and avoidance make up two distinct dimensions, which can be explained as the outcome of two opposing learning histories, and can, therefore, not be represented psychometrically by a single continuum from escape/avoidance to approach. After the deletion of one 'affiliation' item, a satisfactory two-factor approach-avoidance model was obtained, with adequate goodness-of-fit scores.

The actual hypothesis testing was split up into two main parts. First of all, the hypotheses concerning store-colour-evoked emotions were tested by means of multivariate analysis of variance (MANCOVA). Here pre-existing mood was introduced as a covariate, to control for its potentially confounding effect, and the different emotions elicited by store-colour hue, brightness and saturation were examined in detail. A three-way full factorial multivariate analysis of variance, with mood as a covariate, revealed significant main effects for store-colour hue and value on the emotions elicited, but not for store-colour saturation. Nevertheless, a significant two-way (hue x saturation) as well as three-way (hue x value x saturation) interaction effect also emerged. The respondents' pre-existing mood (the covariate introduced to the model) also proved, as expected, to have a highly significant effect on the emotions experienced after exposure to the stimulus, thus revealing clearly the necessity to control for this intervening variable. We refer to paragraph 6.8. for a comprehensive table, summarizing the proposed hypotheses and obtained results. We present a short overview:

Pleasure

As expected (H1), store-colour-evoked pleasure was found to differ significantly among the different hue categories. In contrast to expectations however, no clear pattern seemed to emerge in the pleasure evoked by short to long wavelength hues. Post-hoc comparisons among the hues showed only the difference in elicited pleasure between blue and green-yellow to be significant, with blue eliciting the most pleasure and green-yellow the least. According to increasing pleasure, hues can be ranged as follows: Green-Yellow / Red / Blue-Green / Purple-Blue / Green / Yellow-Red / Yellow / Blue. The value or brightness of the colour in the store interior also appears to have a significant impact on pleasurable feelings, as hypothesized (H2), with brighter coloured stores evoking more pleasant feelings than darker coloured stores. Our expectation (H3), that colour saturation would also have a positive effect on store-elicited pleasure could, however, not be confirmed.

Tension

As hypothesized (H4a), significant differences could be revealed in store-colour-evoked tension among the different hue categories. Still, no clear pattern appeared to emerge in the tension elicited by short to long wavelength hues. Post-hoc comparisons among the hues showed only the difference in elicited tension between blue and green-yellow to be significant. The blue-coloured store environment appeared to cause less tension (i.e. more relaxation) than the green-yellow coloured interior. This finding was contrary to expectations, which were based on findings in a retail context by Crowley (1993), but is in line with findings by Valdez and Mehrabian (1994) concerning colour-patches. The mid-wavelength colour green-yellow actually appeared to be the most tense colour, followed by red. According to increasing tension, hues can be arranged as follows: Blue / Green / Blue-Green / Purple-Blue / Yellow / Yellow-Red / Red / Green-Yellow. The value or brightness of the store-interior, as hypothesized (H5a), also appears to have a significant impact on experienced tension. The obtained results confirm that brighter coloured stores, in general, evoke less tension than darker coloured stores. Our findings were also supportive of the expectation (H6a) that, in general, more saturated coloured stores are judged more tense (i.e. less relaxing) than less saturated coloured stores.

Excitement

With regard to the excitement elicited by store colours, the interpretation of the results is more complex. In this case no independence was achieved between hue, brightness and saturation effects, but instead, complex two-way (hue x saturation) and three-way (hue x value x saturation) interaction effects were found, which will not be discussed here in further detail. We refer to section 6.6.4. for a more detailed interpretation.

Dominance

From the results of the MANCOVA analysis, we could not reveal any significant effects for store-colour hue, brightness, or saturation on feelings of dominance. Consequently, none of the hypothesized effects with regard to store-colour-evoked dominance (H7-H8-H9) could be supported. For this reason, the dominance construct was omitted in subsequent analyses.

Testing for *the moderating effects of gender* on the emotions elicited by store-interior-colours revealed no significant main or interaction effects with regard to store-colour-evoked emotions in general. Nevertheless, the univariate statistics reveal a significant hue by gender

interaction with regard to store-colour-evoked tension, suggesting that different store-colour-hues appear to elicit a different amount of tension in males and females. Applied to a store-environment, the hues blue-green, and green-yellow appear to elicit more tension in females than in males. On the other hand, green, yellow and yellow-red seem to evoke a little more tension in males than in females. These results suggest that the gender of the target audience should not be ignored in store-colour decision-making.

Assessing *the moderating effect of age*, we also could not reveal significant main or interaction effects of age-category with regard to store-colour-evoked emotions in general. Nevertheless, the univariate statistics reveal that younger respondents appear to experience more excitement than middle-aged and older respondents. We can also identify a significant 'hue by age' interaction with regard to elicited excitement. Although, generally, store colours elicited higher amounts of excitement in younger respondents, the opposite appears to be true for blue, blue-green and green-yellow, which actually seem to elicit most excitement in the oldest age category. However, no obvious pattern seems to emerge from the obtained results, suggesting that for each hue different conclusions should be drawn. This result points to the importance of considering the target-age-group when making store colour decisions.

The next set of hypotheses was tested by means of Structural Equation Modelling (SEM). Providing support for the proposed hypotheses (H10-H11), the results reveal a significant positive path between store-colour-evoked pleasure and approach intentions towards the store (.79) and a significant negative path between elicited in-store pleasure and avoidance responses (-.68). In light of the fact that two separate arousal factors, tension and excitement, emerged from our data, the original hypotheses concerning arousal were adapted to take on a two-dimensional view of arousal. This allowed us to integrate the presumed pleasure-arousal interaction in our hypotheses. As expected (H12a-H12b), the results suggest a significant positive path between store-colour-evoked excitement and approach intentions towards the store (.47) and a significant negative path between elicited tension and approach (-.69). With regard to avoidance, as hypothesized (H13a-H13b), a negative effect was detected for excitement (-.38) and a positive one for tension (.72). Thus, our findings provide strong support for the proposed interaction effect. Not only with regard to approach intentions, significant paths could be identified from store-elicited feelings of pleasure, tension and excitement, but also for avoidance reverse effects could be revealed. Thus our findings support the presumption that in-store induced emotions can induce approach and avoidance

responses. Approach intentions towards the store appear to be positively affected by store-colour-evoked pleasure and excitement and negatively by feelings of tension. Store-colour-evoked tension, on the other hand, appears to induce avoidance responses, which also seem to increase when less pleasure and less excitement are experienced.

Although the path-coefficients with regard to approach and avoidance intentions appear to be very similar, only pointing at opposite directions, they were found to differ significantly from each other, emphasizing the importance of holding on to both related, but separate constructs.

The relationships between the emotions elicited by store-interior-colour and approach and avoidance responses towards the store, were in general not found to be significantly affected by a consumer's gender or age. Nevertheless, some minor discrepancies between the different age-categories could be revealed. Actually, for older respondents (aged between 45-60), the relations between store-colour evoked tension and subsequent approach and avoidance intentions seemed to be weaker than those for the younger age-group (aged between 18-30), while the relation between store-colour-evoked boredom (i.e. the opposite pole of excitement) and avoidance appeared to be stronger, especially with regard to the middle-age-group (aged between 30-45). However, in general, we can conclude that the differences among the different age-groups, in the relationships between store-colour-elicited emotions and subsequent approach and avoidance intentions, are not very significant.

In conclusion, store interior colour was demonstrated to affect feelings of pleasure and excitement, but also tension. Moreover, such store-colour-evoked emotions were found to be significantly related to approach and avoidance intentions towards the store. A comprehensive overview of these findings can be found in section 6.8. Furthermore, we established that it is reasonable to assume that store-colour-elicited emotions act, at least partially, as a 'mediator', representing the general mechanism through which store-colour is able to influence approach/avoidance intentions towards the store. This appeared to be particularly the case for store-colour-evoked feelings of pleasure and excitement.

7.3. IMPLICATIONS

7.3.1. THEORETICAL IMPLICATIONS

In this study we examined the impact of colour in the store environment on affective responses and subsequent approach and avoidance behaviours. As the prevalent research on the impact of store-interior colour is scarce and methodologically flawed, we contributed with our study to marketing scholars' understanding of this subject. Based on the literature, we first supplied a detailed review of general colour effects and of the effects of colour applied to the store environment. We demonstrated the shortcomings in these research streams and attempted to address them in our own empirical study.

In a methodological sense, this study distinguishes itself from other studies on the impact of colour in the store environment in several respects. First of all, in this study a full range of store-colours has been examined. A total of 32 different colours, have been included as stimuli (8 hues by 2 brightness levels by 2 saturation levels), in contrast to the existing studies, which have focused on a maximum of only four hues. Moreover, this study clearly illustrates the necessity of investigating the effects of several individual hues, as findings on the basis of two or four hues are by no means to be generalized to other warm or cold colours. Secondly, in the current study hue-effects have been examined while controlling for saturation and brightness levels. The few studies on the impact of store-interior-colour carried out so far, have mostly used fully saturated colours and have neglected to control for the potentially confounding colour attributes of brightness and saturation when investigating hue effects. Moreover, they have neglected to fully specify the utilized colour samples according to a standard colour system. Thirdly, besides hue effects, the specified research design, allowed us to examine the effects of store-colour-saturation and brightness, as well as interaction effects between the three colour dimensions. Our findings showed that saturation and brightness have a significant impact on colour-evoked emotions in their own right, while also significant interaction effects appeared to emerge between store-colour hue, brightness and saturation. These results clearly emphasize the importance of considering the three colour attributes together when studying environmental colour effects.

Although the effects of colour brightness and saturation on elicited emotions have been examined in an advertising context and with regard to plain colour patches, they have, thus far, never been examined in a retail context. However, this study clearly demonstrates the necessity to study colour in context, as previous findings on colour effects in other contexts, could not always be confirmed in a store context.

Finally, in this study special attention was devoted to construct validation of the PAD-emotion scale and the approach-avoidance scale.

Construct validation of the PAD-emotion scale revealed two separate ‘tension’ and ‘excitement’ dimensions within the arousal scale. These uncorrelated factors actually appeared very useful to examine the pleasure-arousal interaction effect on approach responses, as ‘excitement’ is positively related to pleasure, whereas ‘tension’ is negatively related to pleasure. Distinguishing these two separate arousal dimensions can possibly resolve some of the ambiguity with regard to the effects of arousal in a retail context. In line with previous empirical studies in a retailing context, dominance was found to be a rather weak construct, which appeared in this study highly correlated with pleasure. Although significant correlations among the PAD scales are not unusual when used to assess stimuli that represent ‘limited realms of affective experience’ (cfr. Valdez and Mehrabian, 1994; see Mehrabian, 1998), no significant differences could be detected in dominance responses elicited by different store colours. Therefore, this dimension appears to be a redundant factor, which is in line with the contention by Russell and Pratt (1980) and findings by Donovan and Rossiter (1982) and Greenland and McGoldrick (1994).

Concerning the approach-avoidance scale, the results obtained in this study through confirmatory factor analysis provide strong empirical evidence for the existence of two separate approach and avoidance dimensions within the approach/avoidance construct (cfr. Foxall 1990, 1997, Foxall and Greenley, 2000), revealing that also in a retailing context these are two related but separate dimensions. As a matter of fact, the path coefficients with regard to the emotional determinants regarding approach and avoidance behaviours, have been proven to be not only reversed, but actually significantly different from each other. Thus, in-store elicited pleasure, tension and excitement were found to exert independent influences upon approach and avoidance responses. This demonstrates the necessity to consider both behavioural intentions of approach as well as avoidance, as these are not evoked to the same extent by different emotions.

7.3.2. MANAGERIAL IMPLICATIONS

The recent finding that almost two thirds of all purchase decisions are made in the store (POPAI, 1998) has turned the attention to the point-of-purchase and to store atmospherics. As other marketing tools become neutralized in the competitive battle, 'atmospherics' play, as contended by Kotler (1973), a growing role in the unending search of firms for differential advantage. According to Bitner (1990), atmospheric planning can make the difference between a business success or failure. As the effect of the store environment on retailer performance has been demonstrated (Kumar and Karande, 2000), 'atmospherics' has become a highly relevant marketing instrument for retailers.

Particularly because store-interior-colour has been proven to be a potentially influential store-design element, which can, in practice, easily be adapted at minimal costs, the booming retailing industry appears very interested in this specific research topic (Brenngman, 2002; Retail-Update, 2002; POPAI-Benelux; Cahan, 2002). Knowing the effects of specific colours applied to the store environment can provide retailers with powerful guidelines for making store-interior colour decisions, enabling them to design shopping environments that induce specific emotions in shoppers, which enhance their purchase probability. We feel that this study can provide guidance in making appropriate store interior colour decisions. Based on insights gained from this study, store-managers can make better-informed decisions in the selection or avoidance of specific store colours.

Our results suggest to avoid dark and saturated colours, as they appear to evoke tension in shoppers, which, in turn, leads to avoidance behaviours. The application of light store interior colours can, on the other hand, be advocated because they seem to elicit pleasurable and relaxed feelings, which appear to prompt approach intentions, such as spending time browsing around in the store, enjoying shopping and spending more money than planned. With regard to particular hues, basic findings suggest that, in general, the use of blue, green, yellow and yellow-red in the store interior could elicit favourable effects, while green-yellow and red should clearly be avoided. However, a careful examination of the detailed results is recommended because of the complex 'hue x brightness x saturation' interaction effects.

Our findings also specifically suggest that the age and gender of the target store-audience should not be ignored in store-colour decision-making. In fact, a significant ‘hue by gender’ interaction with regard to store-colour-evoked tension could be revealed, suggesting that different store-colour-hues appear to elicit a different amount of tension in males and females. Our results also point to the importance of considering the target-age-group when making store colour decisions. Whereas, in general, younger respondents appear to experience more excitement than middle-aged and older respondents, a significant ‘hue by age’ interaction reveals that blue, blue-green and green-yellow actually seem to elicit most excitement in the oldest age category. Therefore in order to be able to select an appropriate store-colour, the main target’s age and gender should be taken into account.

7.3.3. CONSUMER IMPLICATIONS

Also for consumers it is nicer to shop in a pleasant and attractive store environment. Nevertheless, it may be important for them to realize that the store itself can be a hidden persuader. Even when a consumer is not planning to buy anything, an attractive store atmosphere may impel him/her to do so anyway. Although this may happen unconsciously, it is important for consumers to realize that they may be affected by such subtleties as store colour. At times when consumers cannot afford any excess spending, the only way to protect themselves from these temptations is by avoiding such attractive store environments.

7.4. LIMITATIONS

It has to be acknowledged that this study has some limitations. Several biases might have occurred in collecting our data and interpreting our results.

One important limitation to this study concerns the '*external validity*' of the findings. Unfortunately, as a direct consequence of the main concern for internal validity, laboratory experiments are generally rather weak in generalizability. Therefore, an extension of this study to field experiments is called for to determine the ecological validity and generalizability of our findings. Actually 'being' in an environment where the wall colours are manipulated, would probably evoke stronger emotional reactions than 'viewing a picture' in which wall colours are manipulated.

Furthermore, the findings of this study cannot be generalized to other hues and other value and saturation levels than those investigated. More empirical research is necessary to determine to what extent our findings can be generalized, with regard to other store colours. Also with regard to other store formats more research is called for. It is obvious that colours that evoke pleasure in a furniture store may differ from the ones that do so in a grocery store.

As this study is based on a brief exposure to the stimulus, only short-term affective responses to store-interior-colour were assessed. It would be interesting to assess emotional reactions over a longer time period, in order to determine whether some adaptation to the environmental colour occurs or not.

A potential source of bias in this study, may result from the fact that '*the external environment*' of the respondent, while viewing the experimental picture, was not controlled for. The influence of lighting and other colours in the environment, for example, could represent potentially confounding factors. However, controlling for these factors would have called for a very stringent laboratory setting, which would have been very costly and might have introduced other biases of its own.

The '*omission of potentially important variables*' might have introduced another bias. We did, for example, not check for the respondents' involvement with the product category of 'design furniture and accessories', which might possibly have a moderating role in the relation between store-colour-evoked emotions and subsequent approach/avoidance responses.

Another limitation concerns the measurement of the '*arousal construct*'. In this study, emotional responses to the store environment were measured by means of self-report questionnaires. Gröppel-Klein and Baun (2001) however, point out that verbal scales may not be appropriate to capture arousal. Construct validation of the PAD-emotion scale revealed two separate 'tension' and 'excitement' dimensions within the arousal scale. However, purification of the scale resulted in only two remaining items capturing tension and two other items measuring excitement. For future research, we recommend the use of better 'tension' and 'excitement' scales and suggest that perhaps also electrodermal activity could be measured as an arousal indicator (cfr. Gröppel-Klein and Baun, 2001). In retrospect, some verbal protocol procedures could also have been used to capture tension and excitement (cfr. Gorn et al., 1997). However, such procedures do not always provide usable responses (e.g. Geuens, 1998).

'*Common method variance*' may be another possible threat to validity. As we used one single questionnaire to measure all constructs included in the study, the strength of the relationships between these constructs may be somewhat inflated. This is related to the potential existence of *halo effects*, in that respondents might be worried to provide inconsistent answers. However, mixing the items and reversing some of them should have reduced this potential bias.

Another potential bias that may have confounded our findings might result from '*experimenter bias*'. However, intensive experimenter briefing and training were provided, prior to data collection, aiming to overcome this potential weakness. The use of a structured questionnaire, including detailed instructions for the respondents, automatically diminished this risk. Moreover, experimenters were not aware of the actual hypotheses investigated.

7.5. DIRECTIONS FOR FURTHER RESEARCH

A myriad of unresolved research issues still needs to be addressed. Some of the limitations mentioned above, provide interesting directions for further research. A major avenue for such research encompasses the replication and extension of our study across different store types and involving different colour-samples. Such replications might shed light on the generalizability of our findings in order to establish external validity of our results. In the current study the impact of store colour was investigated with respect to a design furniture and accessories store. Future research should study the effects of interior colours for different store formats in order to determine to what extent the obtained results can be generalized. Also more colour-samples should be tested. Future studies should especially focus on more hues: as no clear patterns seem to emerge with regard to the emotions elicited with respect to colour-wavelength, results are prone to be hue-specific. Also the impact of more value and saturation-levels should be examined.

Moreover, an extension of this study to field experiments is called for in order to determine the ecological validity and generalizability of our findings. As a matter of fact, POPAI Benelux, the Point-of-Purchase-Advertising-Institute has already shown a profound interest in this study and appears to be willing to carry this experiment one step further, into the actual store environment.

A cross-cultural replication could also be extremely valuable to determine the extent to which store-colour-effects are generalizable across cultures.

In this study the moderating effects of the demographic characteristics age and gender have been assessed. It may also be interesting to examine the moderating effects of personality variables such as arousal seeking tendency or optimum stimulation level.

Longitudinal research could examine the potential moderating influence of colour trends on store colour effects.

Another potential avenue for further research involves the possible interactions of the effects of store colour with the effects of other store characteristics such as music or crowding.

As Gorn et al. (1997) already indicated, there is little systematic empirical research in marketing on the effects of colour. Although some initial work has been carried out by Gorn et al. (1997) with regard to the use of colour in advertising, there are still a lot of colour-applications in a marketing context, which remain unexplored. For instance the effects of colour applied to packaging, coupons, in-store displays, shopping carts, salespersons' dress, web-sites, etc... all still have to be investigated.

In fact, a lot of further research is required in order to increase our understanding of the effects of colour in consumer behaviour...

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Appendix

Selected colours according to the Munsell notation and their corresponding RGB values

5.00 GY				
Chroma	14	14	6	6
Value	5	8	5	8
R	110	188	125	202
G	146	223	142	217
B	0	0	72	139

5.00G				
Chroma	14	14	6	6
Value	5	8	5	8
R	0	0	80	152
G	158	237	147	224
B	102	167	118	187

5.00PB				
Chroma	14	14	6	6
Value	3	6	3	6
R	0	54	59	138
G	87	163	88	161
B	177	255	128	199

5.00B				
Chroma	14	14	6	6
Value	4	7	4	7
R	0	0	22	123
G	128	205	119	194
B	187	255	142	215

5.00YR				
Chroma	14	14	6	6
Value	5	8	5	8
R	201	255	176	254
G	113	186	124	199
B	0	63	85	157

5.00R				
Chroma	14	14	6	6
Value	4	7	4	7
R	197	255	155	231
G	56	142	94	170
B	67	135	92	165

5.00BG				
Chroma	14	14	6	6
Value	5	8	5	8
R	0	0	60	140
G	158	237	147	224
B	154	221	143	213

5.00Y				
Chroma	14	14	6	6
Value	6	9	6	9
R	190	255	180	255
G	157	234	159	235
B	0	0	85	154

