Bitter Cold, Sharp Cheese and Loud Colours:

The Chromatic Cacophony of Cross-modal Sensory Perception

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Statement of Authentication

The work presented in this thesis is, to the best of my knowledge and belief, original except as acknowledged in the text. I hereby declare that I have not submitted this material, either in full or in part, for a degree at this or any other institution.

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Abstract

This thesis addresses the question of how a consumer's different sensory modalities interact to guide perception and decision-making. Specifically, in three studies, its primary objective is to investigate the cross-modal link between vision (colour) and touch.

Colour has a profound influence on human perception. Not only does it cause changes in physiological or emotional states, it can shape what is perceived in other sensory modalities. However, the body of research on these “cross-modal” experiences has predominantly examined colour’s influence on taste and smell. Instead, Study 1 sets out to identify the cross-modal association between vision (colour) and touch (perceived texture of food). Results from Study 1 show colour influences 'perceived' texture of the food during consumption.

The extant literature on cross-modal associations involving colour are heavily skewed to situation involving food consumption. To extend existing knowledge, Study 2 applies these cross-modal effects between vision and touch to an advertising setting, where colour is found to influence 'expected' texture.

Finally, Study 3 examines the multidirectional nature of the colour-touch relationship, specifically whether touching a product influences perception relating to product colour. Findings from Study 3 demonstrate, under certain conditions, touch does have a cross-modal influence that shapes affective responses to colour cues. Together, the three studies provide further understanding of the cross-modal relationship between vision and touch, and demonstrate the existence of the cross-modal effect in different scenarios and with different products.

Prologue

Introduction

> *"All our knowledge begins with the senses, proceeds then to the understanding, and ends with reason. There is nothing higher than reason."*
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> - Immanuel Kant, *'Critique of Pure reason'*

For many marketers, consumer interaction with a product or brand is the fundamental principle underpinning marketing strategy. Whether this is direct physical manipulation of a product or packaging, the response to in-store ambience or the psychological interaction that comes about from viewing an advertisement, our five cardinal senses are driving the experience. Because of this, academics and practitioners are now exploring the concept of "sensory marketing", a process that Krishna (2012; p332) says "engages the consumers' senses and affects their perception, judgment and behavior". This idea of 'sensory' marketing provides a more holistic, embodied framework that incorporates the basic human desires for sensory stimulation.

However, recent research in psychology and neurology suggests the sensory modalities don't necessarily operate independently. Previously, if marketers wanted a consumer to experience a different taste while eating a snack food, for example, they would work with food scientists and focus on the specific product ingredients. Now, however, a similar result might come about from changing the colour of the food, or by modifying its constituents to alter the sound it creates when being chewed. It is these 'cross-modal' associations that form the basis of this thesis.

Cross-modal perception was previously thought to apply to a small group of the population that experienced synaesthesia (Cytowic, 1989), a condition where a stimulus in one modality causes a concurrent experience in another modality

(Ramachandran and Hubbard, 2001). However, there is a growing school of thought that says all humans may lie somewhere along a cross-modal spectrum (Spence, 2011; Bien at al., 2012). As such, this thesis aims to identify cross-modal associations between vision and touch and investigate their influence in a marketing context. To assist the reader, the remainder of the prologue chapter is set out as follows. First, a brief summary of literature pertaining to colour is included to provide background knowledge. Similarly, a brief summary of literature relating to touch is provided. This provides the necessary context for the research questions and objectives that are then presented along with a discussion of the key contributions. Finally, the organisation of the thesis is presented.

Colour

Colour in everyday life

In modern life, the prevalence of colour and colour choices is profound. The clothes we wear, the devices we carry, the instruments we write with, the food we eat and the scenery we view are just some examples of where colour's influence is seen. Because of this, colour can impact on both our physiological and psychological states.

One of the primary consequences of colour is that viewing particular colours can lead to increased arousal, stimulation and excitement (Clarke and Costall, 2008; Wexner, 1954). This arousal is also linked to variations in physiological states, such as changes in pupil dilation or skin conductance. For example, using galvanic skin response as a measure, colour has been shown to influence electrodermal conductivity in individuals (Jacobs and Hustmyer, 1974; Wilson, 1966).

Apart from arousal and excitement, colour also has the ability to shape anxiety levels. For example, Jacobs and Suess (1975) conducted a study that investigated the influence of 'four primary colours' (red, blue, yellow, green) and found that red and yellow cause

significantly higher levels of stress and anxiety than green and blue. This might explain why colour, and red in particular, also has a significant effect on sexual attraction (Elliot and Niesta, 2008) and athletic performance (Hill and Barton, 2005).

A by-product of these effects is that colour appears to influence emotions. What is more, the emotional associations with colour are seen across cultures (Hupka et al., 1997). For example, black and red are universally associated with anger, fear is associated with black and jealousy is associated with red. While the research by Hupka et al. (1997) also found cross-cultural differences, the similarities indicate some colour-emotion associations are developmental in origin. This is a critical point for any research involving colour, as it means colour has the potential to shape perception through both developmental and learned pathways. Nowhere is this 'dual pathway' effect of colour more evident than in modern day marketing and product development.

Colour in marketing

Colour is big business for marketers. Products, logos, brand collateral and packaging are but some of the targets for colour applications. In such instances, repetitive exposure to brand colours lets consumers develop colour preferences and brand associations through a suite of experiences (Grossman and Wisenblit, 1999). As a result, colour and aesthetics have been shown to play an integral role in consumer product evaluation and satisfaction (Kotler, 1973).

This is because colour conveys meaning and information related to the brand. For example, the iconic red of the Coca-Cola can makes it readily identifiable around the world, while the distinctive Cadbury purple is a catalyst for a range of emotions (Hynes, 2009). In the United States, the power of colour has afforded it a special place in the business environment, with the development of "Trade Dress" protection laws that allow colour to be claimed as a distinct, identifying brand attribute (Kilmer, 1995). But colour is not simply a brand identifier. In fact, the colour of product packaging has been

shown to influence attention, aesthetic experience and communication (Kauppinen-Räisänen and Luomala, 2010). Similarly, when colours are used in advertising, those colours which highlights aspects that are highly relevant to ad claims assist information processing, particularly when the ad requires substantial allocation of cognitive resources (Meyers-Levy and Peracchio, 1995). This is because colour allows the viewer to find and obtain information easier, which reduces search times in cluttered environments (Jansson et al., 2004).

Some of the effects exhibited by colour are learned through experience. For example, the connotations and emotions one experiences when they see the red Coca-Cola can or the golden arches of McDonald's. At the same time, colour also has the ability to influence human perception at an innate, biological level. To account for this dual nature of colour influence, Labrecque et al. (2013) proposed a framework in which colour associations can be both learned and embodied. Thus, on the one hand, colour provides learned or referential meaning that "emerges from the network of semantic associations or real-world concepts that are drawn out by exposure to aesthetic stimuli" (p.192). Alternately, embodied meaning comes about due to the "attributes embodied in the aesthetic stimulus, independent of context and the semantic content it may evoke" (p.188). Specifically, embodied meaning is not learned but developmental, biological and intrinsic to one's self. The result is that colour can influence perception with a high degree of automaticity and consistency outside the boundaries of conscious awareness. What is more as discussed below, the influence of colour can extend across other sensory modalities.

Embodied colour and cross-modal perception

Human experience that involves stimuli affecting multiple sensory modalities is known as cross-modal perception. Cross-modal perception was previously thought to apply to a small group of the population that experienced synaesthesia (Simner et al., 2006).

However, cross-modality and cross-modal associations have a much broader footprint. Current research points to a growing evidence of similarities in the sensory associations made by synaesthetic and non-synaesthetic adults and children (e.g. Rich et al., 2005; Simner et al., 2005; Ward et al., 2006). In his seminal work, Marks (1975; p303) concluded that both synaesthetes and non-synaesthetes "align dimensions on different modalities in ways that are qualitatively similar" to each other. In another study, Spector and Maurer (2008) found that both synaesthetes and non-synaesthetes consistently mapped colours to the same letters of the alphabet, for example, A is red, O is white and X is black. Because of this research, we now know that the general population has the potential to perceive some cross-modal stimuli. Historically, though, cross-modal perception has been seen as either a result of a vivid imagination or due to some psychological cause (Ramachandran and Hubbard, 2001). However, increased research in the field, particularly by neurologists, has shown that there are some underlying physiological reasons (Driver and Noesselt, 2008).

Initially, it was thought that the brain functioned in a modular fashion. As a result, the different parts of the brain were studied independently and considered in isolation. However, Kayser and Logothetis (2007) indicate recent studies have challenged this view and that cross-modal interactions between different parts of the brain are commonplace. They point to a range of subcortical nuclei that have the ability to relay cross-modal signals to sensory cortices. With this in mind, it would appear that Kandinsky (1946) was ahead of his time. In his work *On the Spiritual in Art*, he talks about synthesis and how observation and selection come together to create perception. He took this concept a step further in his Bauhaus lessons, where he compared human nerves to the strings of a piano. In this situation, if a note is struck on one of two pianos standing next to each other, the same note on the second piano will resonate (Van Campen, 1999). However, the fact we all share the ability for our brains to

communicate between regions is not the only similarity amongst the population. Research suggests we also share neurocognitive mechanisms.

In terms of neurocognitive mechanisms, it is widely believed that at least some of the mechanisms employed in human perception do actually reflect universal, cross-modal systems (Sagiv and Ward, 2006; Martino and Marks, 2001). One example is that people tend to use the same heuristics for matching auditory stimuli to visual domains. For example, lighter colours are generally associated with higher pitched sounds (Ward et al., 2006; Giraud et al., 2001). Humans also deal with intensity in universal ways, for example perceptions of things that are louder, bigger or brighter. In this situation, as volume increases, perceptions of size increase. Likewise, as pitch decreases, a corresponding colour may appear darker. One reason for this is that people tend to 'binarize' pieces of information to minimize cognitive load (Ramachandran and Hubbard, 2001). Effectively, people will link or block concepts together, so as to maximise efficiency in cognitive processing.

As a result of the shared neural activity and the neurocognitive mechanisms that humans employ, we now know there are a range of cross-modal associations between colour and other modalities that apply to the broader population (Rich and Mattingley, 2002; Sagiv and Ward, 2006; Ward, 2004).

Colour and Taste

Of all the cardinal modalities, possibly the most researched in terms of a cross-modal colour association is that of taste. Previous research (Koch and Koch, 2005) has shown when individuals are asked to match colours to different taste and flavour terms, commonalities exist showing people will systematically map tastes and flavours to a range of hues. Similarly, when people are asked to consume products, colour influences the identification of sweetness (Pangborn, 1960) as well as the identity (flavour profile) of the food (Garber et al., 2000; Spence et al., 2010). What is more, changes in

colour have a marked influence on the overall flavour intensity (Bayarri et al., 2001). In line with this, as the concentration of food colorant increases, perceived flavour intensity increases (Calvo et al., 2001). However, it isn't just the colour of the food product that can influence taste. Instead, the colour of the serving dish (Harrar et al., 2011), drink container (Van Doorn et al., 2014) or cutlery (Harrar and Spence, 2013) is likely to shape an individual's taste experience.

Colour and Smell

As the second of the two chemical senses, olfaction (smell) appears to have a slightly more subtle cross-modal relationship with colour than does taste. Part of this might be due to olfaction being a less proximal sense, in that odours can often be experienced when the source is some distance away and may not be evident. Irrespective of the subtleties and nuances, existing research indicates clear, consistent mappings between colours and odours across the broader population (Luisa Dematte et al., 2006). As a result, colour has the potential to influence odour identification (Parr et al., 2003). At the same time, changes in colour have been shown to moderate odour intensity (Zellner and Kautz, 1990). In a study by Gatti et al. (2014), these changes in cross-modal colour-olfactory effects were also shown to occur as a result of colour changes in product packaging. Their findings demonstrate the colour of a liquid soap container corresponds to changes in perceived intensity of the soap's fragrance. Part of the reasoning behind this is that people attend to the colour and discount or disregard the olfactory stimulus (Morrot et al., 2001), a situation that Parr et al. (2003) call 'colour-induced olfactory bias'.

Colour and Hearing

Most research to date that has looked at cross-modal associations between colour and audition (hearing) has focused on the experiences of synaesthetes. As a result, the cross-modal relationship is often described as unidirectional, with sound as the

antecedent and colour as the outcome. For example, research by Marks (1975) found that sounds induce photisms or visual images that vary in brightness according to the brightness of the sounds. Interestingly, this form of coloured hearing can be produced by both speech and non-speech sounds. When produced by speech sounds, the induced hues and brightness are attributed to the formant structures of the vowels. However, this is directly relevant to the broader population, given that both synaesthetes and non-synaesthetes "use the same heuristics for matching between auditory and visual domains" (Ward et al., 2006; p.264). As a result, colour has the ability to increase or decrease judgements of sound volume, with colours such as red/pink increasing estimates of loudness and grey/pale green decreasing loudness estimates (Menzel et al., 2010). In addition, colour influences perception of pitch. For example, in a study by Mondloch and Maurer (2004), children were shown both a white ball and a grey ball while hearing high and low pitched tones. Results showed a significant relationship between the lighter (white) ball and the higher frequency sound. When applied to a consumer situation these effects hold, such that the colour (red) of a sports car has been shown to directly influence estimates of the cars loudness (Menzel et al, 2008).

Colour and Touch

Given the previous sections have discussed cross-modal perception, the role of sensory integration in human experience and the ability for colour to influence physiology and psychology, one would expect existing research to have identified cross-modal associations between colour (vision) and our sense of touch. However, the extant literature indicates this is an area that has received little, if any, research attention.

In a review of existing research, Whitaker et al. (2008) cite a range of sources to show that colour is commonly used as a guide for textural segmentation in order to facilitate foreground and background identification, so as to aid shape perception. However, this appears to be more of a visual discrimination process than a cross-modal vision-touch

transfer. The most relevant research is a study done by Tom et al. (1987), in which three different shades of pudding (light, medium and dark brown) were used to determine the effects of colour. Not only was the colour positively correlated with the perceived flavour (dark brown being more chocolate than the lighter browns, despite all being vanilla flavoured) but it was negatively correlated with perceived texture (the lighter the pudding, the creamier it was perceived). However, the colour manipulations in this research were manipulations of saturation (the shade of the colour) as opposed to hue. This presents opportunities for future research to identify the cross-modal influence of different hues on the sense of touch, determine the boundary conditions in which colour operates and add to existing knowledge of cross-modal perception. For this to take place, though, a deeper understanding of touch is required to guide future studies.

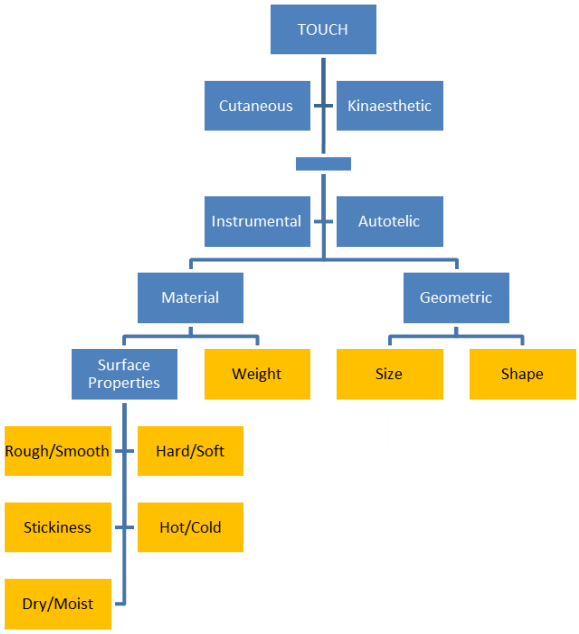
The human sense of touch

Touch is arguably the most central sense within human perception. It is the first sense we detect while in the womb, and the last to leave us as we age (Gallace and Spence, 2010). What's more, as a proximal sense, it allows us to interact with and explore the immediate environment and obtain information that assists in object identification. Touch has three dimensions that determine its role in human perception. The first dimension is how we touch things and this can take two forms, cutaneous or kinaesthetic touch.

The second dimension is why we touch things. For example, is the touch experience undertaken to determine pragmatic, instrumental attributes of an object? Or is touch used to facilitate a hedonic, autotelic experience? The beauty of human nature is the variety of individuals. Because of that, people interact with the physical world for different reasons. The final dimension is what happens once a person employs their

sense of touch. Figure 1 outlines the various elements of human touch that are then discussed in greater detail below.

Figure 1: The Human Sense of Touch



How we touch things

Our sense of touch occurs through a dynamic, complex set of sensory systems that operate independently of each other, yet provide an integrated view of the physical world. In its broadest terms, touch involves both cutaneous and kinaesthetic elements. Cutaneous touch is what we perceive through the different receptors in the skin, for example, what we feel when we hold something with our hands or brush past something with our elbow. Cutaneous touch allows us to determine textural dimensions including roughness, softness, stickiness, temperature and moisture. Along with this, human touch includes nociceptors (pain receptors) that detect potentially harmful stimuli above a given threshold (Burgess and Perl, 1973). Alternately, kinaesthetic touch (also called proprioception) enables us to detect size, weight and motion through the movement of our limbs and interconnected tissues. For example, holding a new watch or phone in your hand will let you judge both the texture and

weight of the object. Together, cutaneous and kinaesthetic touch allows us to accurately identify objects in terms of their size, weight and surface attributes. As a result, the benefits to marketing are that touch excels at providing information on texture, hardness, temperature and weight and is a critical component in the consumer's ability to identify objects (Klatzky and Lederman, 1992; Lederman and Klatzky, 1993).

Why we touch things

Apart from understanding what we can experience through our sense of touch, it is important to understand why we might touch things. Peck and Childers (2003a) developed the 'Need for Touch' (NFT) scale as a way to measure individual differences in preference for haptic (touch) information. The results of this research provide two important outcomes. Firstly, using the 12-item NFT scale, those individuals who score highly are said to have a predisposition to touching objects. Secondly, the scale also consists of two underlying dimensions that govern the consumer's need for touch – instrumental touch and autotelic touch. As such, instrumental touch is geared to obtaining information on the product attributes such as texture, size or weight. By contrast, autotelic touch relates to the hedonic, experiential nature of touch where sensory experience is the goal. In a marketing context, this allows segmentation of the target audience according to either their overall haptic (touch) predisposition (using the full 12-item scale), or to their haptic objectives based on the instrumental or autotelic dimensions. However, the critical piece in the haptic puzzle is the effect on consumer attitudes and behaviour as a result of the touch experience.

What happens when we touch things

Touch provides a range of benefits for people throughout their daily activities. Firstly, it can make people feel more positive about the external stimuli or the environment in which they operate (Burgoon et al., 1992; Goldman et al., 1985). Secondly, it makes people feel more positive about the source (i.e. the person or object touching them) by

influencing feelings of social attachment and intimacy. As a result, people feel closer, warmer and more affectionate (Hornik, 1992; Mehrabian, 1981). The third aspect is that touch allows us to augment other sensory information or to substitute for missing sensory inputs (Bach-y-Rita, 2004).

When this is applied to studies where subjects touch products, we see some interesting effects. For example, in a study carried out by Krishna and Morrin (2008), subjects were given water samples in 'flimsy' cups. Subjects that did not touch the cup while drinking reported the water as being higher quality, compared to subjects who held the cup. A similar study by Piqueras-Fiszman et al. (2011) found subjects rated yoghurt as being different in perceived density, expected pricing and likeability depending on the weight of the dish in which it was served. It is because of this that we hear people talk about 'the look and feel' of a product (Yun et al., 2003). In recent times, bricks and mortar retailers have been seeing customers come to their stores, only to try things on, feel what they're like then return home to buy the product online (Rapp et al., 2015). While this practice of 'showrooming' demonstrates the current shortcomings in the online environment with regards to haptic (touch) interfaces, it also points to the consumer need for touch and how important this is in the decision-making process. Finally, particularly in a consumer setting, touch has the ability to empower people. This is because the sense of touch provides people with information, so they feel more knowledgeable and in control of proceedings. It increases their attachment and, ultimately, affords them a sense of ownership (Peck and Shu, 2009).

The influence of touch in consumer settings

In a consumer environment, touch can influence perception when it occurs between two people (interpersonal touch) or when it occurs between a person and a product (product interaction).

While interpersonal touch is not the focus of this thesis, it is very influential in shaping an individual's attitudes. Because of this, a brief summary of related literature is offered to provide a deeper appreciation for the power of touch. Interpersonal touch can create a bond between people, making them more inclined to trust or believe the source. For example, restaurant patrons have been found to offer more tips when touched by wait staff (Crusco and Wetzel, 1984; Stephen and Zweigenhaft, 1986). Similarly, people are more willing to interact or participate in tasks if another person has touched them. For example, subjects in a shopping mall were approached to take part in a survey. Those that were touched by the researcher were more willing to participate and reported the experience as being less burdensome (Hornik and Ellis, 1988). Likewise, Guéguen (2004) found that students in a classroom setting were more likely to volunteer and participate in various learning activities if they had been touched by the teacher.

One reason put forward for these findings is that touch originating from a familiar, high-status person is perceived as a sign of distinction and conveys a certain status to the recipient. In addition, interpersonal touch tends to make people more compliant (Kleinke, 1977; Patterson et al., 1986; Segrin, 1993), particularly if the request is complex or the decision requires a high level of cognitive processing (Willis and Hamm, 1980). This has been observed in product marketing settings. For example, in an experiment where shoppers were asked to sample a food product, those that were touched during the request were more likely to try and buy the product (Smith et al., 1982). Guéguen et al. (2007) built on this and found that, when wait-staff touched patrons while recommending a dish, they were more likely to order that meal. Given this, it may be that rather than experiencing a change in status, people are looking to others for product-related advice and information, and it is this trust that supports their behaviours. Stone (1954) identified these types as ‘personalised consumers’ who are looking for strong attachments and intimacy. Possible consequences from this were

shown in an observational study carried out in a retail setting. In this situation, interpersonal touch can lead to increased shopping time, higher store evaluations and increased expenditure (Hornik, 1992a).

While the effects of interpersonal touch are generally positive, there are also negative consequences associated with it, particularly when the touch is unsolicited or accidental. A recent study by Martin (2012) involved a field experiment in a retail setting to determine whether accidental touch had any influence on consumer attitudes or behaviour. It was found that shoppers who have been accidentally touched by another consumer while examining products report more negative brand evaluations and product beliefs. In addition, they are less willing to pay and tend to spend less time in-store than consumers that have not been touched. To avoid duplication where possible, and to remain concise, the role of touch in relation to product interaction will be covered in more detail in Chapters 1, 2 and 3

In all, the literature presented indicates the sense of touch has a profound influence on human perception. One explanation for this is that touch influences people through its physical impact. For example, interpersonal touch has been shown to have a range of physiological benefits including lower anxiety levels, induced relaxation, lower blood pressure, lower respiratory rate and reduced heart rate (Post-White et al., 2003; Wright, 1987; Turner et al., 1998). From this, we can determine that interpersonal touch can play a significant role in consumer attitudes. However, what happens when the interaction is a consumer-generated active touch of a product? One explanation proposed by Spence (2002) is that once the tactile modality is engaged, it can be harder to pull attention away, particularly when compared to audition or vision. As a result, we become attached to the product, so that the concept of ownership is influenced. In this case, the proposition is that the more you handle an object, the more it becomes yours (Peck and Shu, 2009). At the same time, it has also been hypothesized the tactile

stimuli contribute to higher order constructs like quality, value and performance. For these reasons, companies are now incorporating tactile design features into the product specifications. The general argument is that the tactile design of a product can result in pre-purchase affect, which is triggered by distinctive features such as size, shape and colour, integrative features such as product layout and interactive features such as controls and ease of manipulation (Seva et al., 2007). For example, results of a questionnaire given to fifty car buyers showed subjects reported increased satisfaction when external panels of the car are harder or stiffer. They also rated panel thickness as a variable that increased satisfaction ratings (Rhiu et al., 2011). Similarly, mobile phone companies were quick to incorporate these concepts, as tactile attributes are high on the consumers initial wish list for the product (Yun et al., 2003).

Overarching Theoretical Framework

The interdisciplinary nature of this thesis means the overarching theoretical framework draws from a number of areas including psychology, neurology, psychophysics and marketing. From these broad areas of research, three pillars of theory were used to provide the structure for the thesis.

Theory of synaesthesia: Synaesthesia is a condition in which a stimulus experienced in one modality, such as vision, results in a concurrent experience in another sensory modality, such as touch (See Baron-Cohen and Harrison, 1997; Ramachandran and Hubbard, 2001; Ward and Mattingley, 2006). Typically, synaesthesia was thought to apply to a very small part of the population in what Martino and Marks (2001) termed 'strong' synaesthesia.

Cross-modal perception: In contrast to strong synaesthesia, Martino and Marks (2001) coined the term 'weak' synaesthesia, whereby non-synaesthetes - essentially the broader neurologically-normal population - may not experience vivid, concurrent

experiences in other modalities but are nonetheless subject to some cross-modal influence. This concept of weak synaesthesia was labelled 'cross-modal transfer' by Rudel and Teuber (1964) and is supported by Kayser and Logothetis (2007), who reviewed studies employing neuro-imaging techniques and found that, across the broader population, cross-modal interactions between different parts of the brain are commonplace. Specifically relevant to this thesis is further research by Hadjikhani and Roland (1998) in which neuro-imaging (PET) techniques were used to identify cross-modal transfers occur between tactile and visual representations.

The dual role of colour in consumer behaviour: In a marketing context, one of the more prevalent visual cues encountered by consumers is that of colour. However, a framework provided by Labrecque, Patrick and Milne (2013) indicates colour conveys two different types of meaning. The first is referential meaning, which is developed from leaned associations that come about through experience. The second is embodied meaning, which is not learned but stems from biological responses to stimuli. These biological, embodied responses have an evolutionary origin and are present at birth. It is the embodied meaning of colour and its cross-modal influence on the sense of touch that is the focus of this thesis.

Research Questions and Objectives

The primary objective of this research is to investigate the cross-modal link between vision (colour) and touch. To guide the research, three core research questions are considered throughout the thesis:

I. Does colour influence perception of information primarily received through the sense of touch, such as texture?
II. Do cross-modal effects between vision (colour) and touch occur in advertising?
III. Does the sense of touch influence an individual's perception of colour?

Key Contributions

This thesis sets out to investigate the cross-modal relationship between colour and the sense of touch and provide a number of theoretical and managerial contributions. Although recent years has seen a growing interest in 'sensory marketing', there still appears to be a dearth of information on the interactions *between* sensory modalities. While there is a broad body of consumer research that examines colour and its influence on things like brand, ad recall, likability and purchase intent, we still have limited understanding of how colour might affect other modalities, like the sense of touch. Examining the colour-touch relationship and identifying a cross-modal effect will contribute to our understanding of human sensory perception. In addition, by demonstrating an increased range of influence for colour, it contributes to the sensory marketing arsenal.

The successful application of any cross-modal colour-touch effects in an advertising context will present two major contributions. Any effects demonstrated using physical products would highlight the influence of colour on 'perceived' changes in touch-relevant measures. By contrast, any effects observed in an advertising context would be a result of colour's influence on 'expected' changes in touch-relevant measures. Therefore, at a theoretical level, this would represent a major contribution to existing knowledge, as there presently appears to be limited research indicating the role of cross-modal effects on expectations. In addition, from a managerial perspective this would also demonstrate the key role of colour in conveying information about sensory level product attributes, both physically and via marketing communications.

Within the current the body of literature on colour and cross-modal perception, there is a very dominant bias for research that investigates the unidirectional nature of colour's influence. That is, the influence originates at colour and projects outwards, influencing a range of outcomes. As a result, there is a distinct lack of empirical research involving

any cross-modal influence originating from the sense of touch. To address this shortcoming in the extant literature, this thesis examines how touch might influence perception of colour. At the same time, it sets out to determine any conditions that might affect this multidirectional cross-modal association and its role in consumer decision-making.

Research Structure

	Chapter 1	Chapter 2	Chapter 3
Aims and Objectives	Investigate the cross-modal relationship between vision (colour) and touch	Investigate the colour-touch effect in print advertising	Examine the multidirectional nature of the colour-touch cross-modal effect
Research Questions Addressed	i	i and ii	iii
Number of Studies	5	4	3
Methodology	Mixed and between-subjects experimental design	Between-subjects experimental design	Between-subjects experimental design
Research Context	Food Consumption	Food Advertising	Retail
Primary IV	Product colour	Product colour	Touch (Tactile product manipulation)
Primary DV	Perceived Creaminess and Crunchiness	Expected Creaminess and Crunchiness	Colour likability
Covariates	Haptic Predisposition (NFT)	NFT and advertising copy	NFT and product ownership
Key outcome	Colour influences 'perceived' creaminess and crunchiness of food products	Colour influences 'expected' creaminess and crunchiness of food products	The cross-modal effect of touch on colour perception is moderated by legal ownership and NFT

This thesis consists of three studies, with each study including a set of experiments that address the primary research questions, as well as additional research objectives. The theoretical foundations, design and findings of each study are presented in three stand-alone chapters, such that Chapter 1 is Study 1, Chapter 2 is Study 2 and Chapter 3 is Study 3.

Given the chapters correspond to the relevant studies, throughout the thesis, reference will be made to the studies, rather than chapter numbers. As such, the research in Chapter 1 will be referred to as Study 1 as an overall description. Within that, each smaller study will be referred to as Study 1.1, Study 1.2 and so on. The same system of numbering will be used to refer to Study 2.1-2.4 and Study 3.1-3.3.

The studies

Study 1

Study 1 has been published in Psychology & Marketing. Refer to Appendix 1 for a full list of publications generated from this thesis.

Study 1 begins by looking at the effects of colour on the perceived texture of food. Despite the ubiquitous nature of colour in everyday life, there still appears to be limited understanding about the impact of colour on human perception in a marketing context. For example, previous research (Tom et al., 1987) has demonstrated that certain aspects of colour (such as saturation) are capable of moderating perceived texture. However, there is limited research on the influence of hue. Complicating this is the fact that, for many people, vision dominates other sensory modalities when it comes to product identification and evaluation (Schifferstein, 2006b). The sense of touch typically comes in second. However, particularly with food products, people usually don't rely on one modality, rather they engage multiple senses to perceive and evaluate the product (Chylinski et al., 2014). Findings from Study 1 demonstrate that product

colour is a key component in the determination of food texture. Interestingly, the colour appears to interact with the actual texture of the food to create the perceived texture. Along with this, a person's haptic orientation, or 'need for touch' (Peck and Childers, 2003a) moderates their perception. Finally, the effects on various marketing metrics are examined and results show that colour and perceived texture are key components for these higher order constructs.

Study 2

Study 2 takes the cross-modal colour-texture effects identified in Study 1 and seeks to examine their application in an advertising context. Specifically, it examines how colour in a food advertisement influences expected texture of food products and how a person's haptic predisposition moderates their perception. In addition, it looks at how ad copy can be used to interrupt or add to this effect and the influence on marketing metrics, such as consumer expectations of quality, pleasure, likability and purchase intent. The findings of the study show that cross-modal colour-texture effects will influence a consumer's expectation of product creaminess and crunchiness, when viewing an advertisement. Moreover, the effects of colour on perceived texture are moderated by a person's haptic orientation, or their 'need for touch'. At the same time, semantically congruent ad copy can interrupt or limit the cross-modal colour-texture effect. Results also show a significant cross-modal effect on marketing metrics, indicating that for people who have a low haptic orientation, the effects of colour on marketing metrics are mediated by expected textures.

Study 3

Study 3 builds on the effects identified in Study 1 and Study 2 and applies them to scenarios involving non-food products. While Study 1 and Study 2 focused on the cross-modal effect of vision (colour) on touch (perceived texture), Study 3 examines how haptic stimuli influences evaluation of product colour. Borrowing from a range of

theory including embodied cognition, situated cognition and the endowment effect, the findings provide evidence that cross-modal associations are multidirectional. Moreover, findings demonstrate the role of haptic predisposition (NFT) as a proxy for overall sensory sensitivity and how this sensitivity mediates the relationship between touch and marketing metrics.

Ethics

Ethics approval (H10129) for this thesis was granted by the Western Sydney University Human Research Ethics Committee, under the project title "Crossmodal Haptic Associations in Language, Vision and Audition". A copy of the approval letter is included in Appendix 5.

CHAPTER 1

Cross-modal interactions between colour and texture of food.

Introduction

> *"Synaesthesia can best be explained as an exaggeration of cross-modal mechanisms common to us all rather than a privileged, direct pathway…. that is present in synaesthetes but not in others" (Ward et al., 2006)*

On a daily basis, consumers make a large number of decisions about food choices that have both immediate and long-term consequences for their wellbeing. Many of those decisions use colour of the food as a guide to taste and texture. Yet, "despite evidence from studies and real-world examples, marketers know little about the boundary conditions of the effects of altered food colors" (Labrecque et al., 2013; p198). In particular, it is not known if consumers obtain a sensory feel of the product through visual inspection of colour, or to what extent unexpected food colours such as blue beans or red rice alter that sensory experience (Labrecque et al., 2013). Significantly, colour is so ubiquitous that it has the ability to profoundly influence perception in other sensory modalities and there is a large body of research (e.g. Spence and Gallace, 2011; Bellizzi and Hite, 1992; Sagiv and Ward, 2006) that says this happens in everyday life. When eating a lunch snack for example, consumers typically view the snack before experiencing its texture in the mouth. Because of this, the colour of the snack may affect perceived texture. This effect is referred to as a cross-modal sensory interaction (Spence, 2011), so that the oral somatosensory experience of texture is altered by the prior visual perception of its colour.

While some of the cross-modal perception can be attributed to learned or acquired knowledge, Labrecque et al. (2013) suggest that "the phenomenon of synaesthesia supports the notion that colors have strong biological links to emotions and physical reactions" [p192]. These cross-modal effects are unique in that a stimulus in one sensory modality (such as vision) is expressed in another modality (i.e. touch). This implies effects of colour on processing of non-visual information such as texture.

This research examines the cross-modal effect of colour on perceptions of texture (in the form of oral somatosensory experience) and considers the mediating role a person's 'Need-for-Touch' (NFT) plays as a link between cross-modal sensitivity and embodied cognition in sensory information processing. Findings from the study indicate not only the two-way interactions between colour and actual texture on perceived texture, but also three-way interactions between colour, actual texture, and NFT.

The article begins with a review of current literature on colour and perception involving the cardinal modalities. In particular, it examines the influence of cross-modal colour associations on haptic perception. It then outlines the role that a person's haptic predisposition (NFT) plays in their overall sensory sensitivity, and details current research in neurology, psychology and psychophysics that supports the concept of a 'colour-touch' cross-modal mechanism. The article then identifies the components and methodology of the study, followed by a discussion on the results and findings and finishes with the conclusions.

Literature review and hypotheses

In its purest form, colour might be defined by changes in the light spectrum, characteristics of visual acuity and the relationships between hue, saturation and value. But this would be a clinical description that would overlook the role of colour in human experience. In fact, a walk through any shopping mall in the world will very quickly highlight the ubiquity, and importance, of colour in everyday life. Moreover, it would show that colour has the ability to influence both physiological and psychological components of perception and the resultant behaviours. But what is it about colour that is responsible for these effects? Research by Crowley (1993) suggests the influence of colour occurs as either an activation effect (arousal) or an evaluation effect and that these effects are fundamentally "a function of colour wavelength" commonly perceived

as hue. This is an important point when looking at research involving colour. A review of the literature shows that the broad body of work on colours does incorporate many hues, but there is a general skew towards red and blue as independent variables throughout (Bellizzi and Hite, 1992). As such, many studies compare effects between long wavelength (red: 700nm) and short wavelength (blue: 450nm) light. For that reason, and due to their positions at opposite ends of the visual spectrum, this study will focus on red and blue and examine their effects on the human sense of touch.

Psycho-physiological influences of colour

On their own, both red and blue have significant influence over our perception. Typically, red has long been associated with arousal, stimulation and excitement more than blue (Wexner, 1954; Clarke and Costall, 2008). It follows then that red has also been associated with higher levels of perceived anxiety than blue (Jacobs and Suess, 1975). In research that examined the influence of environmental colours in a retail environment, red was found to be perceived as negative, tense and physically arousing, while blue was reported as being calm, cool and positive (Bellizzi and Hite, 1992). It may be that this physical arousal is why red has been found to enhance men's attraction to women (Elliot and Niesta, 2008), or increase performance (and the likelihood of winning) in sporting contests (Hill and Barton, 2005).

Just like colour will influence psychology, it has a similarly strong influence on physiology. For instance, various studies (Jacobs and Hustmyer, 1974; Wilson, 1966) have used galvanic skin response to show that red is significantly more 'arousing' than blue. Red has also been shown to influence human motor functions. Specifically, a red stimulus was found to facilitate both pinch-grip and hand-grip force (Elliot and Aarts, 2011). Typically, much of the research on touch in consumer settings focuses on cutaneous haptic experience, but this shows an association between colour and kinaesthetic touch. In addition to these direct physical effects, there exist a number of

cross-modal associations, whereby colour (which is unique to vision) has a profound effect on the other sensory modalities.

Cross-modal influences of colour

In a study that combined sounds with images of sports cars, it was found that "the sounds heard during the presentation of a red car produced higher loudness ratings", while no other hue reached statistical significance (Menzel et al., 2008). The authors made note of the fact there may be a learned association between sports cars and the colour red and that this learned or acquired knowledge may have influenced the results. However, a similar cross-modal association between vision and audition was found when video game players were presented with different coloured screens (red/blue) and different sound levels (loud/quiet). Interestingly, the sound levels alone had no significant effect on performance, rather it was the interaction between the sound and the colour that was associated with changes in perceived excitement and performance (Wolfson and Case, 2000).

In the same way that colour influences audition, there appears to be a similar association between colour and olfaction. For example, Zellner and Kautz (1990) coloured solutions with both appropriate and novel colours and found that odour intensity increased when solutions were coloured, as opposed to clear. In a different study, both social drinkers and, to a lesser extent, wine experts reported different perceived aromas when white wine was presented with different amounts of red colour (Parr et al., 2003). Staying within the chemical senses, the effects of colour on taste are even more prolific.

Koch and Koch (2005) found consistent positive relationship between red and sweetness, as well as red and 'fruity'. Conversely, red was found to have a negative relationship with sour, bitter and salty. At the other end of the light spectrum, blue was found to have significant negative associations with tastes including sour, bitter, salty,

'citrusy' and 'syrupy'. Likewise, Lavin and Lawless (1998) showed that, for adults, a change in colour (red) saturation has a positive association with the perceived intensity of sweetness. In fact, a review of current literature by Spence et al. (2010) indicates colour is found to have a positive affect on perceived intensity in general. Moreover, the influence of colour over taste is so pervasive that the colouring of the food item itself doesn't need to be manipulated to experience changes in perceived taste. Instead, changes in the colour of product packaging (Ares and Deliza, 2010) the colour of the serving dish (Harrar et al., 2011), the colour of the cutlery used to eat the product (Harrar and Spence, 2013) and even the text used to describe product colour – such as 'dark chocolate' or 'milk chocolate' – can result in significant changes of perceived taste (Shankar et al., 2009).

Given that colour is seen to have an affect on both olfaction and gustation, it is natural then to also see the influence of colour on flavour identification (Garber et al., 2000) and perceived flavour intensity (Bayarri et al., 2001). This is important for two main reasons. Current literature shows that flavour perception is a product of taste, smell and oral somatosensation, where all three combine to produce the gustatory experience (Spence et al., 2010). In the first instance, this provides evidence that multisensory, cross-modal associations influence our perception on a daily basis. Secondly, there is a dearth of research that links colour to texture so that, even though people might form mental representations of objects that tightly link colour to the surface properties of objects (Davidoff, 1991), the question of whether colour actually has the ability to influence haptic perception remains unanswered. In a study using vanilla custard, Tom et al. (1987) identified a connection between colour and both perceived creaminess and flavour intensity. However, using the HSV colour model as a guide, the design of the study called for manipulations of colour value (six different shades from light brown to dark brown) as opposed to hue. In this case, the darker brown pudding was considered the 'most chocolate' and thickest, while the light brown

pudding was considered 'creamiest'. In light of the limited research on the topic, it may be necessary to examine the role that texture itself plays in human perception, and whether colour and actual texture have any cross-modal interaction that shapes perceived texture.

The role of texture and cross-modal associations

The concept that perception and cognition are directly influenced by the integration of information from the different sensory modalities is a central tenet of grounded cognition. However, while proponents of grounded or embodied cognition would typically speak of sensory-motor associations (e.g.; Rosa, 2001; Wilson, 2002), cross-modal aspects of grounded cognition (i.e.: the interaction between body sensations and the perceptions of colour and texture) remain under-explored. Specifically, the link between hue and perceived texture, compared to other aspects of cross-modal perception, appears to have been overlooked in the extant literature. This is no different in food related research, where the bulk of research on food appears to focus on relationships between taste and other sensory components (Eertmans et al., 2001). But within the literature that does incorporate different aspects of texture, two key variables re-occur throughout the research, these being creaminess and crunchiness. In a word association test by Szczesniak (1971), the importance of texture in food consumption was demonstrated when it was mentioned as a product attribute more often than flavour and colour. Of the foods used in the study, those that elicited the greatest texture-related responses were ones that were considered crunchy or crisp. In fact, a subsequent study suggested that the terms crunchy and crisp were very similar in meaning, except that a crisp product usually has a 'snap' to it (Szczesniak, 1988). By contrast, creaminess is said to be predicted from scores on 'smoothness' and 'thickness' (Kokini, 1987) and its multisensory appeal is evident in the fact that it is often used to describe flavour, appearance or texture (Elmore et al., 1999). In addition, creaminess

has “an intrinsic positive hedonic component” (Frųst and Janhųj, 2007) and consumers will typically associate creaminess with ‘pleasantness’ (Antmann et al., 2011).

In this regard, previous research has shown that crunchiness and creaminess may have an inverse relationship to each other. In research that involved changing a food’s fat content, it was found that increasing fat content can result in lower sensations of ‘roughness’ or higher sensations of ‘creaminess’ (De Wijk and Prinz, 2005), where ‘roughness’ is used as a proxy for ‘crunchiness’. The obvious result from this is that changing the ‘actual’ texture of the food will cause a corresponding change in the ‘perceived’ texture of the food. In addition, the evidence suggests that if the colour of the food is simultaneously changed, there will be a cross-modal interaction between the colour and actual texture that influences perceived texture.

Recent literature indicates that there may be a physiological mechanism underpinning any cross-modal interactions between colour and actual texture. In a review of studies that employed various techniques such as fMRI, Kayser and Logothetis (2007) were able to determine that cross-modal interactions between different parts of the brain are commonplace. They point to a range of subcortical nuclei that have the ability to relay cross-modal signals to sensory cortices, and this type of multi-sensory integration in the neural cortex has also been used to explain the link between colour and olfaction (Österbauer et al., 2005). Likewise, research suggests that the primary taste cortex ‘provides separate and combined representations of the taste, temperature and texture of food in the mouth’ (Rolls, 2005). This supports the idea that sensory inputs relating to texture are integrated with sensory information from other modalities. As a result, the following hypothesis is put forward:

- (H1) – Perceived texture will be moderated by a cross-modal interaction between actual texture and colour.

Apart from cross-modal integration at a neural level, Ward et al. (2006) suggested cross-modal perception may be due to people using universal cross-modal mechanisms. For example, people typically don't treat vision, texture and haptic perception as independent experiences (Jones and O'Neil, 1985). As a result, when assessing roughness, or in this case crunchiness or creaminess, no single modality will dominate perception. Rather, 'modality appropriateness' regulates the allocation of sensory resources so that the most appropriate modality, or combination of modalities, is employed (Guest and Spence, 2003). In the case of food texture, this will often mean all five cardinal senses are called upon to interpret stimuli. However, what may occur is that one modality will 'bias' information from other modalities. Ultimately, the various streams of sensory information are brought into alignment and this modulates "a person's overall (multisensory) product experience" (Spence and Gallace, 2011). Because of this, it is likely that colour and texture will interact to create a cross-modal effect that will, in turn, influence perceived texture.

Colour-Product Fit

The identification of cross-modal interactions between colour and texture would indicate the relationship between these variables is unlearned or developmental, and this fits within the framework for embodied cognition. Typically, this type of automatic response to sensory stimuli was reserved for synaesthetes, where cross-modal interactions involving colour are not based on memory associations (Ramachandran and Hubbard, 2001). However, recent research (Piqueras-Fiszman and Spence, 2012; Harrar et al., 2011) shows this same level of automaticity is seen across the broader population when cross-modal interactions are involved.

Despite this, Labrecque et al (2013) propose a model that suggests, for neurologically normal people, some effects of colour also originate from acquired knowledge. If this is so, then not only does the colour need to fit the product (Bridle and Timberlake, 1997)

it needs to be congruent with various product attributes. This is particularly important for food, where a colour that is incongruent with a person's perception of the product has the potential to affect taste (Koch and Koch, 2005), smell (Zellner et al., 1991) and flavour identification (Garber et al., 2000). Taking this into consideration, a second hypothesis is proposed that allows for an alternate explanation of cross-modal interactions between colour and texture. Thus:

- (H2) – Perceived texture will be moderated by the level of perceived fit between product and colour.

The use of very different products (in terms of taste, smell, texture and flavour) throughout the experiments means that subjects may accept the colours (red or blue) as more or less appropriate depending on previous experience. Prior research by Piqueras-Fiszman and Spence (2011) has shown that a person's "differing acquaintance with one brand versus another" will influence cross-modal associations between colour (in their case, of the packaging) and product flavour. However, even when this was taken into account, when the colour of the packaging was incongruent with the product, subjects were unable to correctly identify the flavour. In relation to the existing study, this same sort of familiarity may be evident with the types of food used, as opposed to specific brands. For example, red or blue custard may appear quite normal, while red or blue mayonnaise may not. As such, testing for the influence of product-colour fit will help separate the embodied and referential cross-modal effects of colour and provide clearer insight into cross-modal colour-texture interactions.

The cross-modal Need-For-Touch

To this point, there is a significant body of work that supports the hypothesis on integration of inputs from different sensory modalities. This fits well with Labrecque et al.'s (2013) conceptual model showing the embodied aspects of colour associations, levels of automaticity and the fundamental link to biological responses. Extending this,

it may be that a person's predisposition to sensory stimuli will also influence any cross-modal effect between colour and texture. Given that texture is an attribute primarily related to the sense of touch, it follows then that a person's haptic predisposition, or their 'need for touch', will be the key indicator.

The Need for Touch (NFT) scale was developed by Peck and Childers (2003a) to measure a person's preference for haptic information. Their findings showed that individuals differ greatly in the way they interact with objects, how much they touch things and what their motivations are for touching. Given the different motivations that are shaped by NFT, it has a direct impact on both consumer attitudes and behaviour. More importantly, it appears that a person's NFT relates to their overall predisposition for sensory stimuli (Krishna and Morrin, 2008). In the first instance, this means that when people are not allowed to touch a product during the decision process, those that have a high NFT typically have less confidence in their decision (Peck and Childers, 2003a; Peck and Childers, 2003b). Yet, when they do encounter a setting that includes a touch element, those with a high NFT will experience increased persuasion (Peck and Wiggins, 2006). What is more, the interaction between the haptic element and NFT is so strong that people with high NFT will experience increased persuasion, regardless of their involvement with the message (Peck and Johnson, 2011). In fact, the strength of this interaction is such that the haptic element can be provided by a third party haptic interface and still create significant responses in the subject. Considering NFT in the context of texture and colour interactions indicates an influence of embodied cognition in cross-modal perception. This influence distinguishes embodied cognition from acquired knowledge as a possible enabler of cross-modal effects. As a result, the authors hypothesize the following:

- (H3) A person's Need-For-Touch will interact with the cross-modal effect (colour x texture), causing a three-way interaction (colour x texture x NFT) so that those people who are high NFT will respond more strongly to the cross-modal interaction of colour and texture.

Three way interaction effects with NFT have been shown to exist. For example, high NFT subjects recorded a three way interaction (actual touch x quality x NFT) when evaluating a high quality product (Grohmann et al., 2007). Ultimately, though, there are a number of factors driving this interaction process. Firstly, high NFT people are more aware of sensory stimuli than low NFT, as well as being more susceptible to affective stimuli (which influence mood) than low NFT people (Yazdanparast and Spears, 2013). At the same time, colour influences people across both psychological and physiological states. These colour effects will interact with the actual texture of the product to create a cross-modal effect. As a result, a person's haptic predisposition (NFT) heightens their sensory awareness and sensitivity so that any cross-modal affect will be more pronounced for high NFT people.

Cross-modal influences and marketing metrics

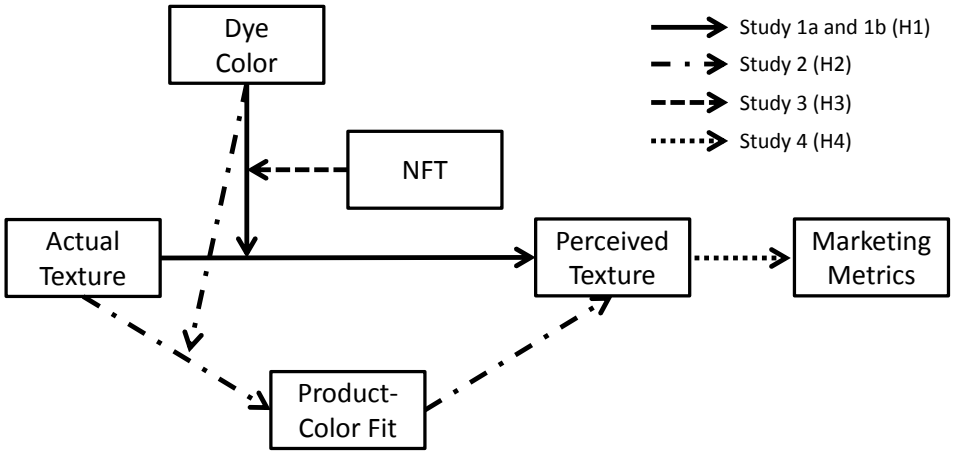
The managerial implications of cross-modal colour and food texture interaction are broad. Product design, packaging, advertising and point-of-sale are all likely to benefit from findings that increase our understanding of consumer cross-modal perception of colour and texture. Not only does haptic sensitivity play a significant role in cross-modal sensitivity, previous research has shown that tactile stimuli contribute to higher order constructs like quality, value and performance. For these reasons, companies are now incorporating tactile features into product specifications. The general argument is that a pre-purchase affect, which is triggered by distinctive features such as colour, affects perceptions of product experience (Seva et al., 2007). Because of this, the authors propose that as a person's cross-modal sensitivity increases, their desire for

product interaction will increase. In particular, the effects of red versus blue colour in relation to haptic sensitivity play an important role in perception of pleasure, purchase intent and quality of food products. This presents the following hypotheses:

- As colour moves from red to blue, pleasure (H4a), purchase intent (H4b) and quality (H4c) will decrease.

The reason is that, while the pre-purchase affect may lead to increased purchase intent, current research suggests that haptic stimuli have a positive influence on general feelings of satisfaction and pleasure. Hence, a cross-modal interaction of colour and texture that leads to improved perceptions of texture should also affect the marketing metrics in relation to satisfaction and pleasure. In relation to durable consumer products, results of a questionnaire given to car buyers showed subjects reported increased satisfaction when external panels of the car felt harder or stiffer (Rhiu et al., 2011). Similarly, mobile phone companies have been quick to incorporate these concepts, as tactile attributes are high on the consumers initial wish list for the product (Yun et al., 2003). Given that these cutaneous, textural encounters increase the pleasure that users experience, it is a logical conclusion that similar pleasure occurs through cross-modal somatosensory stimuli. Typically, blue has been matched with states that are considered more relaxed, more comforting and more inviting than red. However, the increased arousal and subsequent cross-modal sensitivity that people are likely to experience from red colour may alter their orientation. If this happens, their haptic orientation will be more of a hedonic, experiential nature, with less importance being placed on the instrumental, functional nature of their haptic experience. Figure 2 shows the conceptual model for the four studies and the related hypotheses.

Figure 2: Conceptual model of cross-modal interaction between colour and food texture



Given that this study will also be manipulating product textures, the potential change in perceived texture presents an interesting possibility. Current literature would indicate that, of the two food textures to be employed in this study, creaminess, as opposed to crunchiness, is more often matched with the concept of pleasure (Antmann et al., 2011). As a result, it is proposed that the effects of colour on pleasure will be mediated via perceptions of creamy texture. Specifically:

- Perceived texture will mediate the effect of colour on ratings of pleasure (H4d), purchase intent (H4e), and quality (H4f).

The authors base these expectations on the cross-modal interaction of colour and texture, while engaging the person's hedonic, experiential desires. While the hypothesis highlights the mediation effect for pleasure, purchase intent and quality, it is suspected that the effects on pleasure may be stronger due to the congruence between perceived creaminess and pleasure response. The embodied cognition that occurs as a result of the cross-modal interactions taking place makes people more willing to engage in a pursuit of pleasure than a search for quality. Having proposed the mediation effect of perceived creamy texture, the mediation effect of perceived crunchy texture is also explored. A review of the literature did not reveal a strong argument for a mediation effect between crunchy texture and the three marketing metrics. Nonetheless, for

consistency, crunchiness is included in the study to examine its role as a mediator between colour and the three marketing metrics.

Experimental Research

The authors tested the hypotheses in a series of four experiments, where colour (red/blue) and texture (creamy/crunchy) were used as independent variables, with perceived texture (creaminess/crunchiness) as the primary dependent variable along with measures for the relevant marketing metrics. NFT was measured as a covariate.

Study 1.1a – Cross-modal Interaction

The primary purpose of Study 1.1a was to explore the possibility of the cross-modal effect of colour and actual texture on perceived product texture (H1).

Participants

Participants in the experiment were undergraduate and postgraduate students from various schools of a major university. The sample contained data from 128 participants, 47% of whom were female. The mean age of the respondents was 21.9 years (SD = 2.7); ages range from 18 to 31 years. Participants were recruited through the university's research subject pool using ORSEE software (Greiner, 2004) and they received a $10 gift card for their participation.

Procedure

Participants were informed that a new variety of lunch snacks were being considered, and were invited to try these snacks, as well as answer a few survey questions about the snacks. The study was conducted in a dedicated computer experimental laboratory at the university. The ingredients for the snacks were chosen and prepared by a food scientist at the university, and subjects were screened for potential food allergies, sinus or taste problems[1]. Before tasting the snack, participants took a bite of a dry cracker

[1] The authors adapted the tasting procedure used by Lavin and Lawless (1998)

and drink of water. Each participant then tasted the snack. The snacks were set on standard white plastic spoons to the left of the computer screen. Instructions on the computer screen (administered via the Qualtrics online survey tool - www.qualtrics.com) directed participants to try the snack and then to answer a set of survey questions about that snack.

Experimental manipulations: A between subjects factorial design manipulated the 2 (texture: creamy versus crunchy) x 2 (colour: red versus blue) for a single product type: light yogurt with almonds. The creamy texture condition was created by mixing a creamy base (light yogurt) with a low amount of crunchy flakes (almonds). Matching the creamy base with a high amount of the crunchy flakes created the crunchy texture condition. The colour conditions were created by mixing a standard amount of red or blue food dye with the creamy base at a ratio of 19ml of colour per 1kg. The full ingredient list is provided in Appendix 2.

Participants were randomly assigned to one of the four experimental conditions, Creamy/Red (n = 34), Creamy/Blue (n = 35), Crunchy/Red (n = 30), and Crunchy/Blue (n = 29). Sessions scheduled 36 participants at a time, which is the capacity of the laboratory. On arrival, each participant filled out a consent form and agreed to participate on the condition of no food allergies, sinus or taste problems. Participants dismissed from the experiment due to any of these concerns were awarded $5 show up fee. Eligible participants would begin the experiment at the same time, followed instructions and answered questions on the computer screen at their own pace. All instructions, questions, and responses were handled using the Qualtrics online survey. Once all participants finished, they were debriefed and dismissed together; the laboratory was then prepared for the next session. The average duration of the experiment was 25 minutes with 30 minutes preparation time between the sessions.

Measures

After eating each snack, participants were asked a number of preliminary questions to determine the perceived flavour (taste, smell, texture); and the perceived colour of the snacks. To measure perceived taste, participants described the taste in their own words and rated its intensity using a slider on a zero to one hundred scale, where zero was anchored as "not at all" and one hundred as "extremely". All intensity ratings used the same scale. Participants then rated the intensity of the five primary tastes salty, sweet, bitter, and sour as identified by Silverthorn and Johnson (2010). To measure smell, participants described the smell in their own words and to rate its intensity. Since no standard aspects of smell are agreed in the literature (Rozin, 1982), participants were asked to rate the intensity of smell relative to ingredients in our snacks (milky, vanilla, egg, sour cream, nutty, and chocolate). To measure perceived texture, participants described the texture in their own words and rated its intensity. They then rated the intensity of hard, soft, oily, watery, and gummy aspects of the texture (Rosenthal, 1999; Bourne, 2002).

To measure perceived colour, participants described the colour of each snack in their own words and rated its intensity. They then rated the intensity of red and the intensity of blue colour for the snack.

Dependent variables: To examine the effect of colour on perceived texture, participants rated perceived intensity of creaminess and the intensity of crunchiness for the snack.

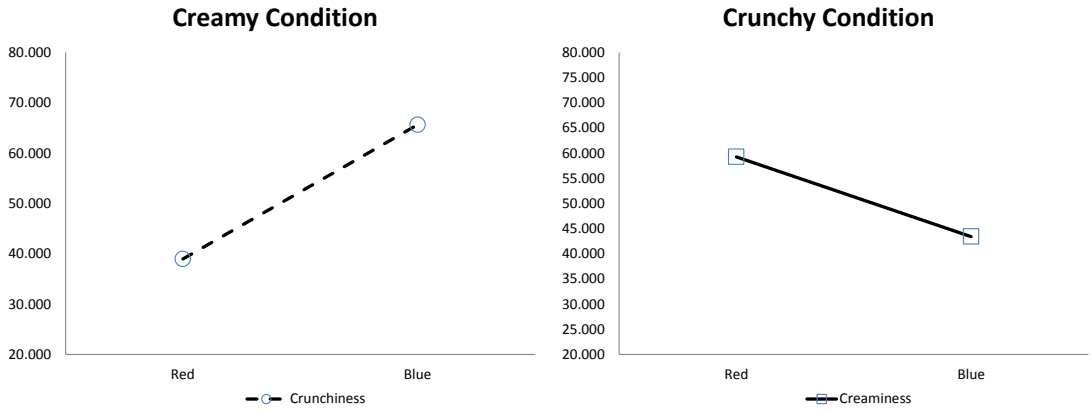
Results

Manipulation Checks. Appendix 3 provides a summary of the results of the multivariate general linear model (GLM) run on the perceived aspects of flavour. The results reveal significant differences between the two snacks in line with the ingredients used in each snack. Generalized linear mixed model (GLMM) run on the perceived intensity of crunchiness (creamy texture condition=52.55, crunchy texture condition=70.34, F(1,

111)=14.24, p<0.001) and perceived intensity of creaminess (creamy texture condition=55.40, crunchy texture condition=51.47, F(1, 111)=0.97, p>0.10) of snacks reveals significant main effect of the texture condition for the crunchiness but not for the creaminess measure. This result is explained by the manipulation where the creamy base (light yogurt) was held constant while the amount of crunchy flakes (almonds) varied to affect the texture. GLMM run on the perceived red colour (red dye condition=58.56, blue dye condition=6.98, F(1, 111)=563.82, p<0.001) and perceived blue colour (red dye condition =4.76, blue dye condition=65.91, F(1, 111)=733.32, p<0.001) of snacks reveals significant main effect of the colour condition based on both these measures.

Cross-Modal Effect: Study 1.1a aimed to demonstrate the cross-modal effect of colour and actual texture on perceived texture, using a light yogurt and almonds product. A random intercept GLMM using standardized variables revealed a statistically significant interaction between colour and actual texture for measures of perceived crunchiness (β=-0.19 F(1,109)=5.24, p<0.05), while only a marginal effect was observed for the perceived creaminess measure (β=-0.16 F(1,109)=2.88, p<0.10) (see Table 1). Analysing the conditional effect for different texture conditions (model 1 according to Hayes, 2012), suggested that colour affected perceptions of crunchiness in the creamy texture conditions (Effect=0.51, t=4.23, p<0.001); while in the crunchy conditions colour affected perceptions of creaminess (Effect=-0.31, t=-2.42, p<0.05). See Appendix 4 for diagrams of all models relating to Hayes PROCESS (Hayes, 2012; Hayes 2013) used throughout this thesis.

Figure 3: Cross-modal effects of colour on perception of food texture (Study 1.1a)



Specifically, in the creamy condition, changing colour from red to blue increased the perception of crunchiness (MD=26.68, t=4.23, $p<0.001$). In the crunchy condition, changing colour from red to blue reduced the perception of creaminess (MD=-15.85, t=2.42, $p<0.05$). See Figure 3. These results are in line with the expectation in H1.

Discussion

Study 1.1a demonstrates the cross-modal interaction of colour and texture on perceived texture. Compared to red, the blue colour was associated with greater perception of crunchiness when the product was creamier (light yogurt with minimal crunchy almond flakes). In contrast, when the amount of the crunch flakes was high (the crunchy condition) the blue colour was associated with reduced perception of creaminess. These results provide the first indication of a cross-modal (vision x texture) processing of somatosensory experience. However, while they are in line with the expected direction of the effect, it would appear the salience of the two product ingredients (creamy base and crunchy almond flakes) has an influence on the overall cross-modal effect. To explore this effect further, the authors chose to run Study 1.1b, where they repeated experiment 1a with a creamier base product. The expectation was that the dominant creamy base would focus participants' attention on perceptions of creaminess rather than crunchiness.

Study 1.1b – Cross-modal interactions and attribute salience

The purpose of Study 1.1b was to investigate the cross-modal effect proposed in H1 but with a creamier product. By repeating the study with a creamier product the experiment hopes to introduce the creaminess as the dominant texture. With creaminess as a more salient attribute, it is expected that the change in colour from red to blue will result in a reduction in perceived creaminess for the overall product.

Participants

Participants in the experiment were undergraduate and postgraduate students from various schools of a major university. The sample contained data from 123 participants. 60.2% of who were women. The mean age of the respondents was 21.8 years (SD = 3.1); ages range from 18 to 31 years. Participants were recruited through the university's research subject pool using ORSEE software and received a $10 gift card in return for their participation.

Procedure

A between subjects factorial design manipulated the 2 (texture: creamy versus crunchy) x 2 (colour: red versus blue) for a single product type: full cream yogurt with muesli. The creamy texture condition was created by mixing a creamy base (full cream yoghurt) with a low amount of crunchy flakes (muesli). Participants were randomly assigned to one of the four resulting experimental conditions, Creamy/Red (n = 31), Creamy/Blue (n = 31), Crunchy/Red (n = 30), and Crunchy/Blue (n = 31). The full ingredient list is provided in Appendix 2. Further procedure and measures were identical to that in Study 1.1a.

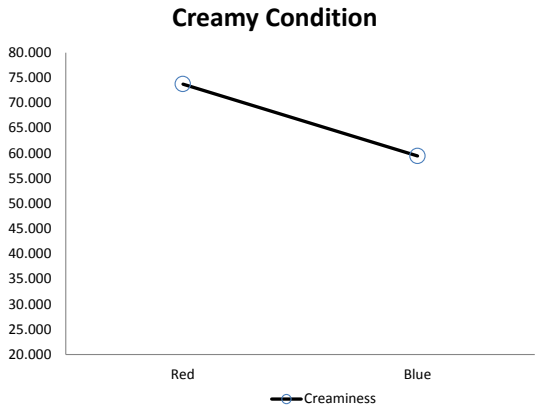
Results

Manipulation Checks: Firstly, manipulation checks were taken for the aspects of flavour, texture (creaminess versus crunchiness) and colour (red dye versus blue dye) of the snacks. Appendix 3 provides a summary of the results of the multivariate general

linear model (GLM) run on the perceived aspects of flavour. The results reveal significant differences between the conditions, in line with the ingredients used in each snack. Generalized linear mixed model (GLMM) run on the perceived intensity of crunchiness (creamy texture condition=40.39, crunchy texture condition=32.77, $F(1, 121)=2.72$, $p>0.10$) and creaminess (creamy texture condition=66.48, crunchy texture condition=28.31, $F(1, 121)=67.04$, $p<0.001$) of snacks reveals significant main effect of the texture condition on the creaminess but not the crunchiness measure. In contrast to Study 1.1a, this result reflects the expected dominance of the creamy base (full cream yogurt). GLMM run on the perceived red colour (red dye condition=61.07, blue dye condition=5.90, $F(1, 121)=629.40$, $p<0.001$) and perceived blue colour (red dye condition=8.13, blue dye condition=70.87, $F(1, 121)=506.432$, $p<0.001$) of snacks reveals significant main effect of the colour condition based on both these measures.

Cross-Modal Effect: Study 1.1b aimed to demonstrate the cross-modal effect of colour and actual texture on perceived texture, using a full cream yogurt with muesli product. A random intercept GLMM using standardized variables did not reveal overall statistically significant interactions between colour and texture for either creaminess or the crunchiness measures (see Table 1). Nonetheless, analysing the conditional effect for different texture conditions (model 1, according to Hayes 2012) indicates that colour significantly affected perceptions of creaminess in the creamy product conditions (Effect=-0.242, $t=2.183$, $p<0.05$).

Figure 4: Cross-modal effect of colour on perception of food texture (Study 1.1b)



Specifically, in the creamy condition, changing colour from red to blue reduced the perception of creaminess (MD=-14.282, t=2.787, $p<0.01$). Figure 4 illustrates the cross-modal effect in the creamy condition. This result is in line with the expectation in H1.

Discussion

It seems creaminess judgments respond to colour manipulations, but the measure on which participants respond follows the dominant texture of the product. Since product type may influence how participants react to the perceptions of texture, it is possible that the results could be very different if different products were used.

Repeating the experiment with a full cream (instead of light) yogurt and muesli flakes (instead of almonds) resulted in a much creamier overall product than in Study 1.1a. Given the dominance of the creamy texture, in comparison to red the blue colour resulted in reduced perceptions of creaminess (rather than an increase in perceived crunchiness as in Study 1.1a) in the low crunchy condition. This effect implies that the exact manner in which the cross-modal effect is expressed might depend on the type of product.

Study 1.2 – Colour-Product Fit

Study 1.1a and 1.1b demonstrated the existence of a cross-modal effect between colour and actual texture, that influences perceived texture. However, to account for the possibility that some product types may be better suited to the red and blue manipulation than others, the goal of Study 1.2 was to explore H1 under the boundary condition of colour and product fit.

To check the extent to which this fit affects conclusions about H1, Study 1.2 increased the fit contrast by using two new products – 1) a custard-based product, which in the pre-tests was found to suit the red or blue colour 2) a mayonnaise-based product, which in the pre-tests tested as unusual for the red or blue colour.

Participants

Participants in the experiment were undergraduate and postgraduate students from various schools of a major university. The Study 1.2 sample contained data from 205 participants, 55.8% of whom were female. The mean age of the respondents was 22 years (SD = 3.2); ages range from 18 to 39 years. Participants were recruited through the university's research subject pool using ORSEE software and subjects received a $10 gift card in return for their participation.

Procedure

The experiment was a 2 (texture: creamy versus crunchy) x 2 (colour: red versus blue) x 2 (product type: chocolate flakes with custard versus pine-nuts with mayonnaise) between subjects factorial design. Allowing for the two products, participants were randomly assigned to one of the eight resulting experimental conditions: Custard (Creamy/Red (n = 27), Creamy/Blue (n = 19), Crunchy/Red (n = 30), and Crunchy/Blue (n = 29)) and Mayonnaise (Creamy/Red (n = 24), Creamy/Blue (n = 16), Crunchy/Red (n = 29), and Crunchy/Blue (n = 31)). The procedure was the same as the previous studies in all other respects. The full ingredient list is provided in the Appendix 2.

Measures

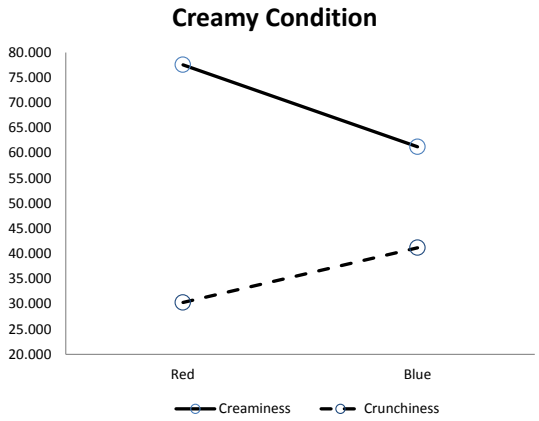
In addition to the measures used in the above studies, study 1.2 also measured perceived fit of colour with product. The 'Colour Appropriateness' scale developed by Bottomley and Doyle (2006) was used, whereby subjects were asked to rate, on an 11-point scale with anchors at 1 (highly inappropriate) and 11 (highly appropriate), how suitable the colour was in relation to the product.

Results

Manipulation Checks: Firstly, manipulation checks were taken for the aspects of flavour, texture (creaminess versus crunchiness) and the colour (red dye versus blue dye) of the snacks. Appendix 3 summarizes the results of the multivariate general linear model (GLM) run on the perceived aspects of flavour. The results reveal significant differences between the two snacks in line with the ingredients used in each snack. Generalized linear mixed model (GLMM) run on the perceived intensity of crunchiness (creamy texture condition=34.16, crunchy texture condition=45.99, $F(1, 206)=10.08$, $p<0.01$) and creaminess (creamy texture condition=70.83, crunchy texture condition=65.34, $F(1, 206)=2.33$, $p>0.10$) of snacks reveals significant main effect of the texture condition on the crunchiness but not on the creaminess measure. The result is explained by the manipulation where the creamy base was held constant while the amount of crunchy flakes was varied to affect the texture. GLMM run on the perceived red colour (red dye condition=70.53, blue dye condition=9.40, $F(1, 206)=643.72$, $p<0.001$) and perceived blue colour (red dye condition =7.50, blue dye condition=76.17, $F(1, 206)=818.87$, $p<0.001$) of snacks reveals significant main effect of the colour condition based on both these measures. GLMM also indicated a significant effect of product type on perceived product fit, $F(1,206)=16.182$, $p<0.001$, suggesting that the custard and the mayonnaise products were perceived differently in terms colour and product fit.

Cross-Modal Effect: Firstly, Study 1.2 aimed to replicate the cross-modal effect of colour and actual texture on perceived texture using the custard and the mayonnaise based products. A random intercept GLMM using standardized variables revealed a statistically significant interaction between colour and texture for measures of perceived creaminess only (β=0.18 F(1,200)=6.79, p<0.01) (see Table 1). Specifically, in the creamy condition, changing colour from red to blue reduced the perception of creaminess (MD=-16.31, t=2.94, p<0.01) but it also increased perceptions of crunchiness (MD=10.88, t=2.00, p<0.05). This result is in line with our expectation in H1, and the results observed in Studies 1a and 1b.

Figure 5: Cross-modal effect of colour on perception of food texture (Study 1.2)



Fit with Product Type: However, the main objective of Study 1.2 was to test whether the cross-modal effect in H1 depends on the fit of colour with the product type. GLMM analysis looking at the interaction of the cross-modal effect (i.e.: colour x texture) with the product type revealed no statistically significant effect for perceptions of creaminess (β=0.03, F(1,200)=0.22, p>0.10), and a marginally significant effect for perceptions of crunchiness (β=-0.12, F(1,200)=3.34, p=0.69). Investigating further, a moderated mediation test (model 7, according to Hayes 2012) using the perceived product and colour fit as the mediator between the cross modal effect (colour x texture) and perceptions of texture (creaminess or crunchiness), while keeping product type as the moderating variable, revealed no significant mediation or indirect

conditional effects. However, a conditional direct effect was noted, such that the cross-modal perceptions of creaminess were significant for the mayonnaise based product (Effect=0.20, t=1.97, p<0.05) but not for the custard based product (Effect=0.16, t=1.619, p>.10). The means analysis further revealed that changing colour from red to blue reduced perceptions of creaminess in the creamy condition for the mayonnaise product (MD=-21.17, t=2.60, p<0.01). In the case of the custard product the effect did not reach statistical significance (MD=-11.452, t=1.516, p>0.10). Similarly, perceptions of crunchiness in the creamy condition increased for the mayonnaise product (MD=17.625, t=2.184, p<0.05), but did not reach significance for the custard product (MD=4.138, t=0.553, p>0.10). By contrast, in the crunchy condition, perceptions of crunchiness seemed to increase, but in this case the effect was statistically significant only for the custard-based product (MD=13.066, t=2.041, p<0.05). See Figure 5. Taken together, these results do not provide consistent evidence that the fit between colour and product has a connection with the cross-modal effect.

Discussion

Study 1.2 replicated the cross-modal effect observed in studies 1a and 1b by using custard and mayonnaise based products. In contrast to our supposition (H2), there was no consistent evidence for the influence of a fit between colour and product type in our sample. Accordingly, the results favour the belief that the cross-modal effect holds across a range of products, some of which may or may not be typically associated with the red or blue colour. As such, it argues against the learned association effect, but leaves the option of embodied cognition as a viable hypothesis. Since an embodied cognition effect might be influenced by individual predispositions to the sense of touch, one way to investigate its nature is to study the cross-modal effect in relation to the existing Need for Touch (NFT) scales.

Study 1.3 – Cross-modal interactions and NFT

Study 3 focused on the embodied cognition implication of cross-modal perception by looking for the moderating role of NFT (H3).

Participants

Participants in the experiment were undergraduate and postgraduate students from various schools of a major university. The final sample contained data from 464 participants. 55.2% of who were female. The mean age of the respondents was 22.1 years (SD = 3.1); ages range from 18 to 41 years. Participants were recruited through the university's research subject pool using ORSEE software and received course credit in return for their participation.

Procedure

Study 1.3 applied a within subject design based on the four product combinations introduced in Studies 1a, 1b and 2. That is, participants tried each of the four snacks (almonds with light yogurt, muesli with full-cream yogurt, chocolate with custard, and pine nuts with mayonnaise) one at a time in a random order while taking a bite of a dry cracker and drink of water before each snack. Snacks were set on standard white plastic spoons and covered with white sheets of paper to the left of the computer screen. The spoons were labelled A, B, C, or D and instructions on the computer screen (administered via the Qualtrics online survey tool - www.qualtrics.com) directed participants to try particular snack and then to answer a set of survey questions about that snack.

Experimental manipulations: Study 1.3 used a mixed within-between subject design that manipulated the 2 (texture: creamy versus crunchy) x 2 (colour: red versus blue) between participants; and product type (almonds with light yogurt, muesli with full-cream yogurt, chocolate with custard, and pine nuts with mayonnaise) within participants (i.e.: every participant tried all four product types in a random order). In

addition, the saturation of the colour manipulations was reduced compared to studies 1 and 2 to investigate robustness of the cross-modal effect. Participants were randomly assigned to one of the four resulting between subject groups, Creamy/Red (n = 118), Creamy/Blue (n = 115), Crunchy/Red (n = 116), and Crunchy/Blue (n = 115). The full ingredient list is provided in Appendix 2. The average duration of the experiment was 45 minutes with 30 minutes preparation time between the sessions.

Measures

In addition to the measures described in Studies 1.1 and 1.2, Study 1.3 also collected information about the respondents' personal predisposition for the Need for Touch (NFT) (Peck and Childers, 2003a), as well as measures for perceived pleasure (Sweeney and Soutar, 2001), quality (Yoo et al., 2000), and intention to purchase (Baker and Churchill Jr, 1977) for each of the snacks.

Results

Manipulation Checks: As before, the authors examined the manipulation checks for the aspects of flavour, texture (creaminess versus crunchiness) and the colour (red dye versus blue dye) of the snacks. Appendix 3 summarizes the results of the multivariate general linear model (GLM) run on the perceived aspects of flavour. The results reveal significant differences between the four snacks in line with the ingredients used in each snack. Repeated measures generalized linear mixed model (GLMM) run on the perceived intensity of creaminess (creamy texture condition=64.75, crunchy texture condition=50.84, $F(1, 1839)=104.04$, $p<0.001$) and crunchiness (creamy texture condition=33.11, crunchy texture condition=39.85, $F(1, 1839)=26.46$, $p<0.001$) of snacks reveals significant main effect of the texture condition on both these measures. Similarly, repeated measures GLMM run on the perceived red colour (red dye condition=53.46, blue dye condition=7.56, $F(1, 1733)=5178.88$, $p<0.001$) and perceived blue colour (red dye condition =3.93, blue dye condition=49.07,

F(1, 1566)=5178.88, p<0.001) of snacks reveals significant main effect of the colour condition based on both of these measures.

NFT Interaction: The objective of Study 1.3 was to test the hypothesis that NFT will moderate the cross-modal effect of texture and colour on perceptions of texture. Full factorial repeated measures random intercept GLMM using standardized variables (including dye colour and food texture as factors, and NFT as covariate) replicated the interaction effect of colour and texture in the case of the perceived creaminess measure (β=0.126, F(1,1848)=12.253, p<0.000). In addition, it indicated a significant interaction between the cross-modal effect (colour X texture) and the NFT (β=-0.095, F(1,1848)=4.475, p<0.05).

Table 1: Results from GLMM analysis of Studies 1.1a, 1.1b, 1.2 and 1.3

	Perceived Creaminess				Perceived Crunchiness			
Study:	1a	1b	2	3	1a	1b	2	3
Intercept	0.00	-0.18	-0.02	0.40	0.00	0.23	0.00	-0.08
	(0.69)	(0.61)	(0.70)	(0.68)	(0.63)	(0.65)	(0.66)	(0.70)
Colour	-0.16*	-0.15	-0.10	-0.01	0.031***	0.12	0.16**	-0.08***
	(0.09)	(0.08)	(0.07)	(0.06)	(0.08)	(0.08)	(0.07)	(0.03)
Texture	-0.09	-0.65***	-0.09	-0.51***	0.34***	-0.134	0.19***	0.13***
	(0.09)	(0.08)	(0.07)	(0.06)	(0.08)	(0.08)	(0.07)	(0.03)
Colour*Texture	-0.16*	0.10	0.18***	0.13***	-0.19***	-0.07	-0.03	0.05
	(0.09)	(0.08)	(0.07)	(0.03)	(0.08)	(0.08)	(0.07)	(0.03)
Product			0.05				0.31***	
			(0.07)				(0.07)	
Colour*Product			-0.06				-0.02	
			(0.07)				(0.07)	
Texture*Product			0.00				0.02	
			(0.07)				(0.07)	
Colour*Texture*Product			0.03				-0.12	
			(0.07)				(0.07)	
NFT				-0.15***				-0.03
				(0.05)				(0.04)
Colour*NFT				0.00				0.02
				(0.05)				(0.05)
Texture*NFT				0.04				-0.02
				(0.05)				(0.05)
Colour*Texture*NFT				-0.095**				-0.07
				(0.045)				(0.05)

[a]standard error reported in parentheses; *p< 0.05, **p<0.01, ***p<0.001.

Analysing the hypothesized conditional effect at values of NFT (model 4, according to Hayes 2012) suggested that on average, high levels of NFT boosted sensitivity to the cross-modal interaction (Effect=0.172, t=2.878, $p<0.01$), while low levels of NFT had no statistical effect (Effect=0.044, t=0.726, $p>0.10$). These results suggest that the effect of colour on perceived texture is a cross-modal effect and that the effect is dependent on high levels of haptic sensitivity, which predicts the direction of the conditional effect in hypothesis H3.

Discussion

Study 1.3 focused on the embodied nature of cross-modal interaction. By using all four products it replicated the cross-modal effect observed in the previous studies across the different products. Importantly, the results show a three-way interaction between colour, texture, and NFT. In particular, high levels of NFT boost the cross-modal effect (colour x texture) as hypothesized in H3. This result, according to current literature, appears to be the first indication of the role of haptic sensitivity and embodied cognition in relation to cross-modal perception.

Study 1.4 – Cross-modal Interactions and Marketing Metrics

Study 1.4 considered the "so what?" question. That is, it looked at the role of the sensory variables in relation to standard marketing metrics such as purchase intent, product quality, and pleasure (H4).

Design

Study 1.4 used the marketing metrics data from Study 1.3 and compared a set of PLS models in relation to the cross-modal effects of colour and product texture. SEM-PLS analysis was carried out using SmartPLS 3.0.

Results

To assess the reliability and validity of the measures, individual item reliabilities were calculated, as well as composite reliability, and average variance extracted (AVE). As shown in Table 2, all factor loadings of focal constructs (i.e. pleasure, choice, and quality) were greater than the minimum cut-off suggested by Hulland (1999), indicating adequate item reliabilities. In addition, support was found for convergent validity because composite reliability values of focal constructs in the model exceeded the threshold of 0.7 (Nunnally, 1978; Fornell and Larcker, 1981).

Table 2: Measurement Statistics

Constructs[a]	*Items*	*Loading*[b]
Pleasure	The product is one that I would enjoy	0.96
CR=0.98; AVE=0.89	The product would make me want to crave it	0.92
	This product would make me feel good	0.93
	This product would give me pleasure	0.95
	This product is one that I would feel relaxed about eating	0.96
Purchase intent	Would you like to try this product	0.95
CR=0.96; AVE=0.89	Would you actively seek out this product (in a store in order to purchase it)	0.96
	Would you buy this product if you happened to see it in a store	0.91
Quality	The product is of high quality	0.81
CR=0.93; AVE=0.70	The product must be of very good quality	0.79
	the likelihood that the product would be functional is very high	0.75
	The likely quality of the product is extremely high	0.79
	The product appears to be of very poor quality	0.80
	The likelihood that the product is reliable is very high	0.55

[a] Denotes measurement model loadings for items of constructs. All items are greater than 0.50 as suggested by Hulland (1999).

[b] Denotes average variance extracted (AVE), and composite reliability of measures (CR), which is calculated as follows: $\left(\sum \lambda_{yi}\right)^2 / \left[\left(\sum \lambda_{yi}\right)^2 + \sum var(\varepsilon_i)\right]$, where $var(\varepsilon_i) = 1 - \lambda_{yi}$ (Fornell & Larcker, 1981)

To assess discriminant validity of each construct, analysis was guided by Gaski and Nevin (1985), who stated that satisfactory discriminant validity among constructs is obtained when the correlation between two constructs is not higher than their respective reliability estimates. As shown in Table 3, results indicate that discriminant validity is evident as no individual correlations (ranged from .00 to .88) were higher than their respective reliabilities (ranged from .93 to .98).

Table 3: Construct-level measurement statistics and correlation of constructs

	1	2	3	4	5	6
1. Colour	-					
2. Creaminess	-0.05	-				
3. Crunchiness	-0.07	0.04	-			
4. Pleasure	-0.05	0.16	-0.03	**0.94**		
5. Purchase Intent	-0.04	0.16	-0.02	0.88	**0.94**	
6. Quality	-0.00	0.15	0.02	0.67	0.66	**0.84**

[a] Diagonal entries show the square roots of average variance extracted, others represent correlation coefficients

To test mediation, the authors followed the method recommended by Preacher and Hayes (2008) and Zhao, Lynch, and Chen (2010), as outlined by Hair, Hult, Ringle, and Sarstedt (2014) and reported in Table 4. With respect to Hypothesis 4a, the direct relationship between colour and pleasure is positive and significant in the absence of the mediator, creaminess (Model 1, β = -.05; t=2.06). When creaminess is included, colour has a positive and significant effect on creaminess (Model 2, β = .05; t=2.04). Creaminess, in turn, positively and significantly impacts pleasure (Model 2, β = .16; t=7.34). Moreover, the direct path from colour to pleasure is reduced in magnitude and becomes insignificant (Model 2, β = -.04; t=1.81). The variance accounted for (VAF) was then calculated to determine the size of the indirect effect in relation to the total effect, which is .25. Therefore, 25% of the total effect of colour on pleasure is indirect, indicating that partial mediation via creaminess, supporting Hypothesis 4a. Similarly, with respect to Hypothesis 4b, the direct relationship between colour and purchase intent is positive and significant in the absence of the mediator, creaminess (Model 1, β

= -.04; t=2.03). When creaminess is included, colour has a positive and significant effect on creaminess (Model 2, β = .05; t=2.04). Creaminess, in turn, positively and significantly impacts purchase intent (Model 2, β = .16; t=7.44). Moreover, the direct path from colour to purchase intent is reduced in magnitude and becomes insignificant (Model 2, β = -.03; t=1.60). The VAF by the indirect effect is .36. Thus, 36% of the total effect of colour on purchase intent is indirect, indicating partial mediation via creaminess, supporting Hypothesis 4b.

Table 4: Test of hypothesised relationships: beta coefficients and t-values

	Endogenous variables							
	Model 1			Model 2				
Exogenous variables	Pleasure	Purchase Intent	Quality	Creaminess	Crunchiness	Pleasure	Purchase Intent	Quality
Colour	-0.05*	-0.04*	-0.04	0.05*	-0.07**	-0.04	-0.03	0.01
	(2.06)	(2.03)	(0.88)	(2.04)	(2.95)	(1.81)	(1.60)	(0.21)
Creaminess	-	-	-	-	-	0.16*	0.16*	0.15*
						(7.34)	(7.44)	(6.10)
Crunchiness	-	-	-	-	-	-0.04	-0.03	0.02
						(1.71)	(1.19)	(0.62)
Control	-	-	-	-0.24*	0.11	-	-	-
(Texture)				(10.57)	(4.84)			

[a]t-values reported in parentheses; *p< 0.01.

As reported above, colour has no significant effect on quality (Model 1). As a result, it was not possible to test the mediation effect of creaminess on the relationship between colour and quality, thus Hypothesis 4c is not supported. With respect to crunchiness, colour has significant effect on crunchiness (Model 2, β = .07; t=2.95), which however has no significant effect on pleasure (Model 2, β = -0.04; t=1.71), purchase intent (Model 2, β = 0.03; t=1.19), and quality (Model 2, β = -0.02; t=0.62). Thus, crunchiness is not a mediator of the relationship between colour and pleasure (4d), purchase intent (4e), and quality (4f).

Discussion

Study 1.4 examined the extent to which the sensory variables (e.g. perceived creaminess and perceived crunchiness) may account for the effects of colour on standard marketing metrics such as pleasure, purchase intent, and quality. In line with the supposition, it is not colour per se but rather the active role of creaminess that influences customers' perception of pleasure and purchase intent. Specifically, the findings offer new insights that colour's potential for influencing pleasure and purchase intent can be realized, in part, through perceived creaminess texture. Interestingly, the results showed no direct effect between colour and quality; as such creaminess is not a concern. In contrast to creaminess, the findings show that crunchiness has no effect on pleasure, purchase intent, and quality. The inactive role of crunchiness, in contrast to creaminess as a mediator of colour-metrics linkages strengthens prior research that found crunchiness and creaminess may have an inverse relationship to each other.

General Discussion

The primary objective of this research was to explore the cross-modal interactions between vision and touch. Across four studies, the findings show that the human sense of touch perceives texture through a cross-modal interaction involving colour and actual texture. Studies 1a and 1b showed that red and blue colour positively influences perceptions of creaminess and crunchiness respectively. However, while the use of red and blue colour might be appropriate for some food types (i.e.; ice cream or chocolate), for many it would seem highly inappropriate. For this reason, Study 1.2 was undertaken to account for any potential issues surrounding colour-product fit. The results showed the underlying cross-modal interactions between colour and texture hold regardless of product type or its fit with the colour.

The results of the first two studies build on the model put forward by Labrecque et al. (2013) and show that synaesthesia-like cross-modal interactions between colour and

texture are embodied and automatic. Moreover, they are independent of any learned, referential meaning. At first glance, the findings show a distinct directional effect between the colours (red/blue) and the perceived textures (creaminess/crunchiness), such that red tends to accentuate creaminess, while blue will accentuate crunchiness. On closer inspection, though, the results indicate a possible bias towards the hedonic role of creaminess. In Study 1.1a, this meant that for the creamy product, red colour suppressed the perceived crunchiness. By contrast, for the crunchy product, the red colour amplified the perceived creaminess. However, in Study 1.1b, the actual texture of the product was adjusted so that the creamy product was made even creamier. Once the dominant texture became creaminess, the perceived creaminess became the focal point for any colour-texture interaction.

Since the literature suggested at least two plausible (though not mutually exclusive) mechanisms behind the cross-modal effect of colour and texture, the authors chose to investigate both. The type of product affected cross-modal interaction in Studies 1a and 1b; it seemed reasonable it might do so in Study 1.2 that considered product fit. Because some products like custard may be associated with red or blue colour more often than mayonnaise, Study 1.2 implicitly tested the role of acquired knowledge in relation to the cross-modal effect. The results, however, found no consistent effect for product fit; there was no interaction or mediation effect. The means analysis suggested custard and mayonnaise responded to colour changes but the pattern was not consistent to allow reliable rejection of the null to H2.

While the initial studies identified cross-modal interactions between vision and the sense of touch, Study 1.3 explored the role a person's haptic predisposition, or 'Need For Touch', plays in such interactions. Conceptually, it was proposed that a person's NFT would moderate the cross-modal colour-texture interaction. The results show that, in line with current literature, those people with high NFT tend to be more sensitive to

haptic stimuli. This increased sensitivity manifested itself in a heightened awareness and response to the cross-modal interactions between colour and texture. Because of this, the findings extend current research and indicate the influence of a person's predisposition to physical interaction isn't necessarily limited to cutaneous or kinaesthetic experiences. Instead, a person's 'Need For Touch' may play a role in cross-modal awareness and have the capacity to shape perception across other sensory modalities. This dovetails nicely with the findings from Studies 1 and 2, in that it reinforces the embodied aspects of cross-modal interactions involving colour.

In Study 1.4, the results were analysed using SEM-PLS to better understand the influence of the cross-modal (colour-texture) effect on marketing metrics. On its own, colour is found to have a significant influence on expected pleasure and purchase intent. However, when creaminess is included in the model, texture mediates the relationship so that the paths for colour-pleasure and colour-purchase intent become insignificant. Effectively, this indicates that the sensory-level cross-modal interactions in the first three studies are driving higher-order constructs. So, in the first instance, actual texture and colour interact to shape perceived texture. From this point, the perceived texture, specifically creaminess, takes command of the process and, ultimately, determines expected pleasure and purchase intent. While this offers a neat explanation of cross-modal interactions through the consumer decision process, it raises a number of questions for future research.

Since multiple sensory inputs are necessary to form the typical marketing evaluations such as pleasure, quality or intention to purchase, investigation of the cross-modal effects in different sensory modalities suggests new ways marketing stimuli may be related with consumer behaviour. In this study, the interaction between colour and actual texture on perceptions of texture was demonstrated. However, in many retail settings (especially where food products are involved) texture is inferred from cues

other than actual texture; such as shape and size of labels or packaging, language, and/or sounds used during marketing communications. At this stage, it isn't clear if cross-modal interactions persist in settings where direct sensory information is not available, and must be inferred from secondary cues. That is, how can advertisers use cross-modal effects in communicating texture with customers? A future study of when selective sensory information can be removed or included will help researchers better understand the nature of cross-modal interactions. Additionally, this research found the effects using the colour and texture of the product as variables. However, colour perception in particular is sensitive to the colour of the background context (Jameson and Hurvich, 1972). In our study, the context was primarily black and white: White laboratory desk, white plastic spoons, white sheets of paper to cover the spoons; and black computer peripherals. Most real world settings are not so clinical. In fact, vibrant colour is used extensively as background in retail settings (e.g. grocery and department stores), and consumption settings (e.g. restaurants) (Bellizzi and Hite 1992). Currently, researchers do not fully understand the implications of background colour on the cross-modal effects of perceived texture. For example, how can cross-modal effects be enhanced or suppressed by the use of background colour? Further exploration of this concept would serve to better explicate the effects of cross-modal interactions. Also, in the current experiments participants ate the product; which means they first saw the lunch snack and then realized its texture in the mouth (see Labrecque, Patrick, and Milne 2013, RQ12, p199). The cross-modal effect postulated suggests a blending of the two sensory inputs. However, there is a clear sequence in the order in which the sensations were experienced. Blending of the sensory inputs requires additional cognitive processing based on memory and/or expectation formation to extend the influence of colour beyond the immediate sensation. As such, the role of semantic processing in formation of expectations deserves additional study in the context of cross-modal associations. Similarly, the role of memory in relation to cross-modal

information processing is not fully understood in the literature (Gallace and Spence, 2009). However, from the marketing perspective this is highly relevant. Consumers rarely approach a purchase or consumption situation without a set of existing priors. These priors are often based on advertising, word of mouth, or previous experience. Priors that help or hinder cross-modal processing remain an important research question in the area of cross-modal sensory integration.

While the experiments attempted to control for potential influences such as product-colour fit or the influence of ambient colours and lighting, limitations still exist. A major limitation is that it is extremely difficult to isolate vision and oral-somatosensation during food consumption. As such, smell and taste are always likely to have a major influence on overall perception. Future research could involve products where colour, smell, taste and texture are simultaneously manipulated to provide further understanding about the interactions between the modalities. In addition, the current study used a student sample, where the average age of the subjects was early twenties. As people age, it is possible their sensory modalities and perception become less sensitive. As such, replicating this research with an older sample would provide further validity for the current findings.

The results have several managerial implications. They provide evidence that perception of food texture changes with the change in colour hue. In addition, the consumer's haptic sensitivity affects the processing of such cross-modal interactions. The decision for selecting the colour of a product, therefore, should consider both the consumer's underlying sensory integration processes, and the market segment for which the product is intended. In particular, it was demonstrated that perceived texture mediates the effects of colour on the extent to which consumers like the product, and their intentions to purchase the product. Ultimately, the effect of cross-modal information processing on marketing metrics is an underexplored domain that

provides a fascinating link between marketing stimuli, consumer behaviour, and marketing outcomes.

Chapter 2

The cross-modal effects of colour in food advertising

Introduction

"Man needs colour to live; it's just as necessary an element as fire and water."

Fernand Leger, French Artist.

In 2015 global expenditure on food items is expected to exceed $US7 trillion (IFC, 2014). As such, every day around the world, consumers make a large number of decisions about food choices. In many of these decisions the visual appearance of the food, in particular the product colour, will be the primary choice determinant. This is because the colour of a food product presents the consumer with critical information related to edibility, as well as the identity and intensity of flavour (Shankar et al., 2010). Many of the associations between food colour and its potential edibility or quality are learned from experience. However, a framework developed by Labrecque et al. (2013) suggests colour influences consumer perception and choice through two routes. The first is the learned or acquired route, which we gain through experience. The second is a developmental or biological route that is innate, rather than learned. This second route is particularly interesting since colours appear to have strong biological links not just to emotions and physical reactions, but also across sensory modalities. Research in psychology and food science has demonstrated the presence of these cross-modal associations, where colour influences perceptions of taste, smell and texture (for a review, see Spence et al. (2010)). However, it would appear the link between colour (a purely visual stimulus) and physical reactions in other sensory modalities has mostly been restricted to situations involving food consumption. As a result, there is limited research demonstrating these cross-modal effects in situations where consumption does not take place, for example in advertising, where much of consumer decision making is based on expectations of consumption. The current study addresses this gap in the extant literature by examining the cross-modal relationships between vision (colour) and touch (food texture) in food advertising.

This article begins with a review of colour and its effects on other sensory modalities. It then applies the theory to a print advertising context, where results show cross-modal effects between colour and touch exist even when immediate consumption of a food product does not take place. The paper then examines whether the cross-modal effects of product colour continue to influence perceptions of texture when advertising copy is included in an advertisement. Following this, it examines the influence a person's haptic (touch) predisposition has in shaping their sensitivity to sensory stimuli and how this sensitivity guides their reception of advertising messages that include sensory information. A person's haptic predisposition determines how likely an individual is to touch a product and how important the sense of touch is to their overall perception. For the current research, Peck and Childers (2003a) 'Need For Touch' (NFT) scale was used to measure a person's predisposition to haptic stimuli. Results show a person's NFT has a positive influence on their sensitivity to the colour-touch cross-modal effects. Finally, it looks at how these three factors (colour, ad copy, haptic predisposition) combine to influence perceptions of quality, purchase intent, expected pleasure and product likability.

Conceptual Development and Hypotheses

Colour has both an aesthetic and cognitive influence on human perception. Historically, it has been thought the effect of colour operates through an 'associative learning' framework, whereby people learn colour associations through experience (Grossman and Wisenblit, 1999). These learned associations then shape a person's preferences for colour in relation to products. In a consumer setting, this means colour associations may change depending on the context. For example, red wine may evoke positive responses, while red mayonnaise is likely to result in very negative evaluations.

Elliot and Maier (2012) support this with their 'colour-in-context' theory and point out that context specific issues arise with colour because it is both aesthetic and carries

meaning. Specifically, while most people see colour primarily as an aesthetic agent, it is actually a “nonlexical visual stimulus that can symbolically convey various types of information” including functional and aesthetic value (p67). This suggests colour has two distinct functions. Initially it is experienced at a sensory level and this will have an influence on perception. However, colour will also convey additional higher-order meaning that is learned through experience. As such, the involuntary, sensory level experience of colour is what drives aesthetic experience, while voluntary attention leads to communication of more complex meaning in relation to things such as quality and brand identity (Kauppinen-Räisänen and Luomala, 2010). The involuntary attention that links to aesthetic experience is supported in research by McManus et al. (1981) who show the influence of colour on aesthetic experience has a level of automaticity that is not found in learned associations of colour. Effectively, this suggests the involuntary, automatic influence of colour on perception appears to have some embodied, physiological grounding that is hardwired to a person's genetic blueprint.

To account for this ‘dual nature’ of colour, Labrecque et al. (2013) developed a framework that accounts for both learned and embodied colour associations. In this framework, colour conveys meaning via two different routes. Embodied meaning is developmental (biological, not acquired) and is directly related to the attributes of the stimulus. For colour this would be due to the effects of attributes like wavelength, saturation or chroma. Referential meaning is learned or acquired knowledge gained through experience. Figure 6 provides an illustration of Labrecque et al.'s (2013) model.

Figure 6: Consumer colour perception and evaluations

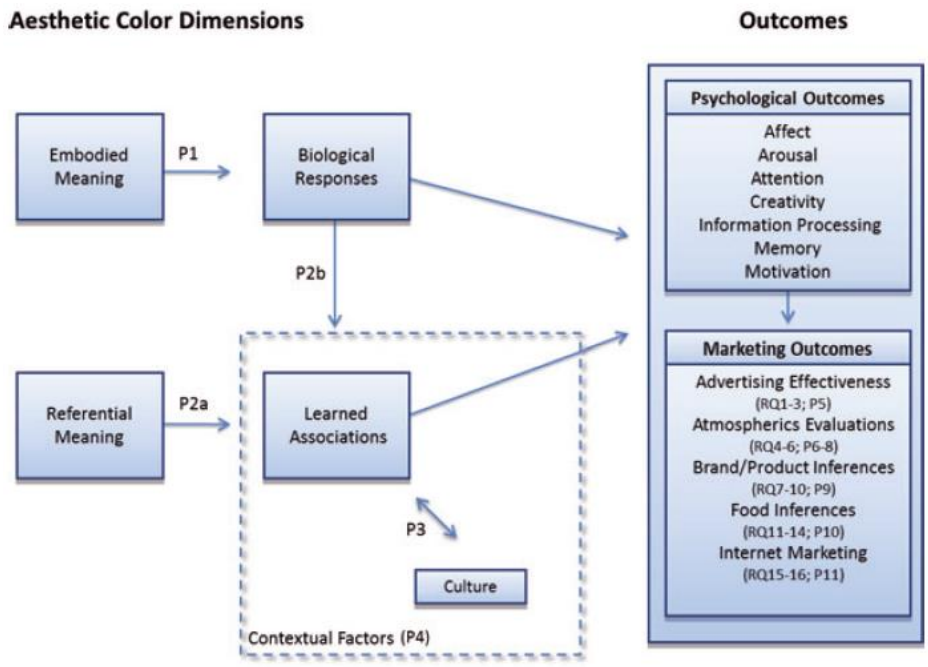


Figure 6: Consumer colour perception and evaluations. Reprinted from The Marketers' Prismatic Palette: A Review of Colour Research and Future Directions by L. Labrecque, V. Patrick and G. Milne (2013), Psychology & Marketing, 30(2), p193. Copyright 2013 Wiley Periodicals

The embodied, cross-modal effects of colour

Colour has a profound physiological influence on human perception. Importantly, though, not all colours have the same influence. In fact, when discussing the physiological effects of colour, the extant literature has a very dominant bias for using red or blue as the main independent variables (e.g. Bellizzi and Hite, 1992; Mehta and Zhu, 2009; Labrecque and Milne, 2012). To reflect this trend and to link with existing theory, the current research will also focus on red and blue as the primary colour agents.

For example, a number of studies (e.g. Jacobs and Hustmeyer, 1974; Wilson, 1996) have demonstrated the arousing nature of red while measuring physical reactions using galvanic skin response. In addition, previous research (e.g. Wexner, 1954; Clarke and Costall, 2008) has shown it is red, as opposed to blue, that is associated with arousal, stimulation and excitement. In a marketing context, Bellizzi and Hite (1992) compared the effects of environmental colour in a retail setting and found that while

red was reported as being arousing, tense and negative, blue was reported as being calm, cool and positive.

Apart from the arousal and stimulation effects of colour, additional physiological effects are observed when colour influences perception in other sensory modalities. In a process called 'cross-modal transfer' (Rudel and Teuber, 1964), information received via one modality shapes or guides perception in another modality. The ability of colour to influence other sensory modalities has been studied extensively in psychology, neurology and physiology (e.g. Van Doorn, Wuillemin and Spence, 2014; Ludwig and Simner, 2013). Much of the work on cross-modal perception stems from research involving synaesthesia. Synaesthesia is a condition that affects a small part of the population, who encounter a stimulus in one sensory modality and this induces a concurrent experience in another modality (for more in-depth reading, see Baron-Cohen and Harrison, 1997; Ramachandran and Hubbard, 2001; Ward and Mattingley, 2006; Sagiv and Ward, 2006). For example, Simner and Ludwig (2012) reported the case of an individual who experienced colour sensations from tactile stimulation. Similarly, Simner and Haywood (2009) reported cases of lexical-gustatory synaesthesia, where different words and phonemes trigger automatic sensations of taste. Importantly, research has shown that some of these same cross-modal associations occur in the regular, non-synaesthetic population (see Spence (2011) for an in-depth review). This is particularly evident in perception of food products, where colour has the potential to shape the perceived taste, smell or texture of a food being consumed.

The cross-modal influence of colour on food

When people think of food or are asked to describe it, for many the first point of reference will be the flavour. Historically, flavour has been considered a product of the interaction between taste and smell (Beidler, 1958). More recently, a broader definition

of flavour has been developed that defines it as 'a combination of olfactory, gustatory and trigeminal sensations perceived during tasting' (ISO, 2008). Under this definition, we see three distinct modalities (smell, taste, touch) working in concert to produce the end result. Because of this, a review of current literature was undertaken to determine just how pervasive the influence of colour is on each of these three modalities and subsequent product evaluation.

Colour and taste

Cross-modal relationships between colour and taste are widely noted throughout the literature. In a study that has implications for food advertising, Koch and Koch (2005) used a questionnaire to identify associations between colour and taste. Without actually tasting any products, results showed that three of the four cardinal tastes had associated meaning for respondents. Specifically, subjects associated red/orange with sweet, while green/yellow are associated with sour. White was positively linked to saltiness. When foods are actually consumed, similar associations are seen, in that colour influences perceived taste profoundly. In fact, evidence would suggest the cross-modal relationship between colour and taste is much stronger than previously thought. For example, Harrar et al. (2011) demonstrated that simply changing the colour of the serving dish has been shown to influence perceived sweetness and saltiness of the food. Likewise, changing the colour of a coffee mug modifies the perceived sweetness of the coffee beverage (Van Doorn et al., 2014). Extending this, the colour of the cutlery has also been shown to influence both sweet and salty perception of a food product (Harrar and Spence, 2013).

Colour and smell

While existing research shows a bias towards experiments involving colour–taste associations, there is also research into the interplay of colour and odour. For example, Luisa Dematte et al. (2006) showed that colour and odours also appear to be

consistently interrelated. However, their study used response times to gauge the influence of congruent/incongruent colour-odour matches, rather than the specific cross-modal effect of colour on odour perception. A more pragmatic study was carried out by Morrot et al. (2001) which illustrated how colour can shape the perceived smell of a beverage. In their study, when wine tasters were presented with white wine that was coloured red, the colour made them discount the olfactory information they were receiving, so they perceived the coloured, white wine samples as red wine. Similar effects of colour on wine aroma were reported by Parr et al. (2003), who coined the term 'colour-induced perceptual bias'. In effect, this means that both taste and smell, two of the three flavour determinants, can be influenced by colour. This raises the question whether colour has the ability to influence the third arm of the flavour triumvirate – the sense of touch.

Colour and touch

The sense of touch relating to the consumption of food is known as oral somatosensory perception. Oral somatosensation is a complex interaction that involves both cutaneous and kinaesthetic sensory stimuli in what is often labelled 'mouthfeel' (Guinard and Mazzucchelli, 1996). Existing research (Tom et al., 1987) has shown that colour – different 'shades' of pudding from light brown to dark brown – will not only influence flavour intensity, but the perceived texture of the food. The theory from Tom et al.'s (1987) research was extended in Study 1 of this thesis, whereby colour (specifically red/blue hue) was found to have a similar effect on perceived texture (creaminess and crunchiness) of different food products. In that study, red food colour was found to have a positive influence on perceived creaminess, while blue food colour had a positive influence on perceived crunchiness.

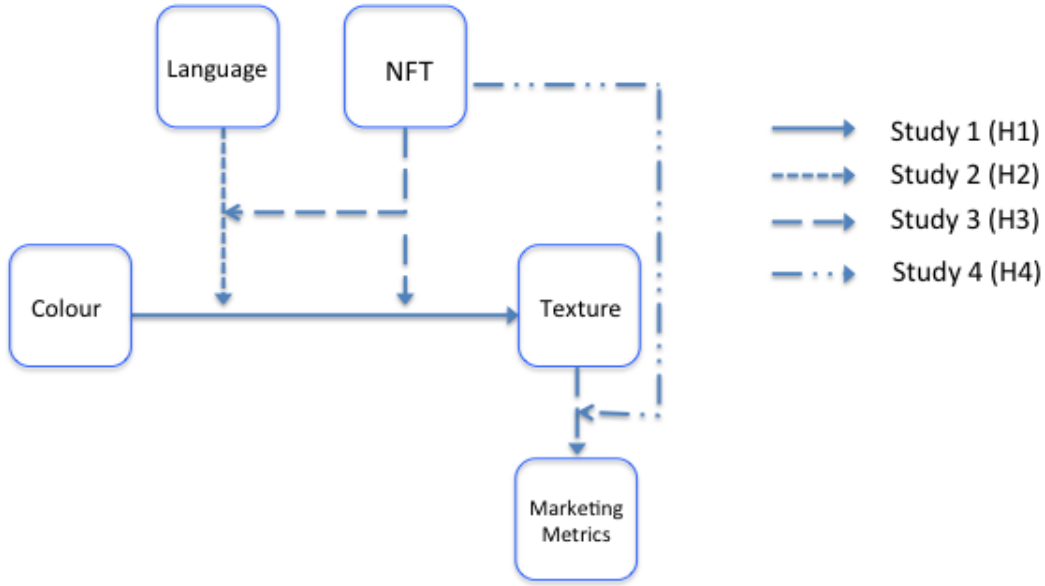
Importantly, the cross-modal effects of colour on perceived texture in Study 1 and in the research by Tom et al. (1987) involved consumption of a food product. This method

provides the respondent with a link from colour to perceived texture, with the actual texture of the product providing the basis for perception. However, within an advertisement the perception of creaminess and crunchiness using only visual stimuli necessitates a change in information processing for subjects. The inability to physically interact with the product requires that people call on heuristics and synaesthesia-like cross-modal mechanisms common to us all (Martino and Marks, 2001). To do this, individuals will typically pair different sensory stimuli based on attributes of each stimulus. For example, when people concurrently see colours and hear sounds, individuals will pair high-pitched tones with lighter colours and low-pitched tones with darker colours. Gallace and Spence (2011) attribute this type of cross-modal experience to Gestalt grouping principles and, importantly for this research, point out that "principles of proximity, similarity, common fate, good continuation, and closure affect tactile perception in both unimodal and crossmodal settings" (p. 538). Effectively, this suggests individuals will use colour-texture groupings to construct meaning. Based on this, it would be expected when those in the broader population are evaluating a product's texture via an advertisement, they will access stored knowledge and mental models related to texture perception to assist with the immediate texture evaluation (Wilson, 2002). In doing so, it is expected they will evaluate product texture in a similar way as if they would have directly experienced or consumed the food product. That is, that red product colour will be associated with increased creaminess, while blue colouring will be associated with increased crunchiness. As such, the following hypothesis is proposed:

- H1: When viewing a food advertisement, red product colour (H1a) will have a positive influence on expected creaminess, while blue product colour (H1b) will have a positive influence on expected crunchiness.

While the potential for colour to influence all three components of flavour has a range of implications for marketers in both product development and communications, seldom do advertisements only contain a product image. In fact, a review of any magazine will show how product images share the spotlight with language (ad copy). Because of this, it is necessary to consider whether any cross-modal colour-texture effects are influenced by the presence of ad copy. To assist the reader during the conceptual development, a full conceptual model is provided in Figure 7.

Figure 7: Conceptual Model



The role of language in sensory perception

When colour and language are paired in a message, it is logical that people will use both sources of information to construct meaning (e.g. Babin, Darden and Giffin, 1994; Holbrook and Hirschman, 1982). However, the simultaneous processing of both inputs introduces the potential for interference between the two stimuli, which may have downstream effects on overall perception.

A common form of interference between language and colour is known as Stroop interference (Stroop, 1935). In his studies, J. Ridley Stroop used cards with colour names printed in either congruent or incongruent coloured ink. He asked subjects to

say the colour of the ink, not the colour name. When the colour and name are congruent, subjects have little trouble with the task. However, when the colour and name are incongruent, response times show a distinct interference as a result of the lexical component. If the printed word says RED, but the ink colour is blue, subjects have difficulty reporting the ink colour as blue. They are more likely to say red, or take a much longer time to say blue. Essentially, when colour and language are seen together, language dominates.

Advertising of food products is similar, in that a milder form of stroop interference is observed when ad copy is paired with colour cues. For example, recent research by Hoegg and Alba (2007) demonstrated that even though colour is the primary determinant in conflicts between colour and taste, text labels identifying the brand will influence consumer evaluation. In their research, the combination of visual (colour, brand label) cues dominated other sensory inputs (taste) in relation to taste discrimination tasks and product preference. One explanation they propose is that consumers identify "the most reliable predictors and differentiators of utility" (p. 497) to assist with diagnostic tasks. When both product colour and ad copy are present in an advertisement, what may happen is that the colour occupies sensory-level, online cognitive resources, while the words activate internal visual, phonological and even semantic codes despite little or no attention to the text (Posner et al., 1988). This process then calls upon offline cognitive resources where the individual attends to one thing over all else, so that it “fills the mind, if only for a brief moment” (LaBerge, 1995, p1). The result is that, for food-related advertising, the colour of the product in the advertisement will have a sensory level effect, while the ad copy will influence things like our sense of taste by affecting sensory cognitions (Elder and Krishna, 2010). In Elder and Krishna’s research, the use of multisensory ads (using the label ‘stimulate your senses’) led to higher likability ratings for taste than ads using the unisensory label ‘long lasting flavour’. In subsequent experiments, additional ad copy was included

that involved terms to convey aroma and texture and these too had a positive influence on ratings of product taste.

Together, the research by Hoegg and Alba (2007) and Elder and Krishna (2010) indicates both product colour and ad copy influence perception. Because of this, it is proposed that semantically relevant, texture-related language within the advertisement (where text labels state 'Creamy Quality' or 'Crunchy Quality') will influence the cross-modal effect of colour on expected texture (creaminess and crunchiness) of the food product being advertised. While colour will influence expected texture, the semantically relevant language will also contribute to texture perception. What we would expect, then, is for the effect of colour on expected texture hypothesised in H1 to be moderated by ad copy. As such, the following hypothesis is proposed:

- H2: When viewing a food advertisement, the cross-modal effects between colour (red/blue) and texture (creamy/crunchy) will be positively influenced by semantically relevant ad copy, where text labels describe 'Creamy Quality' (H2a) or 'Crunchy Quality' (H2b).

Advertising copy is a powerful method for transferring information about product attributes. This is especially true for conveying haptic or touch-related information when only visual stimuli are available (Peck and Childers, 2003b). For example, such language influence has been shown to reduce the uncertainty of online purchasing, even when consumers buy a product they would typically want to feel or touch before purchase (McCabe and Nowlis, 2003). This creates a situation where lexical inputs are used as a proxy when haptic interaction is unavailable. Effectively, the processing of semantically relevant language primes the visual sense and the information received creates expectations for the sense of touch. The cross-modal information experienced (in this case, colour) which is relevant to the sense of touch (to assess the expected

texture of the product) is then used to confirm or modify anticipated experiences (Dagman et al., 2010).

Given that individuals will refer to their sense of touch to guide perception, it is possible that any traits or predispositions people have about touching objects will influence the outcome. For this reason, we must consider the role that a person's haptic (touch) predisposition plays in the cross-modal colour-texture relationship.

The moderating influence of haptic orientation

Haptic predisposition relates to a person's tendency to use their sense of touch for object identification and evaluation. The preference for haptic information has been termed 'Need For Touch' (NFT) by Peck and Childers (2003a), who developed the NFT scale to measure a person's haptic orientation. Their findings showed that individuals differ greatly in the style, amount and motivation for touching a product. The composite NFT scale also contains two different dimensions that can be used to classify people as either instrumental or autotelic. Those that have an instrumental orientation use touch to ascertain goal-driven information such as comfort, quality or value. By contrast, those with an autotelic orientation see touch as an end in itself. These people are likely to engage in touch for the pleasure, arousal and enjoyment that it affords.

Previous research (Krishna and Morrin, 2008) has shown that an individual's autotelic orientation corresponds with their overall sensitivity to sensory stimuli. In their research, Krishna and Morrin found that, when subjects were asked to consume a mineral water product using a standard drinking cup, high autotelics generally provided a higher overall evaluation of quality. However, when the drinking cup used was switched to lower quality (i.e. a 'flimsy' feeling cup), it "elicited more negative evaluations" (p. 811) for those individuals with a low autotelic orientation. Similar results were found in Study 1.3 using the composite NFT scale, though the differences between high and low NFT were reversed. Specifically, results from Study 1.3 indicate

cross-modal effects of colour on texture are "dependent on high levels of haptic sensitivity" (p57). The differences between these results and those of Krishna and Morrin are likely due to Krishna and Morrin primarily investigating the effects of non-diagnostic haptic cues (i.e. a flimsy cup) on evaluations of taste, quality and likability. In their study, low autotelics are said to be unable to change their information processing and decision style to accommodate the non-diagnostic inputs. By contrast, the findings from Study 1.3 indicate colour will have a more pronounced cross-modal effect on those people with a high NFT, due to their overall higher sensitivity to sensory stimuli.

The association between NFT, touch and colour links to embodied cognition. Effectively, the sense of touch shapes an individual's sensory (Ernst and Bülthoff, 2004, Peck, 2009) and cognitive (Wilson, 2002) evaluations. This suggests that high NFT people are more aware of sensory stimuli than low NFT people, are more willing to use it to guide decision-making, and are more susceptible to the mood altering effects of such affective stimuli (Yazdanparast and Spears, 2013). It follows then that this heightened sensitivity will cause both the embodied and referential meanings of colour to have a more pronounced effect on those people with higher NFT levels. However, given the proposed model also includes language as an independent variable, it is appropriate to point out there appears to be limited research involving the influence of NFT on language generally, or ad copy in particular. However, given the ad copy used in the current study (Creamy Quality/Crunchy Quality) is both diagnostic and semantically relevant to the task faced by subjects (evaluating expected creaminess/crunchiness of the product when viewing an advertisement), it is anticipated ad copy, like colour, will have a more pronounced influence on those with a high NFT. Because of this, the following hypothesis is proposed:

- H3: The effect of ad copy on the cross-modal colour-texture relationship will be positively influenced by a person’s haptic orientation (NFT).

The three-way interaction between NFT, ad copy and colour creates a situation that can also be labelled 'moderated moderation' (Hayes, 2012). Essentially, this moderated moderation manifests itself such that individuals who have a higher 'Need For Touch' will experience a more pronounced influence of ad copy on the colour-texture association. While these are all sensory level occurrences, the resulting impact on a consumer's expected creaminess or crunchiness may also have an influence on decisional level concepts and subsequent consumer behaviours. This is because both creaminess (Frųst and Janhųj, 2007) and crunchiness (Fillion and Kilcast, 2002; Kwak, 2015) of food products are complex, multi-dimensional constructs and that expectations related to these are likely to guide "future behaviour, cognitions, and affect." (Bowen and Tomoyasu, 1992. p.1061). For this reason, the influence of cross-modal colour-texture effects on marketing outcomes must be considered.

Cross-modal effects on marketing metrics

The managerial implications of cross-modal colour-texture associations in food advertising are broad. The use of colour in product design, packaging and marketing communications takes on more significance when colour is shown to directly influence perceptions of product attributes such as creaminess and crunchiness. This is particularly important given that ad copy also has the potential to magnify the cross-modal effects of colour and the overall influence on marketing outcomes. The link between colour and perceived texture means a person will develop haptic constructs (creaminess/crunchiness) by calling upon embodied and referential knowledge involving their sense of touch, in line with the framework developed by Labrecque et al. (2013). This information will then be used to evaluate marketing outcomes, such as expected quality, expected pleasure, expected likability and purchase intent. When this happens, a person's haptic orientation (NFT) has the potential to moderate their response. In a study by Peck and Wiggins (2006), touch created an affective response, which mediates the effect of touch on persuasion. At the same time, the mediation is

moderated by a person's NFT. The difference between Peck and Wiggins' experiment and the current study is that Peck and Wiggins included physical interaction in their experiment. However, findings by Elder and Krishna (2012) indicate NFT may operate even when direct contact is not available. They report the impact of visual product depiction on purchase intent is mediated by a person's amount of embodied mental simulation. It is expected that people with high sensory sensitivity (high NFT) will focus their attention on sensory level stimuli, such as colour, and this will drive their product evaluation. In addition, the presence of objective language that provides message-related haptic information will increase their decision-making confidence and persuasion (Peck and Wiggins, 2006). By contrast, people who have a lower sensory sensitivity (low NFT) are less prone to the direct effects of colour and language. Instead, they incorporate the effects of colour and language and engage in further cognitive processes, so the effects of sensory stimuli are mediated by multi-dimensional constructs like perceived creaminess or crunchiness. However, results from Study 1.4 indicated that perceived creaminess and crunchiness are not equal in this matter. In fact, the findings from that study demonstrate "it is not colour per se but rather the active role of creaminess that influences customers' perception of pleasure and purchase intent". Perceived crunchiness had no influence on marketing outcomes. While the effects of 'perceived' creaminess were observed when subjects consumed the relevant food products, it is anticipated the 'expected' creaminess of the food products communicated through an advertisement will have a similar influence on respondents. As such, the following hypothesis is proposed:

- H4: When viewing a food-related advertisement, the effect of colour and ad copy on marketing metrics will be mediated by expected creaminess, and the mediation will be positively moderated by a person's NFT.

Ultimately, the physical nature of the product attributes being communicated (creaminess and crunchiness) mean individuals will call upon both embodied and

learned knowledge to guide cognition. In turn, this physical experience is then linked to activation of broader, related semantic concepts (Möller and Herm, 2013) which will guide the development of more subjective marketing outcomes.

Experimental Research

The hypotheses were tested in a series of four experiments, where colour (red/blue) and language (creamy/crunchy) were used as independent variables. To replicate Study 1, expected texture (creaminess/crunchiness) was measured as the primary dependent variable. NFT was measured as a covariate.

Study 2.1 – Cross-modal effects in advertising

The objective of Study 2.1 was to identify the presence of a cross-modal effect between vision (colour) and touch when viewing an advertisement (H1).

Participants

Participants for Study 2.1 were randomly recruited through an online research portal, based on their willingness to be a part of the study. The sample consisted of 82 participants, with no limiting criteria set for recruitment. Ages of the participants ranged from 19-68, with the mean age 38.24 years (SD=11.11). Gender was randomly distributed: 40.8% male/59.02% female.

Experimental manipulations

Study 2.1 was a 2(Colour: red/blue) between subjects design, where colour was manipulated for a single product advertisement.

Advertisements were created with one image of a generic, non-branded snack food. This image was then altered for each of the two conditions, so that it would appear either more red or more blue. The red product image was developed according to RGB colour levels of 255.51.51 (Hex: FF3333), with the blue image at 51.153.255 (Hex:

3399FF). These same colour guidelines are replicated for all experiments within the current research. Figure 8 provides an example of the product image used in Study 2.1

Figure 8: Product used for both red and blue treatments in Study 2.1

Procedure

Participants received a dedicated URL to access the online survey, via the Qualtrics online survey tool (www.qualtrics.com). Participants were informed that a new range of snacks had been developed and the research was being carried out to assist with future advertising. Subjects were randomly assigned via Qualtrics to one of two groups. Randomisation was unconstrained, resulting in the following numbers per condition: Red (n=49), Blue (n=33).

During the survey, participants were shown a single product image in one of the two treatment colours and asked a number of questions relating to the expected texture. Expected creaminess and crunchiness were measured on a 0-100 sliding scale, with zero anchored by the words 'not at all' creamy/crunchy, and one hundred anchored by the words 'extremely' creamy/crunchy. The average duration of the experiment was approximately 10 minutes.

Results and Discussion

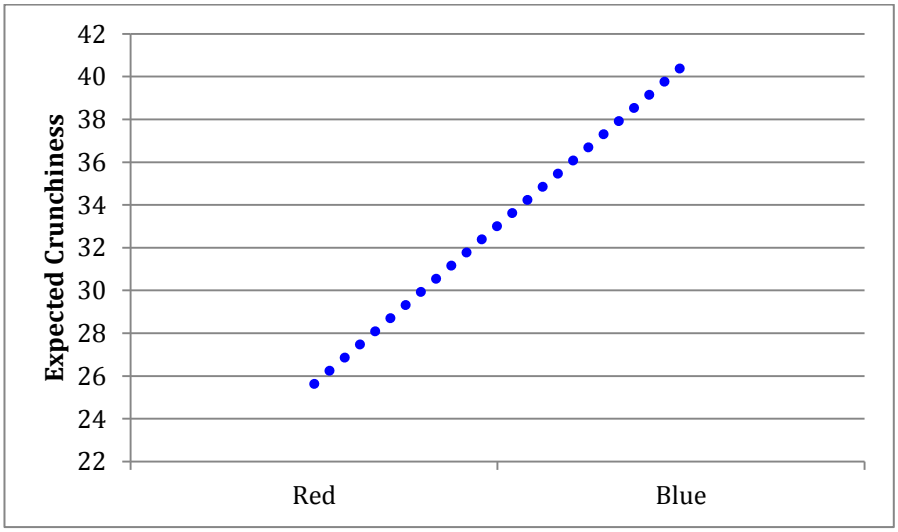
Manipulation checks

Manipulation checks were carried out to ensure the effectiveness of the colour stimuli. Results demonstrate a significant main difference in perceived colour for both the red (red/blue: m=61.36/38.63; t=6.97; p<.01) and blue (red/blue: m=69.39/30.60; t=9.76; p<.01) conditions.

Cross-modal effects

Data was analysed using a univariate general linear model (GLM). Results show a significant effect of colour on expected crunchiness ($F(1,80)=5.27; p=.02$), providing support for H1b. Specifically, within an advertisement, food products that are coloured blue result in higher expected crunchiness than products that are coloured red. This effect is shown in Figure 9.

Figure 9: Effect of colour on expected crunchiness



Findings in Study 2.1 confirm the presence of a cross-modal effect between vision (colour) and touch. The results extend theory developed in Study 1 of this thesis where cross-modal effects were observed when subjects consumed various food products. In Study 2.1, these same effects were reported without consuming food, when the only available stimuli were visual cues. However, the findings merely demonstrate a significant cross-modal effect when subjects are asked to report expected crunchiness.

This discrepancy between creaminess and crunchiness was also found in Study 1, where 'perceived' creaminess and crunchiness had similar levels of significance to Study 2.1. As with Study 1, though, this may be due to the current experiment being limited to one product. As such, testing these effects on a different product will allow for any individual product bias.

In addition, while the results do suggest the presence of cross-modal effects in advertising, further research is required to determine whether these effects hold when advertising copy and text-based labels are included. Study 2.2 sets out to examine this situation.

Study 2.2 – Cross-modal colour-texture effects in the presence of ad copy

The purpose of Study 2.2 was to determine whether the introduction of advertising copy would influence the cross-modal effect between colour and expected texture. In effect, the experiment aimed to identify the moderating influence of ad copy on the cross-modal colour-texture relationship (H2).

Participants

Participants for Study 2.2 were randomly recruited through an online research portal, based on their willingness to be part of the study. The sample consisted of 118 participants, with no defining criteria included for recruitment purposes. Ages of the participants ranged from 18-68, with the mean age of 38.03 years (SD=11.28). Gender was randomly distributed: 54.2% male, 45.8% female.

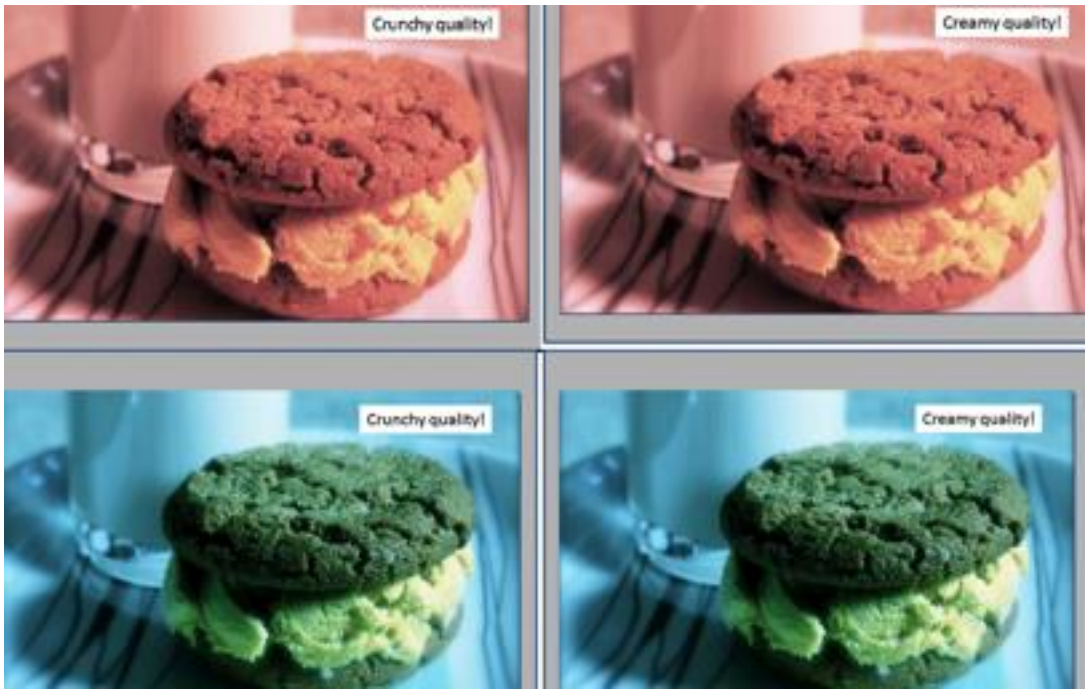
Experimental manipulations

Study 2.2 was a 2(colour: red/blue) x 2(ad copy: creamy/crunchy) between subjects design. One image of a generic, non-branded snack food was used that was different to the image used in Study 2.1. Colour was altered to replicate colour (red/blue) manipulations from Study 2.1 (Red at RGB 255.51.5, Hex FF3333; Blue at RGB

51.153.255, Hex 3399FF). Text labels for the ad copy were then added to the images. When adding the text labels to the images, the texture-related adjective (creamy/crunchy) was paired with a noun (quality) to increase the salience of the adjective and create a phrase that was more representative of an advertisement.

As a result, the four experimental conditions each had a single, corresponding image: Red "Crunchy Quality"/"Creamy Quality" and Blue "Crunchy Quality"/"Creamy Quality". Figure 10 shows the product and text labels used in both red and blue conditions. The procedure and measures replicated that of Study 2.1 in all other aspects. Average time to complete Study 2.2 was approximately 12 minutes.

Figure 10: Product used for both red and blue treatments in Study 2.2



Procedure

As with Study 2.1, participants were randomly assigned via the Qualtrics survey instrument to one of four experiment groups: red/crunchy quality (n=29), blue/crunchy quality (n=29), red/creamy quality (n=36), blue/creamy quality (n=24). In all other respects, procedure replicated that of Study 2.1.

Results and Discussion

Manipulation checks

To ensure the effectiveness of the colour stimuli, manipulation checks were conducted, with results showing a significant main difference in perceived colour for the red (red/blue: m=60.4/39.63; t=6.27;p<.01) and blue (red/blue: m=63.66/36.34; t=7.43;p<.01) conditions.

Cross-modal effects

GLM run on the data shows a significant main effect of colour on expected creaminess ($F(1,114)=11.04$: $p<.01$) and crunchiness ($F(1,114)=13.61$: $p<.01$), as well as a significant main effect of ad copy on expected creaminess ($F(1,114)=7.43$: $p<.01$) and crunchiness ($F(1,114)=25.923$: $p<.01$). In addition, results also show interactions approaching significance ($p<.1$)between colour and ad copy for both dependent measures. A summary of results for each condition is shown in Table 5.

Table 5: Colour-Language influence on expected texture

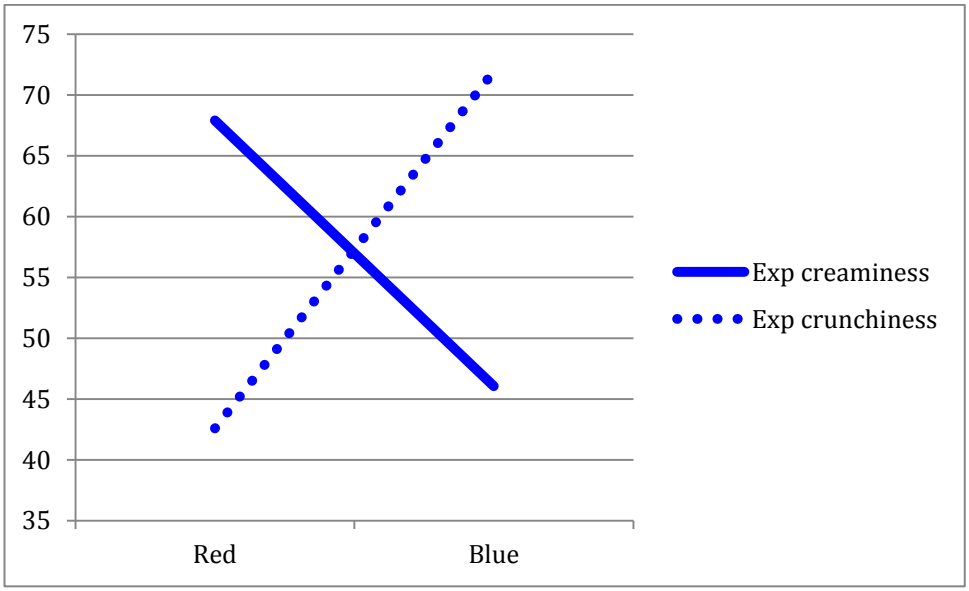
Results show the mean estimate and the standard error in brackets

		Creaminess	Crunchiness
Red	'Crunchy Quality'	67.89	42.58
		(4.36)	(5.25)
	'Creamy Quality'	72.50	25.72
		(3.91)	(4.71)
Blue	'Crunchy Quality'	46.06	71.93
		(4.36)	(5.25)
	'Creamy Quality'	65.29	35.20
		(4.79)	(5.77)

Based on the initial results, planned comparisons were run in order to provide detail regarding the interaction effects and determine support for the hypotheses.

For the planned comparisons, ad copy was held constant to determine the effects of colour changes. Results are illustrated in Figure 11.

Figure 11: Effects of colour on expected texture with 'Crunchy Quality' labels



The results shown in Figure 11 demonstrate when text labels describe product crunchiness ('Crunchy Quality'), colour has a significant influence on both expected creaminess (MD=21.82; p<.01) and expected crunchiness (MD=29.34;p<.01), providing support for H2b. An interesting result is that when ad copy refers to the 'Creamy Quality' of the product, no significant effect of colour on texture is observed for either of the dependent measures. As such, there is no support for hypothesis H2a. Two explanations may account for the lack of support in H2a. First, the experiment involved subjects evaluating one product. As such, the specific individual characteristics of the product may have more influence on subjects' evaluations than colour. This issue is addressed in Study 2.3, where multiple products are used. Second, there is limited research investigating the effects of language on cross-modal relationships. No doubt, the concept of creaminess, as opposed to crunchiness, holds very different semantic connotations for consumers. As such, the 'creamy quality' labels may be causing

distinct affective responses that go beyond the scope of the current study but provide motivation for further research.

These findings indicate a moderating effect of ad copy on the cross-modal association between colour and expected texture. In this respect, 'Crunchy Quality' as opposed to 'Creamy Quality' activates the influence of colour for both expected creaminess and expected crunchiness. According to current literature, these findings appear to be the first indication that language interacts with colour to shape a person's cross-modal perception. Moreover, given the current study is examining cross-modal perception in relation to the haptic sense, it is possible that any traits or predispositions people have about touching objects will influence the outcome. For this reason, Study 2.3 looks at the influence of a person's 'Need For Touch' (NFT) on the cross-modal relationship between vision (colour) and touch in an advertising context.

Study 2.3 – Cross-modal effects and the 'Need for Touch'

The objective of Study 2.3 was to investigate the moderating influence of NFT on the cross-modal language-colour-touch association (H3).

Participants

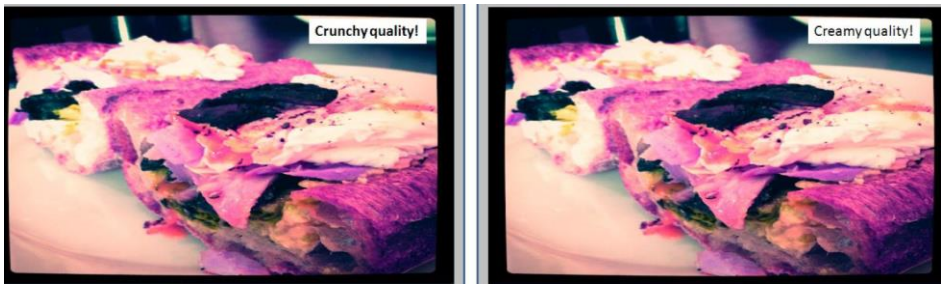
Participants for Study 2.3 were undergraduate and postgraduate students at a large university, who were randomly recruited through the university's ORSEE subject pool (Greiner, 2015) based on their willingness to participate. This experiment was conducted onsite in a dedicated experimental research laboratory at the university to ensure control over the conditions. The average time to complete the survey was approximately twenty minutes. All subjects were given a $10 gift card for participating in the experiment.

The sample consisted of 469 participants and recruitment was open to all, with no criteria set for the sample. Ages of the participants ranged from 18-41, with the mean age 22.12 years (SD= 3.13). Gender was randomly distributed: 45% male; 55% female.

Experimental manipulations

Study 2.3 was a 2(colour: red/blue) x 2(ad copy: creamy/crunchy) between subjects design. Three different product images were used in Study 2.3. These included the product image from Study 2.1, the product image from Study 2.2 and a third image, as shown in Figure 12. NFT was measured using the composite 12-item NFT scale (Peck and Childers, 2003).

Figure 12: Additional third image used in Study 2.3



Procedure

Participants were randomly assigned via Qualtrics to one of four groups: Red - Crunchy Quality (n=116)/Creamy Quality (n=120); Blue - Crunchy Quality (n=116)/ Creamy Quality (n=117). Participants were informed a new range of food products had been developed and the research was being carried out to assist with potential advertising. In all other respects, procedure replicated that of Study 2.1.

Results and Discussion

Manipulation checks

Manipulation checks were conducted to ensure the effectiveness of the colour manipulations. Results of the GLM analysis show a significant main difference in perceived colour for the red (red/blue: m=56.18/18.90; t=30.55;p<.01) and blue (red/blue: m=6.57/49.80; t=33.15;p<.01) conditions.

Cross-modal effects

To determine the influence of NFT on the cross-modal language-colour-texture effect, analysis was conducted using PROCESS plug-in for SPSS (Hayes, 2013). While three

different product images were shown to each subject, it is the three-way interaction between NFT, ad copy and colour that is the focus of the research rather than individual differences between the products. As such, responses for the three products were averaged across subjects and the mean used as a measure of central tendency (Wall and Heslop, 1986) based on experimental conditions. This resulted in a single averaged measure per subject for each variable in the analysis (Abeele and MacLachlan, 1994).

Results show for expected creaminess (Model 3 according to Hayes, 2013), a three-way interaction exists between colour, ad copy and NFT (β=-.41; S.E.=.22; t=1.85; p=.06) that is approaching significance. No significant effect was observed for expected crunchiness. As a result, additional analysis was undertaken to further understand the influence of NFT on the relationship between colour, ad copy and expected creaminess.

For this analysis, the 'pick a point' technique (Bauer and Curran, 2005) was used for NFT. This technique provides values for quantitative moderators at the 10th (NFT=41.25), 25th (NFT=49.91), 50th (NFT=59.08), 75th (NFT=68.75) and 90th (NFT=79.08) percentiles. As such, the lowest level of NFT is at the 10th percentile, while the highest level of NFT is at the 90th percentile. The results are provided in Table 6.

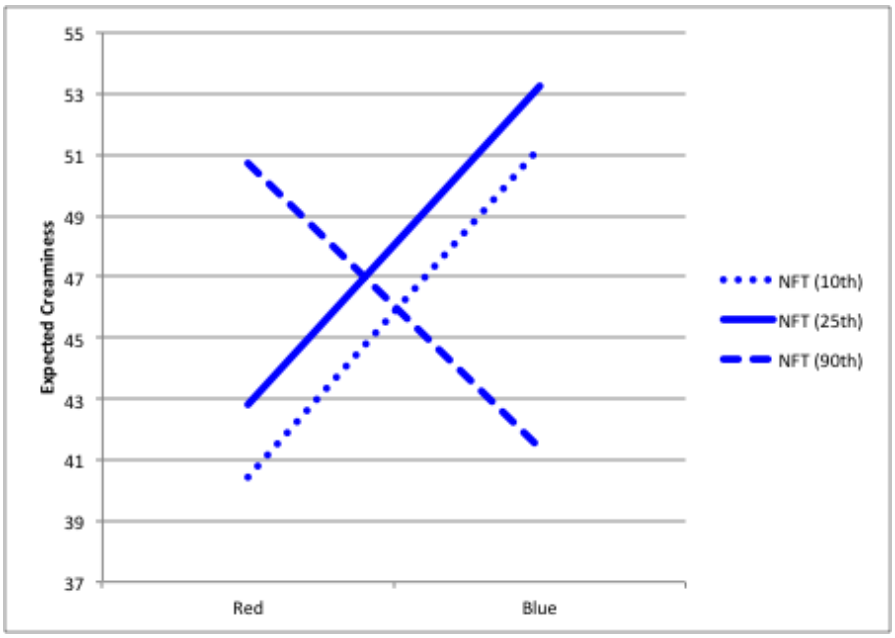
Table 6: Effect of NFT on language-colour-creaminess relationship

		Product Colour	
	NFT	Red	Blue
Creamy Quality	10th	47.69	52.58
	25th	49.40	53.27
	50th	51.21	54.00
	75th	53.11	54.78
	90th	55.15	55.60
Crunchy Quality	10th*	40.43	51.23
	25th*	42.80	53.27
	50th	45.29	46.58
	75th	47.93	44.06
	90th*	50.75	41.37

** = p<.05*

The results in Table 6 show the effects of NFT in the two ad copy conditions. Thus, when ad copy in the advertisements labelled the products as 'Creamy Quality', NFT had no significant moderating effect. However, when the ad copy labelled the products as 'Crunchy Quality', conditional effects of colour on expected creaminess were observed for the low (10th and 25th percentile) and high (90th percentile) NFT subjects, providing partial support for the hypothesis (H3). These conditional effects are shown in Figure 13.

Figure 13: Three-way interaction between colour, 'crunchy quality' ad copy and NFT



As Figure 13 illustrates, when the ad copy refers to the crunchiness of the product, individuals at each end of the NFT spectrum respond to product colour cues very differently. Thus, for high NFTs, red food products appear to be creamier than blue products, which was in line with the hypothesis (H3). By contrast, for the low NFTs, red food products appear to be less creamy than blue food products, which is an unexpected observation for two reasons. First, the fact low NFTs exhibit sensitivity to the visual stimuli (colour, ad copy) was definitely not anticipated. The existing literature, in combination with the findings from Study 1.3, suggests it is high NFTs who are more influenced by sensory inputs. One reason may be that previous research (Krishna and Morrin, 2008) used a median split to determine high/low NFT and dichotomised the data for analysis. In the current study, the use of the 'pick-a-point' technique may provide a more objective sensitivity analysis of the 'moderated moderation' (Hayes, 2012) effect. Second, the directional effect of colour experienced by low NFTs is in contrast to what was observed in Study 2.1 and Study 2.2. For high NFTs, the moderated moderation effect means language magnifies the effect of colour on expected creaminess. Thus, when high NFTs view advertisements with ad copy

suggesting the product is 'Crunchy Quality', blue products are considered less creamy than red food products. By contrast, when low NFTs view advertisements with ad copy suggesting the product is 'Crunchy Quality', blue products are considered creamier than red products.

In Study 2.1, blue product colour was found to positively influence expected crunchiness. In Study 2.2, ad copy was shown to moderate the influence of colour for expected crunchiness and expected creaminess. In Study 2.3, a conditional three-way interaction was observed such that colour elicits very different cross-modal responses, depending on a person's 'need for touch' and the type of ad copy in the advertisement. These results are combined in Study 2.4 to investigate the role of expected creaminess as a mediator of the colour-texture association, and the moderating effects of ad copy and NFT.

Study 2.4 – Cross-modal effects and the influence on marketing metrics

The objective of Study 2.4 was to examine the mediating role of expected creaminess on the relationship between colour and a number of different marketing outcomes, along with the moderating effects of language and NFT.

Design

Study 2.4 used data collected on marketing metrics during Study 2.3. Existing scales were used for expected pleasure (Sweeny and Soutar, 2001; α= .94), quality (Yoo, et al., 2000; α= .93) and purchase intent (Baker and Churchill Jr., 1977, α= .86) as well as the single item likability scale by Kanungo and Johar (1975). Respondents' haptic predisposition was measured using the composite 12-item 'Need For Touch' scale (Peck and Childers, 2003). A table outlining all scale items is included at Appendix 6.

Results and Discussion

Cross-modal effects

Analysis was conducted using PROCESS plug-in for SPSS. For all analyses, model 9 (Hayes, 2013) was used to test for moderated mediation. The initial analysis shows colour has a significant, direct effect on each of the four marketing metrics. In all situations, results indicate red is the preferred colour for food products in that it generates more preferable responses for each of the variables measured. Surprisingly, it would appear red has the opposite effect on expected creaminess, where blue food colour generates higher responses. A summary of results is shown in Table 7.

Table 7; Results of Mediation Analysis (Study 2.4)

Results show the mean estimate and the standard error in brackets

	Expected Creaminess	Quality	Purchase Intent	Pleasure	Likability
Colour	21.31** (6.98)	-3.62** (1.23)	-5.40** (1.66)	-6.98** (1.58)	-8.58** (1.62)
Expected Creaminess		0.18** (0.03)	0.19** (0.04)	0.15** (0.04)	0.15** (0.04)
NFT	0.23** (0.07)				
Ad Copy	-5.84* (2.35)				
	R^2=.05 F(5, 463)=5.59	R^2=.07 F(2, 466)=18.49	R^2=.05 F(2, 466)=13.63	R^2=.06 F(2,466)=15.22	R^2=.07 F(2,466)=19.60

**** = p<.05, **= p<.01***

However, the primary objective of the research was to examine the moderated mediation effects for each of the marketing metrics. To do this, separate bias-corrected bootstrap models were created, with 10,000 bootstrap samples taken from existing

data as recommended by Hayes (2015). This process generates a 95% confidence interval, whereby mediation can be determined if zero falls outside the confidence interval, as per Preacher et al. (2007) and (Zhao et al., 2010).

In addition, for all analyses, NFT is analysed using the 'pick-a-point' method (Bauer and Curran, 2005), whereby values for NFT are provided at the 10th (NFT=41.25), 25th (NFT=49.91), 50th (NFT=59.08), 75th (NFT=68.75) and 90th (NFT=79.08) percentiles.

The results for Study 2.4 are summarised in Table 8. The results from this study build on previous findings from 2.1-2.3. Specifically, it was found that colour has a significant, direct effect not just on expected creaminess but also on the four marketing metrics. In turn, for low NFTs at the 10th percentile, the effect of colour on all marketing metrics is mediated by expected creaminess, resulting in a moderated mediation (Hayes, 2015). This effect occurs in the presence of both forms of ad copy. However, for NFTs at the 25th percentile (where NFT = 49.91), the presence of ad copy indicating the 'Creamy Quality' of the product activates the mediating effect of expected creaminess. Together, the results provide support for the hypothesis (H4). Specifically, when viewing a food-related advertisement, the effect of colour and ad copy on marketing metrics is mediated by expected creaminess. In turn, a person's NFT moderates the influence of expected creaminess, creating a moderated mediation effect.

Table 8: Indirect effects of texture on marketing metrics (Study 2.4)

DV	Language	NFT	Effect	S.E.	LLCI	ULCI
Expected Quality	Creamy Quality	41.25	1.51	0.67	0.45	2.99
		49.91	1.01	0.51	0.19	2.13
		59.08	0.48	0.43	-0.29	1.45
		68.75	-0.07	0.48	-1.16	0.78
		79.08	-0.66	0.65	-2.24	0.43
	Crunchy Quality	41.25	1.21	0.67	0.03	2.72
		49.91	0.71	0.52	-0.27	1.87
		59.08	0.18	0.45	-0.87	1.06
		68.75	-0.36	0.51	-1.64	0.46
		79.08	-0.96	0.68	-2.61	0.07
Purchase Intent	Creamy Quality	41.25	1.58	0.69	0.47	3.29
		49.91	1.05	0.53	0.23	2.34
		59.08	0.50	0.45	-0.32	1.49
		68.75	-0.07	0.50	-1.25	0.82
		79.08	-0.70	0.68	-2.33	0.49
	Crunchy Quality	41.25	1.27	0.72	0.05	2.94
		49.91	0.75	0.56	-0.28	2.03
		59.08	0.19	0.48	-0.86	1.18
		68.75	-0.38	0.53	-1.74	0.48
		79.08	-1.00	0.70	-2.82	0.03
Expected Pleasure	Creamy Quality	41.25	1.24	0.58	0.33	2.75
		49.91	0.83	0.43	0.17	1.95
		59.08	0.39	0.35	-0.19	1.24
		68.75	-0.06	0.39	-1.04	0.67
		79.08	-0.55	0.55	-1.99	0.30
	Crunchy Quality	41.25	1.00	0.59	0.06	2.61
		49.91	0.59	0.45	-0.14	1.74
		59.08	0.15	0.38	-0.62	0.92
		68.75	-0.30	0.42	-1.50	0.37
		79.08	-0.79	0.58	-2.48	0.01
Expected Likability	Creamy Quality	41.25	1.30	0.61	0.40	2.97
		49.91	0.87	0.45	0.18	2.03
		59.08	0.41	0.37	-0.22	1.26
		68.75	-0.06	0.42	-1.13	0.66
		79.08	-0.57	0.59	-2.10	0.34
	Crunchy Quality	41.25	1.05	0.63	0.08	2.65
		49.91	0.62	0.48	-0.17	1.83
		59.08	0.16	0.40	-0.65	0.98
		68.75	-0.31	0.44	-1.60	0.38
		79.08	-0.83	0.60	-2.51	0.01

The findings from Study 2.4 provide further evidence that NFT levels correspond with an individual's overall sensory sensitivity. Thus, for high NFTs, their higher level of sensory sensitivity manifests itself in a way that sees colour directly influencing both sensory level (expected creaminess/crunchiness) and decisional-level (marketing

metrics) constructs. This does not necessarily mean low NFTs are immune to the effects of colour. Rather, the experience of product colour for low NFTs activates a form of dual pathway processing, as evidenced by the mediating effect of expected creaminess.

General Discussion

This research had a number of objectives. In Study 2.1, it set out to identify the existence of cross-modal associations between vision (colour) and touch (product texture) in advertising. In Study 2.2, the aim was to examine the moderating effect of advertising copy on the colour-texture association. The goal of Study 2.3 was to determine the role a person's NFT plays in cross-modal perception. Finally, Study 2.4 set out to extend current theory on the mediating effect of creaminess and apply this to an advertising context.

Results from the four experiments support the propositions and show that colour influences expected creaminess and crunchiness when viewing an advertisement. Study 2.1 found that blue products are expected to be crunchier than red products. This directional effect, whereby red links to creaminess and blue links to crunchiness, is in line with the observations from Study 1. However, previous research linking colour to food texture has all involved actual food products, where subjects in the different studies have consumed the food. In those studies, colour is seen to affect the 'perceived' creaminess and crunchiness of the product. By contrast, the current study involved subjects viewing food advertisements and, as such, appears to be the first to identify the cross-modal affect of colour on 'expected' texture.

In Study 2.2 it was found the inclusion of ad copy in the advertisement moderated the affect of colour on expected texture. On face value, this would appear to be in line with the broad body of work involving 'Stroop' interference (Stroop, 1935), where people

attend to language over colour so that language dominates perception. However, that the cross-modal effect of colour is not totally eliminated supports the notion by Labrecque et al. (2013) that colour is embodied, is linked to physiology and has a permanent, on-going influence over perception. At the same time, the type of ad copy that moderates the cross-modal colour effect is an exciting development. In this study, the cross-modal effect of colour does not occur in the presence of 'Creamy Quality' labels, but does occur when ad copy indicates the 'Crunchy Quality' of the product. While the author stopped short of hypothesising which label would be the source of the moderation, there was a reasonable expectation it would be the 'Creamy Quality' label. This was based on results from Study 1, in which the active role of creaminess was found to be a key determinant in consumer perception. This isn't to say the active role of creaminess is diminished, but it does signify further research is required to investigate the active role of the 'Crunchy Quality' labels on the cross-modal colour effect.

In Study 2.3, a three-way interaction (or moderated moderation) was observed between NFT, ad copy and colour in the determination of expected creaminess and crunchiness. Once again, though, the same active role of the 'Crunchy Quality' ad copy seen in 2.2 was encountered in 2.3. Also observed were the opposing responses at different levels of NFT on the cross-modal 'colour-ad copy' effect. Typically, most literature involving NFT is focused on the responses by individuals with a high level of NFT. As such, it was expected that high NFTs would not only be more influenced by colour, but also by the relevant ad copy. While the hypothesised affect was confirmed for high NFTs, an additional, unplanned observation was made. Specifically, that colour has an opposite cross-modal affect on low NFTs. For high NFTs, viewing 'Crunchy Quality' ad copy results in red food products being higher in expected creaminess than blue products. Conversely, for low NFTs it is blue food products that are higher in expected creaminess. While the reasoning behind this difference is outside the scope of

the present study, it provides motivation for future research investigating the interactions between language and colour in a cross-modal context. For example, it may be the physical characteristics of the colour (i.e. hue, saturation, brightness, wave-length) impact on people differently depending on their NFT. Alternately, it may be various aspects of the ad copy (semantics, phonemic influences) that activates innate, embodied, cross-modal connections.

In Study 2.4, the aim was to answer the 'so what' question. The findings from the study indicate the complex interactions between colour, ad copy and NFT not only guide sensory level perception (expected creaminess and crunchiness), but also higher level cognitive perception relating to product quality, purchase intent, likability and expected pleasure. While these findings dovetail with the results from Study 1, according to current literature this would appear to be the first time such cross-modal effects have been shown to influence marketing metrics in an advertising context. Furthermore, Study 1 identified the "active role of creaminess" as a key determinant for consumer perceptions relating to 'perceived' pleasure and purchase intent of consumed food products. The current study extended this theory in that the active role of 'expected' creaminess was found to be a key determinant for all marketing metrics when viewing advertising.

The implications for this research are many and varied. At a physiological level, the findings suggest current definitions of human sensory modalities are open to change. At the very least, the importance of vision to overall perception has been reinforced. At a deeper level, this research adds to a growing body of evidence that demonstrates the influence of colour on the three dimensions of flavour - taste, smell, touch (oral somatosensation). While it may be premature to herald colour as the fourth dimension of flavour, sufficient groundwork has been laid to consider this as an avenue for future research.

Despite the contributions offered by this research, limitations do exist. The first is the use of only a small number of products. In addition, the advertisements developed for the study were designed to have both creamy and crunchy product attributes. Future research might increase the number and type of products used in the advertisement. For example, using products that are semi-solids and predominantly liquid-based, such as yoghurt and custard. In addition, the current study used advertisements that appeared as print ads. Future research could examine the cross-modal effects across different media types or with additional inputs such as sound.

In terms of managerial implications, the size of the food industry and related advertising makes the findings from this research highly valuable. Current estimates of worldwide expenditure on food products are likely to exceed $US7 trillion (IFC, 2014). Based on current 'revenue-to-ad spend' ratios in the US food industry of approximately 10% (Statista, 2015), this suggests a conservative estimate of $US 700 billion is spent on food advertising around the world each year. This makes the cross-modal effects of colour on expected creaminess and crunchiness in advertising potentially very valuable, particularly when creaminess and crunchiness have been identified as key determinants of product quality, enjoyment, likability and purchase intent. That said, the current research isn't solely a vehicle for increasing consumption or maximising ROI. It may also be the findings can be used to promote consumer wellbeing. For example, the study identified a link between colour and ad copy when forming a view on product quality, yet there appears to be limited research on either the mechanics within this interaction or different contexts where the effects of the interaction are more pronounced. It may also be the results of this research are useful in social policy and social marketing. For example, the requirement for different food products to adhere to predefined colour guidelines could be examined as a way to incorporate social policy goals in product development. Examples of such scenarios might include promotion of organic produce, government health messages or even smoking cessation

campaigns, where the colour of cigarette packaging and communications is highly topical.

While much research remains to be done, the cross-modal influences of colour identified in this paper have extended existing theory and provide further evidence of the boundary conditions for colour in a marketing context.

Chapter 3

Cross-modal relationships between touch and vision

Introduction

"That's what it feels like when you touch me. Like millions of tiny universes being born and then dying in the space between your finger and my skin. Sometimes I forget."

Iain Thomas, 'I Wrote This For You"

In the past ten years, sensory marketing has been a topic of particular interest in marketing research (Raz et al., 2008; Hult et al., 2009; Krishna, 2011; Krishna and Schwarz, 2014). This is because the different sensory modalities humans use to acquire information and create meaning are central to the decision-making process. In this respect, Krishna (2012) proposed that sensory marketing is effectively "marketing that engages the consumers' senses and affects their perception, judgment and behaviour." (p.333). The study on sensory marketing in academia has broadened and is now incorporating concepts from a range of fields including neurology, psychophysics and physiology. Of particular importance is the area of neuromarketing.

Neuromarketing is defined as the application of neuroimaging techniques to product marketing (Ariely and Berns, 2010). Specifically, it uses neuroimaging to determine the location, frequency and timing of neuronal activity so as to evaluate consumer choices, attribute preferences and future behaviours (Lee et al., 2007). The power of this kind of research was demonstrated by Berns and Moore (2012), who used fMRI neuroimaging techniques to predict the popularity and future sales of musical artists based on neural activation data. This provides strong evidence for the argument that the interface between brain and sensory modalities is the critical nexus for consumer attention, perception and behaviour. Such a case is supported by Kayser and Logothetis (2007), who reviewed existing literature on functional imaging and electrophysiology to find the brain allows for interactions between the sensory modalities. Specifically, they refer to a body of work that shows a range of subcortical nuclei exist that are responsible for relaying information between sensory cortices. However, the challenge

facing both academics and practitioners is to understand the conditions that facilitate or inhibit such sensory experience and cross-modal transfer.

Recent research on cross-modal perception has been undertaken to identify cross-modal associations between different modalities (see Spence (2011) and Krishna (2012) for a review of literature). From this literature, it is clear that of all the sensory modalities, vision stands out as the dominant modality, particularly when it comes to evaluating product safety, ease of use and enjoyment (Schifferstein, 2006b). In turn, colour (hue) is the most prevalent visual attribute that influences cross-modal perception. For example, colour has been shown to influence hearing (e.g. Menzel et al., 2008; Wolfson and Case, 2000), smell (Zellner and Kautz (1990), taste (Harrar et al. (2011) and touch (Chylinski et al. (2015).

While the cross-modal effects of colour are many and varied, an interesting observation from Schifferstein's (2006) review is that across the broader population, touch is rated as the second most important sensory modality for evaluating products. Despite this, there appears to be limited research exploring the relationship between vision (colour) and the sense of touch. In this respect, Study 1 and Study 2 explored the unidirectional influence of colour on haptic (touch) perception. The current study builds on this previous research and examines the multidirectional nature of the colour-touch association. Specifically, whether touching a product influences consumer perception of a product's colour and whether ownership of the product moderates the effect of touch on colour evaluation. There are a number of key contributions expected from this study. Previous research is heavily biased towards situations where colour is the determinant in cross-modal perception. As such, identifying sensory-level stimuli (in this case, touch) that influence colour perception would be a significant theoretical contribution. In addition, determining the role of ownership as a boundary condition in the cross-modal transfer of information would extend existing theory on haptics and

the endowment effect. At the same time, better understanding of the cross-modal relationship between vision (colour) and touch will provide marketers with added knowledge and a more complete toolset for product development, marketing communications and retail service delivery.

This paper begins with a review of literature on cross-modal associations involving colour and how these apply to haptic perception. It then looks at how a person's haptic predisposition or their 'Need For Touch' (Peck and Childers, 2003a) influences not just their haptic perception but their overall sensory sensitivity. The moderating influence of ownership is then discussed and finally, the hypothesised effects are discussed in relation to their effects on marketing metrics.

Conceptual development and hypotheses

The role of touch in human perception

Our sense of touch occurs through a dynamic, complex set of sensory systems that operate independently, yet provide an integrated view of the physical world (Paterson, 2007; Klatzky and Lederman, 2003). In marketing terms, this means that touch excels at providing information on texture, hardness, temperature and weight and is a critical component in the consumer's ability to identify objects (Klatzky and Lederman, 1992; Lederman and Klatzky, 1993). Yet the influence of touch goes well beyond object identification, in that touch and physical interaction have the ability to shape both cognitive and affective responses to the product. In addition, the act of touching a product can shape perception in other sensory modalities, in a process known as cross-modal transfer (Rudel and Teuber, 1964; Hadjikhani and Roland, 1998).

Historically, the ability for one sensory modality to influence other sensory modalities was attributed to a condition known as synaesthesia (Cytowic and Wood, 1982). While synaesthesia may take a number of forms, Day (as cited in Ramachandran and

Hubbard, 2001) indicates the most common form is that of grapheme-colour synaesthesia, where the presentation of graphemes (written numbers and letters) causes a concurrent experience of colour for the viewer. For example, the letter A may cause synaesthetes to experience (see) the colour red, while B may result in a blue experience. Importantly, commonalities exist between synaesthetes and non-synaesthetes in how letters are mapped to colours (i.e. A to red, B to blue, O to orange, W to white and Z to black) and it is thought this "stems in part from mechanisms that are common to us all" (Simner et al., 2005; p1069). This has two important implications for this research. First, it suggests we may all lie somewhere on a cross-modal spectrum where perception is a constant interplay between the different sensory modalities. Second, the fact non-synaesthetes are viewing graphemes and subsequently matching them to colours opens the possibility that colour is an outcome or consequence in the cross-modal process. This is an exciting development because existing research, as noted in the introduction, is heavily biased towards scenarios where colour is the primary activating agent. For example, situations where colour influences taste, smell and touch.

In terms of direct cross-modal influences between colour (vision) and the other cardinal senses, significant relationships have been identified. For example, Koch and Koch (2005) determined that for the regular, non-synaesthetic population, individuals will consistently map tastes to colours, such that green is mapped to sour, red is mapped to sweet and white is mapped to salt. These colour-taste associations are so profound that apart from the colour of the food, the colour of the dish (Harrar et al., 2011), mug (Van Doorn et al., 2014) or cutlery (Harrar and Spence, 2013) will influence the perceived taste of the product consumed. Yet taste is not the only chemical sense that is influenced by colour. Research by Luisa Dematte et al. (2006) used response times to determine colours are mapped to odours with a highly significant degree of consistency across the population. For example, aromas of caramel, cucumber, lemon,

spearmint and strawberry were paired with brown, green, yellow, turquoise and pink respectively. Similarly, Morrot et al. (2001) coloured white wine red and discovered the red colour impacts on the ability of the drinker to identify the smell as belonging to red or white wine, or to accurately gauge the intensity. Parr et al. (2003) called this effect on the sense of smell 'colour-induced perceptual bias'.

While this perceptual bias may be developmental in origin (i.e. biological or genetic, rather than learned), Dagman et al. (2010) propose a different explanation. They suggest it may actually be due to information being received through one modality creating expectations for a second modality. In turn, the second modality is used to confirm or modify anticipated experiences. This theory is supported by Spence and Gallace (2011), who apply the concept to the sense of touch. In a situation they term 'affective ventriloquism', they suggest information received by the sense of touch can pull or bias perception to bring the different modalities into alignment. This form of tactile 'affective ventriloquism' was demonstrated by Krishna and Morrin (2008) in a study using either a regular 'feeling' cup or a 'flimsy' cup. Subjects who drank from the 'flimsy' cup reported more negative evaluations of product quality than those who drank from the regular, firmer cup.

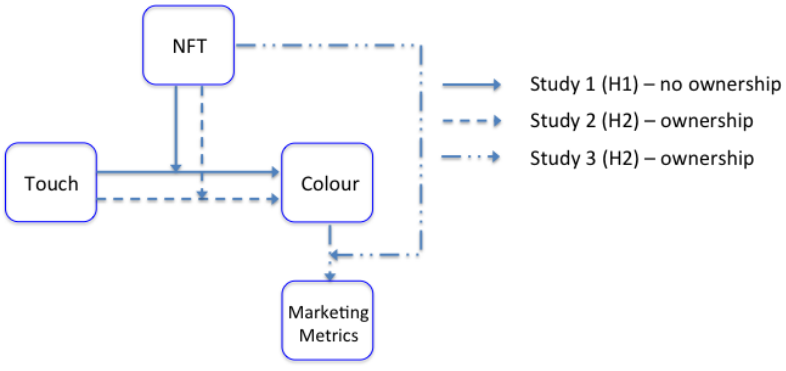
This presents a new dimension in the colour-touch relationship in that rather than colour influencing the sense of touch, haptic experiences may influence how we perceive colour. This kind of experience was observed by Simner and Ludwig (2012), who identified a form of tactile-vision synaesthesia in which tactile stimulation creates concurrent colour sensations. In their case study of synaesthesia patients, actual touch, or observing a third party engaging in touch, caused full synaesthetic colour experiences. The vibrant, concurrent synaesthetic colour experiences encountered by synaesthetes are not expected in the broader population. However, in keeping with Simner et al.'s (2005) proposition that synaesthetes and non-synaesthetes share a

range of common, cross-modal mechanisms, it is anticipated that when neurologically normal consumers touch a product, the information received by the sense of touch will influence how product colour is perceived. This definitely fits with existing theory (e.g. Spence, 2011; Bien at al., 2012) that suggests we all lie somewhere on a cross-modal spectrum where experiences are degrees of vividness rather than being present or not. At the same time, it links to Spence and Gallace's (2011) concept of 'affective ventriloquism' whereby tactile exploration of a product can influence perception in other modalities. As a result, the following hypothesis is proposed:

- H1a: In situations where product ownership does not exist, the ability to physically touch a product will have a positive influence on an individual's evaluation of product colour.

Being able to touch an object, when compared to situations where touch is restricted, has been shown to have a positive effect on a range of consumer measures including likability and persuasion (Peck and Wiggins, 2006). Ultimately, the positive (or negative) impact of physical product interaction will bias perception. However, despite the positive or negative influence that touch has on perception, it is likely to be moderated by a person's predilection to touching objects. This willingness or otherwise to engage in physical exploration using the haptic sense is what is known as a person's 'need for touch'. A conceptual model is provided in Figure 14 to assist with further conceptual development.

Figure 14: Conceptual Model



The moderating effect of NFT

In a consumer environment, individual differences in the 'need for touch' influence "the extent to which tactile cues affect a customer's evaluation of particular products" (Spence and Gallace, 2011; p282). To measure this 'need for touch' (NFT), Peck and Childers (2003a) developed the NFT scale, as a way to identify an individual's preference for haptic (touch) information. Findings from their research show NFT moderates the relationship between direct, physical experience and confidence in product assessments. Specifically, when haptic information is available (i.e. when touching the product is allowed), those people who are high NFTs feel increased confidence in their decisions (Nuszbaum et al., 2010). This is due to the 'mere exposure effect', whereby the more a person touches something, the more they like it, and this is particularly the case for high NFTs (Jakesch and Carbon, 2012). This is because for high NFTs, they rate haptic information as important so they are more willing and able to access this information as part of their overall evaluation process. While confidence in product evaluation is important, a major point of difference between the different levels of NFT is their sensitivity to sensory stimuli (Krishna and Morrin, 2008). In this regard, high NFTs are more aware of, and susceptible to, the influence of sensory stimuli than low NFTs (Yazdanparast and Spears, 2013). This difference in sensory sensitivity at different levels of NFT has been evident in the first two studies in this thesis.

In Study 1, results indicate high levels of NFT boosted sensitivity to the cross-modal colour-texture effect, while no effect was seen for low NFTs. These findings support the concept that haptic sensitivity, as measured through NFT, affects the processing of cross-modal interactions. This means when individuals consume a food product, the influence of colour on perceived food texture (creaminess or crunchiness) is moderated by NFT.

In Study 2, the findings from Study 1 were replicated in an advertising context, where high NFTs were shown to be susceptible to the influence of visual cues such as colour and written language. Specifically, when viewing food-related advertising, the influence of colour and advertising copy on expected texture (expected creaminess or crunchiness) was positively moderated by NFT. Based on these findings, it is suggested that NFT can be used as a proxy for measuring sensory sensitivity. As a result, the following hypothesis is proposed:

- H1b: In situations where product ownership does not exist, an individual's evaluation of product colour will be positively influenced by their overall sensory sensitivity (NFT).

The potential for a person's haptic predisposition (NFT) and their overall sensory sensitivity to be so tightly linked indicates how central the sense of touch is to perception and everyday life. In fact, touching an object is such a personal experience it can generate feelings of ownership (Peck and Shu, 2009), even when the object is another person's property. This presents somewhat of a conundrum for the current study. For example, if an individual was to touch and physically examine a product, is their response to product colour due to cross-modal touch-vision effects, or due to changes in perceived ownership as a result of the tactile experience? For this reason, the influence of ownership must be considered in the context of this study.

Ownership as a sensory activator

The concept of ownership is tightly linked to our sense of touch. Consumers will examine, evaluate and rate products using a number of different systems. As a result, they are able to determine value as it applies to their decision criteria. However, a moderating effect occurs once ownership of the product transfers to the buyer. Known as the 'endowment effect', it holds that once a consumer has taken ownership of the product, the associated value also increases. The premise is that the amount people are

willing to pay for the product prior to ownership is less than they require to give it up (Thaler, 1980). Typically, this effect has been attributed to two different causes Kahneman et al., 1990; Novemsky and Kahneman, 2005). From an economic standpoint, it is assumed that people experience greater suffering giving up an object than they get from acquiring it in the first place. This is the 'loss aversion' explanation. By contrast, the psychology standpoint is that people want to hold on to an object because they see it as an extension of themself rather than the fear that giving it up will be all that painful. This is the 'ownership' explanation. However, recent research would suggest it is ownership that causes the endowment effect, as opposed to the concept of loss aversion (e.g. Morewedge et al., 2009; Beggan, 1992; Tsakiris et al., 2007). In the research by Morewedge et al. (2009), value of a product to be purchased was directly related to existing ownership of a similar product. When ownership was not present, value offered for the product to be purchased was lower.

Part of this influence stems from the fact ownership of an object causes the owner to treat the object as a social entity. Essentially, this is because ownership creates a psychological association between the object and the owner (Beggan, 1992). In situations where the object is not owned, simply touching an object can result in increased perceived ownership (Peck and Shu, 2009). Specifically, the value a person places on a product "is jointly influenced by the perceived ownership and the valence of the touch experience" (p434). Interestingly though, the physical interaction taking place doesn't necessarily have to be with the actual product in question. In a study by Brasel and Gips (2014) looking at the influence of computing devices on consumer perception, it was found subjects using touchscreen interfaces in an online shopping scenario reported increased perceived psychological ownership of the product, when compared to subjects that used a mouse and keyboard interface. In turn, this led to increased endowment effects. What is more, the effect of touch on human perception is so strong that simply imagining touching a product can have a positive effect on

perceived ownership (Peck et al., 2013). Given that touch or touch imagery can influence perceived ownership is indicative of a close association between the two. However, it once again opens the potential for an individual's 'Need For Touch' to influence the relationship.

As previously hypothesised (H1b), it is expected that a person's NFT will have a positive affect on the cross-modal relationship between touch and product colour. This is attributed to the fact people who are high NFT experience more confidence and less frustration about product choice and evaluation when they can physically interact with the product (Peck and Childers, 2003b). At the same time, though, the ability to touch a product can lead to an increase in affective responses for high NFTs (Peck and Wiggins, 2006).

To summarise, the theoretical flow is that actual ownership causes people to value an object more than when they are not owners. Even when legal ownership is not present, touching a product can create a feeling of 'perceived' ownership. As a result, there are two distinct pathways (ownership and touch) that influence an individual's perception of a product. Apart from this, a person's NFT has the potential to moderate any influence afforded when they are able to touch the product. For this research, what is envisaged is that once people take ownership of a product, the influence that touching the product has on perception of product colour will be positive for high NFTs. Effectively, ownership will have a positive influence on all, but touching a product will have a positive influence on high NFTs. As such, the following hypothesis is proposed:

- H2: In situations involving legal ownership, touch/no touch will have a positive/negative effect on an individual's evaluation of product colour (H2a), for those individuals that are high NFT (H2b).

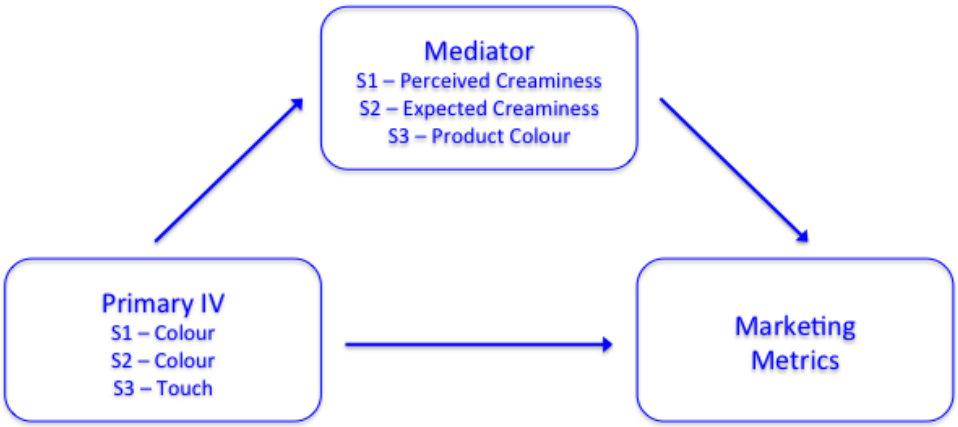
The proposed cross-modal interplay between colour, touch and ownership builds on existing theory from a range of disciplines. However, to ensure the relevance of this

research, identifying the role of these cross-modal effects in relation to marketing outcomes must also be a focus of this study.

Cross-modal effects on marketing metrics

When a consumer touches a product, a number of things take place to shape perception. At a sensory level, engaging the tactile modality can make it harder to pull attention away from a product (Spence, 2002). As a result, attachment levels increase so that a perceived level of ownership develops (Peck and Shu, 2009). The implications from this are that consumers will like the product more (Peck and Wiggins, 2006), will place a higher value on the product (Norton et al., 2012; Peck and Shu, 2009), will be more driven to purchase (Hultén, 2012) and be willing to pay more to acquire it (Brasel and Gips, 2014; Lessard-Bonaventure and Chebat, 2015). In addition, the fact the sense of touch is the antecedent for these affects means that a person's NFT is likely to influence the association between the variables. In Study 1 and Study2, the cross-modal colour-texture association was found to be a key component in consumers' evaluation of higher-order concepts like quality, purchase intent and likability. A summary of the cross-modal associations and their link to marketing outcomes is included in Figure 15.

Figure 15: Cross-modal associations and links to marketing metrics for Studies 1, 2 and 3



As the diagram shows, in Study 1 for all individuals the effect of colour on marketing metrics was mediated by the active role of 'perceived' creaminess when consuming a

food product. In Study 2, when subjects viewed a food advertisement direct effects were observed between colour and marketing metrics, however for low NFTs this relationship was mediated by 'expected' creaminess. In essence, when individuals only have to view and ad, as opposed to consume a product, the higher sensory sensitivity of high NFTs means they attend to the colour, without the need to develop or consider additional concepts. By contrast, low NFTs use the colour to formulate understanding of additional concepts, such as expected creaminess, and it is this that guides their responses to questions involving marketing metrics. However, the aim of the current study has been to examine the cross-modal role of touch in guiding evaluation of product colour and it is this relationship that will be tested against marketing outcomes.

Previous research by Shu and Peck (2011) proposed that affective reaction toward an object is an important mediator of valuation in the endowment effect. However, they measured affective reaction using the PANAS scale developed by Watson et al. (1988), which involves questions designed to measure positive (i.e. interested, moved, captivated) and negative (i.e. puzzled, irritated, annoyed) emotional reactions to a given product. For this study, the proposed mediator is the individuals' evaluation of (or affective reaction to) product colour. Because of this, we would expect the affect of touch on the evaluation of product colour previously hypothesised (H2) to have a direct effect on marketing metrics. However, we would also expect the high NFT sensitivity to colour stimuli observed in Study 2 will moderate the mediating affect of colour on the touch-marketing metrics relationship, creating a moderated mediation. As such, we propose the following hypothesis:

- H3: For high NFT individuals, the effect of touch on evaluation of marketing metrics will be mediated by the individual's evaluation of product colour.

Experimental Research

Study 3.1 – touch, no ownership

Selection of products

To guide the choice of products to be used in this study, a review of literature was undertaken to determine the types of products used in prior consumer research. The review provided a large number of potential products with a selection highlighted in Table 9.

From the review, a shortlist of five products (drinking cup, cutlery, marker pen, mouse pad and chocolate) was identified and a set of criteria was created to guide product selection. To align with the objectives of the study, three criteria were decided which relate to the touch and colour aspects of the products. They are:

1. Touching and handling the product had to be a normal part of product use
2. Any touch experience required of the product was to be primarily functional.
3. Colour had to be a commonly accepted attribute for the product type

With these criteria, the five shortlisted products were assessed against each item. First, if the normal usage situation didn't require customers handle the product, having them manually interact with the product during the experiment would be unnatural. Mouse pads can be visually quite striking, however this was seen as a product that is seldom handled directly. For this reason, the mouse pad was removed from consideration.

Second, handling of the product during use had to be more about utilitarian, goal-directed handling than about hedonic, pleasure seeking. This was to avoid any potential bias that might come about from handling products that were primarily designed for provoking a positive, affective response. For example, blankets, scarves or items of clothing are often selected for their 'feel'. While all four remaining products were deemed acceptable, additional consideration was given to the chocolate product.

However, while chocolate does have the potential to create powerful, highly affective responses, this is primarily in relation to consumption, as opposed to holding a foil-wrapped product. As such, it was maintained in the short list.

Finally, the products were assessed as to how commonly accepted colour is in each product category. The nature of the current study meant that the product colour (or foil packaging, as in the case of the chocolate) had to have a fundamental link to the product's appeal. As a result, the cutlery was removed from the list given metallic cutlery is usually silver and the use of plastic, coloured cutlery might have an unintended negative affective influence. As a result, three products (drinking cup, marker pen, foil-wrapped chocolate bar) were chosen and used for all experiments.

Table 9: Examples of products used in sensory research (Study 3)

Research	***Product***	***IV/DV***
Troye and Supphellen (2012)	Eating dish/cup	active engagement/ outcome evaluation
Spence et al. (2012)*	Cutlery	touch/taste
Rahman (2012)	Denim jeans	touch/functional attributes (i.e. weight) and abstract values
Piqueras-Fiszman and Spence (2012)*	Drinking cup	Colour/flavour and sweetness
Peck et al. (2013)	Koosh ball, Blanket	haptic imagery/perceived ownership
Norton et al. (2012)	Lego	touch & construction/product value
Klatzky and Peck (2012)	Perfume (viewed images)	touchability
Westerman et al. (2012)*	Chocolate packages	Package shape/aesthetic preference and purchase intent
Peck and Wiggins (2006)	Donation pamphlet	touch/'affective response' (likability, persuasion, interest and enjoyment)
Peck and Childers (2006)	Fruit	touch/impulse purchase
Peck and Shu (2009)*	Mechanical pencil, Playfoam	touch/perceived ownership and value
(Akamatsu and Sato, 1994)*	Mouse and Mouse Pad	Device Force Feedback/Selection task response times
Peck and Childers (2003a)	Sweater, Tennis racket	touch/NFT scale validity (accessibility of haptic information)
Kim et al. (2013)	Chocolate milk packaging	Fat content & brand name/ likability & purchase intent

** denotes source of shortlisted product option*

Participants

Participants for Study 3.1 were undergraduate and postgraduate students at a large university, who were randomly recruited through the university's ORSEE subject pool (Greiner, 2015) based on their willingness to participate. The sample consisted of 75 participants. Ages of the participants ranged from 18-26 with the mean age 20.02 years (SD=1.44).

Experimental manipulations

The study was a 2(touch/no touch) between-subjects design. The touch/no touch manipulation meant the 'touch' group was actively encouraged to pick up and manually explore all three products. The 'no touch' group was restricted from touching any products. To measure the participants' evaluation of product colour, Bottomley and Doyle's (2006) 'colour appropriateness' scale was adapted for use in this experiment.

Subjects saw the question "Thinking only about the product's colour, on the scale below, tell us how much you liked the colour of this product". Participants then rated the product in terms of its colour on a sliding 0-100 scale. The scale was anchored at 0 by 'not at all like' and at 100 by 'like very much'. Effectively, then, subjects rated their 'likability' of each product's colour. As a result, for the remainder of this paper, the term 'colour likability' will be used in reference to this measure. Finally, the subjects' haptic predisposition was measured using the composite 12-item 'Need For Touch' scale developed by Peck and Childers (2003a).

Data collection resulted in each subject providing responses for three different products. Because the focus of this research is the effect of touch on consumer evaluations of colour likability, individual differences between products were not included in the analyses. Instead, for each measure, responses for the three products were averaged for each participant and the mean used as a measure of central tendency (Wall and Heslop, 1986) based on experimental conditions. This resulted in a

single averaged measure per subject for each variable in the analysis (Abeele and MacLachlan, 1994). This procedure was used for all experiments within this study.

Procedure

The experiment was conducted in a dedicated experimental research laboratory at the university. Upon arrival in the laboratory, participants were randomly allocated workstations, where the Qualtrics survey instrument (www.qualtrics.com) randomly assigned them to one of two experimental conditions: no touch (n=39) and touch (n=36). All three products were located on a shelf above and behind the computer monitor. The three products included a plastic drinking cup, a plastic marker pen and a foil wrapped chocolate. All products were covered with a white paper cover and the covers were identified with letters (A, B or C). The order in which participants selected each product was fully randomised by Qualtrics. Participants in the touch condition were advised they were free to physically interact with and examine products when instructed. Participants in the no-touch condition were instructed not to touch the products in any way during the study. The average time to complete the survey was approximately thirty minutes. All subjects were given a $10 gift card for participating in the experiment.

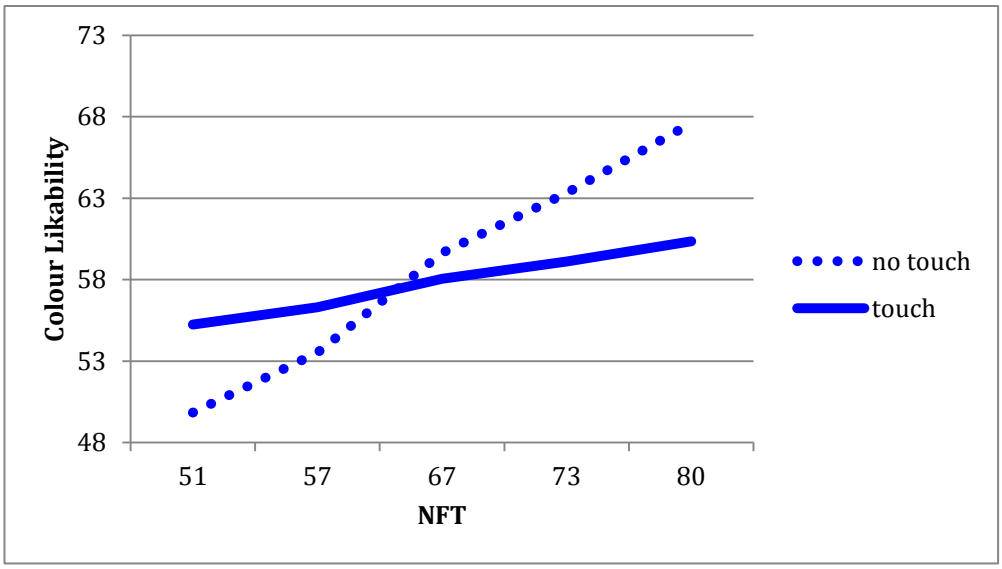
Results and discussion

To determine whether object interaction (touch) influences an individual's colour likability, conditional process modelling was undertaken using PROCESS plugin for SPSS (Hayes, 2013).

Results indicate (model 1, Hayes 2013) that the presence or absence of touch has no significant affect on an individual's colour likability, providing no support for the hypothesis (H1a). However, the data shows a significant effect of NFT (β =.61;SE=.27;t=2.21;p=.02) on respondent's colour likability, in support of the hypothesis (H1b). To further investigate the influence of NFT, data was analysed using

the 'pick-a-point' technique (Bauer and Curran, 2005) whereby values for the quantitative moderator (NFT) were defined at the 10th, 25th, 50th, 75th and 90th percentiles. Results are illustrated in Figure 16.

Figure 16: Influence of NFT in no ownership condition



When individuals are able to touch the products, there is little difference between subjects based on NFT. This is a somewhat surprising result, as it was expected those with a higher predisposition to touching objects would experience a more pronounced effect of physical product interaction. Instead, it is the inability to touch the product that appears to differentiate the groups. In effect, when physical interaction is unavailable, people call on their haptic predisposition to guide their judgement and assessment of product colour. Interestingly, results show an unexpected result, in that not only does a person's NFT appear to influence their sensitivity to visual cues, it has opposite effects on their response to product colour depending where on the NFT spectrum they lie. For example, Figure 16 shows us that for low NFTs (where NFT <57) the inability to touch, compared to when touch is available, has a negative influence on their colour likability. Conversely, the inability to touch sees high NFTs respond more favourably to product colour cues (i.e. they like the colour more).

The findings from Study 3.1 are somewhat mixed. On the one hand, they suggest there is no cross-modal link originating from the sense of touch, which influences the sense of vision (H1a). Despite that, when touch is unavailable, a person's NFT guides visual perception and colour likability (H1b). This fits with the findings from Study 1 and Study 2 of this thesis, where NFT was linked to a person's overall sensory sensitivity. However, it means the link between touch and vision is incomplete. Alternately, it may be that an additional factor not tested acts as the mechanism to activate the touch-vision cross-modal relationship. Based on previous research related to touch and the endowment effect (e.g. Thaler, 1980; Shu and Peck, 2007; Morewedge et al., 2009) one such variable is that of ownership. In fact, the extant literature shows that ownership and physical interaction are tightly linked and together will influence product evaluation. For this reason, Study 3.2 replicated 3.1, but altered the study by providing legal ownership of products to all subjects, irrespective of the touch/no touch condition.

Study 3.2 – touch and ownership

The objective of Study 3.2 was to identify whether legal ownership influences a person's evaluation of a product's colour attributes, as determined by physical product interaction.

Participants

Participants for Study 3.2 were undergraduate and postgraduate students at a large university, who were randomly recruited through the university's ORSEE subject pool (Greiner, 2015) based on their willingness to participate. The sample consisted of 75 participants, with recruitment open to all and no filtering criteria set for the sample. Ages of the participants ranged from 18-27 with the mean age 20.32 years (SD=1.71).

Experimental manipulations

For Study 3.2, participants were provided the same three products reviewed in the first study. They were advised that upon commencement of the study, they owned all products and would be free to take them upon completion of the evaluations. In addition to measures for colour likability and NFT, measures for four marketing metrics were recorded. Existing scales were used for expected pleasure (Sweeny and Soutar, 2001; α= .94), quality (Yoo, et al., 2000; α= .93) and purchase intent (Baker and Churchill Jr., 1977, α= .86) as well as the single item likability scale by Kanungo and Johar (1975). Experimental manipulations were the same as for Study 3.1 in all other respects.

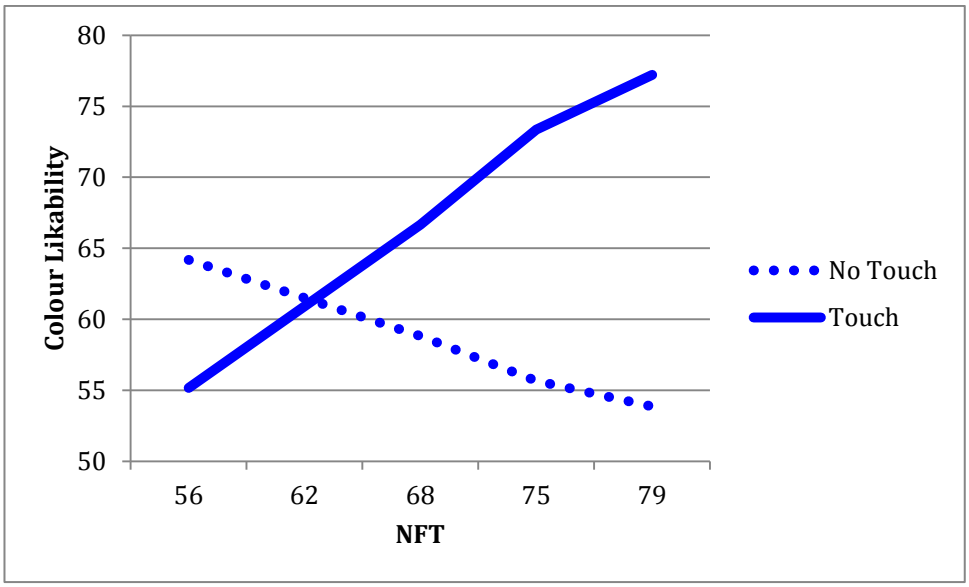
Procedure

For Study 3.2, subjects were randomly assigned to the touch/no touch conditions by the Qualtrics survey instrument: no touch (n=39) and touch (n=42). The procedure was the same as Study 3.1 in all other respects.

Results and discussion

Results show (model 1, Hayes 2013) that when ownership exists, physical product interaction (touch) has a significant cross-modal influence on colour likability (β=-66.70; SE=32.89; t=2.02; p=.04). To establish the moderating influence of a person's haptic predisposition (NFT), data was further analysed using the 'pick-a-point' technique (Bauer and Curran, 2005) whereby values for the quantitative moderator (NFT) are defined at the 10th, 25th, 50th, 75th and 90th percentiles. Results are shown in Figure 17.

Figure 17: Role of active touch and haptic predisposition in ownership condition



For high NFT individuals at the 75th (NFT=75; effect=10.35; SE=5.27; t =1.96; p=.05) and 90th (NFT=79; effect=14.46; SE=6.59; t =2.19; p=.03) percentile bands, the ability to touch the product results in subjects responding to colour cues in a more positive way, compared to when physical product interaction is not available. The findings provide two clear implications.

First, a comparison of Study 3.1 and Study 3.2 results indicates a different process is at work. Specifically, legal ownership enables the potential cross-modal effect between touch and vision. Secondly, the sensitivity analysis afforded by Bauer and Curran's (2005) 'pick-a-point' technique shows this cross-modal effect is moderated by a person's NFT. Essentially, as NFT increases, an individual's colour likability also increases.

In essence, in Study 3.2 the presence of legal ownership presents the opportunity for the cross-modal link between physical interaction (touch) and colour (vision). However, it is a person's overall sensory sensitivity – using NFT as a proxy – that moderates the effect. While these findings provide further understanding of cross-

modal perception and embodied cognition, further investigation was required to understand the impact of these effects in a marketing context.

Study 3.3 - Marketing metrics

The aim of Study 3.3 was to answer the 'so what' question. Specifically, does a person's 'colour likability' mediate the influence of touch on different marketing metrics?

Measures

Data for the marketing metrics was collected during Study 3.2. Existing scales were used for expected pleasure (Sweeny and Soutar, 2001; α= .94), quality (Yoo, et al., 2000; α= .93) and purchase intent (Baker and Churchill Jr., 1977, α= .86) as well as the single item likability scale by Kanungo and Johar (1975). A table outlining all scale items is included at Appendix 6.

Analysis

Mediation analysis was performed using PROCESS plugin for SPSS (Hayes, 2013). For each of the four marketing metrics, separate bias-corrected bootstrap models were created, with 10,000 bootstrap samples taken from the existing data, as per recommendations by Hayes (2015). This generated a 95% confidence interval, whereby mediation can be determined if zero falls outside the confidence interval, as per Preacher et al. (2007) and Zhao et al. (2010). For all analyses, Model 7 according to Hayes (2013) was used.

Results and discussions

The initial analysis shows the ability to touch a product has a significant, positive influence on a person's liking for the product colour. Surprisingly, touch has no direct effect on any marketing metrics other than purchase intent. That said, findings from Study 3.1 demonstrate no effect of touch on sensory level measures, so the fact touch has limited influence over cognitive constructs is plausible. However, the degree to

which a person likes the colour of the product does have a significant, positive affect on both expected pleasure and overall product likability. A summary of results is provided in Table 10.

Table 10: Mediation analysis (Study 3.3)

Dependent Measure	Colour likability	Quality	Purchase Intent	Pleasure	Likability
Touch	-66.70 (32.89)*	0.26 (0.15)	0.62 (0.27)*	0.41 (0.23)	0.38 (0.22)
NFT	-0.20 (0.26)				
Colour Likability		(.00) (.00)	(.00) (.00)	(.01)* (.00)	(0.01)** (.00)
	R^2=.07 F(3, 77)=2.00	R^2=.05 F(2, 78)=2.11	R^2=.07 F(2, 78)=3.29	R^2=.09 F(2, 78)=3.90	R^2=.15 F(2, 78)=7.03

** p<.05,**p<.01*

Results for each of the mediation analyses were then assessed according to Hayes' (2015) 'index of moderated mediation'. Assessment of the confidence intervals (whereby moderated mediation can be determined if zero falls outside the confidence interval) shows moderated mediation is observed for both pleasure (index=.01;SE=.01; CI=.0014 - .0391) and likability (index=.0196; SE=.01; CI= .0048 - .0473). No moderated mediation was observed for quality or purchase intent.

To further examine the moderating effect of NFT, the Bauer and Curran (2005) 'pick-a-point' technique was used for NFT with percentiles defined same as those in E3.2. Results of the moderated mediation analyses are shown in in Table 11.

Table 11: Moderated mediation analysis (Study 3.3)

Dependent Measure	NFT	Effect	S.E.	LLCI	ULCI
Quality	56	-0.04	0.04	-0.19	0.01
	62	-0.01	0.02	-0.10	0.02
	68	0.01	0.02	-0.01	0.12
	75	0.04	0.05	-0.01	0.20
	79	0.06	0.06	-0.02	0.26
Purchase Intent	56	-0.04	0.09	-0.37	0.06
	62	-0.01	0.05	-0.23	0.04
	68	0.01	0.04	-0.03	0.19
	75	0.05	0.09	-0.07	0.33
	79	0.07	0.12	-0.10	0.42
Pleasure	56	-0.08	0.08	-0.34	0.01
	62	-0.02	0.05	-0.19	0.05
	68	0.02	0.04	-0.03	0.17
	75	0.09	0.07	-0.001	0.31
	79	0.13	0.09	0.003	0.42
Likability	56	-0.17	0.13	-0.49	0.05
	62	-0.05	0.09	-0.25	0.12
	68	0.05	0.08	-0.08	0.26
	75	0.19	0.12	0.01	0.49
	79	0.26	0.15	0.03	0.64

Results show for pleasure, the mediating effect of colour likability is positive and significant for those individuals with a high (90th percentile; NFT=79) need for touch. However, given the confidence interval for the index of moderated mediation in relation to those in the 75th percentile (NFT=75) is predominantly positive and only just crosses zero, it suggests the moderating influence of NFT at the 75th percentile cannot be entirely ruled out, as per recommendations by Hayes (2015). Interestingly, the results for product likability may be more reflective of the moderated mediation effect, given that NFT has a significant, moderating influence at all levels of NFT above the 75th percentile (NFT>75).

The results provide partial support for the hypothesis (H3). The mediating effect of colour likability on both pleasure and likability may be due to them sharing some

underlying hedonic or aesthetic attribute. Clearly, colour has a profound psychophysiological influence on humans and it may be this corresponds, either at a semantic or emotional level, to concepts involving product likability and pleasure. This may also be a reason why the likability of a product's colour does not mediate the touch-quality relationship. In this respect, it may be the more complex, multi-dimensional nature of quality (e.g. Garvin, 1984; Dawar and Parker, 1994; Reeves and Bednar, 1994) results in meaning being constructed in such a way that colour likability is moved lower in the hierarchy of effects. Similarly, the lack of a mediation effect for (future) purchase intent may be due to the fact ownership had already passed to the subjects. In either case, further research and analysis may provide clearer understanding of the decision process in this respect.

General Discussion

The aim of Study 3 was to determine cross-modal influence originating in the sense of touch and extending to vision. In a series of experiments, the research examined whether physical product interaction influenced an individual's liking of a product's colour, and whether this sensory level perception influenced decisional level constructs such as quality, future purchase intent, pleasure and likability.

The findings of this research show that, on its own, physical product interaction has no influence on a person's rating of colour likability. Instead, individuals call on their haptic predisposition (NFT) to guide perception, particularly when touching the product is prevented. However, when individuals are given ownership of the products, the ability to touch the product has a significant, positive influence on those individuals who have a high haptic predisposition (NFT). These findings provide valuable insight into the nature of cross-modal perception and extend current knowledge on the endowment effect. Specifically, this research confirms findings by Morewedge et al.

(2009) that ownership moderates people's decision making. What is more, according to existing literature, this would appear to be the first indication that ownership is an activating agent for cross-modal effects between touch and colour (or colour likability) and that the cross-modal effect is multidirectional.

Previous research (Peck and Shu, 2009) on the endowment effect shows that when people touch products, their feelings of perceived ownership increase. This endowment effect is why retail staff and salespeople encourage consumers to hold or touch products. Essentially, physically touching a product, as opposed to not touching, sets the condition in which the typical endowment effect will occur. When this occurs, people will experience a level of attachment with the product that triggers both loss aversion and an endowment effect (Shu and Peck, 2011), whereby individuals are then more likely to attribute greater value to the product (Kahneman et al., 1990). The current study reorganised the typical (touch-perceived ownership-reaction) roles of antecedents and outcomes, whereby legal ownership was provided to subjects within the study. As a result, when ownership was transferred to individuals, the ability to touch a product resulted in a significant, positive response to colour likability, compared to when touching a product was not permitted.

While these findings link to previous research on embodied cognition and the endowment effect, they also indicate that for high NFTs, legal ownership, as opposed to no ownership, establishes the condition in which the cross-modal effect between touch and colour likability activates. In essence, it is the high sensory sensitivity of the high NFTs that allows them to construct meaning through dual pathways. That is, in a no ownership situation (Study 3.1), high NFTs do not differ greatly from low NFTs when they can touch the product. Conversely, when touch is restricted, they call on their haptic predisposition to guide sensory level perception (their liking for product colour). However, when legal product ownership (a cognitive construct) is transferred

to the individual (Study 3.2), being able to touch the product has a pronounced effect on high NFTs' sensory level perception of product colour. In turn, for high NFTs this sensory level perception then mediates the relationship between physical product interaction and higher-order concepts (pleasure and likability).

Apart from the key contributions this paper affords, there are still limitations to this research. One limitation is the small number of products used. While the current study employed products used in previous research, the large number of products in existence provides scope to expand the context. In addition, the current study used products that all had a low price point. To be sure, the large number of participants made this a costly exercise, however future research could examine whether price and perceived value play a role in the cross-modal relationships identified.

This research has a number of managerial implications. Firstly, it validates existing research on product interaction and endowment and shows that it is critically important to facilitate pre-purchase physical interaction with the product. Surprisingly, this may be more important for those consumers who are low NFT, as it would appear pre-purchase product interaction (before ownership has been transferred to the buyer) has a positive influence on their liking of product colour, when compared to situations when touching the product is unavailable.

The findings of the research also indicate a need to support the customer during the purchase or decision process, particularly in promoting the concept of product ownership. While the current study manipulated 'legal' ownership, it is possible that supporting or promoting 'perceived' ownership would alter the style of information processing for high NFTs when evaluating their liking for a product's colour. As such, future research could investigate whether psychological (perceived) ownership has the same ability to activate the cross-modal touch-colour effect as legal ownership. In addition, post-purchase communications that reinforce the benefits of sensory level

attributes are likely to influence post-purchase product evaluation for those consumers who have a high sensory sensitivity.

Epilogue

Overall Summary and Conclusions

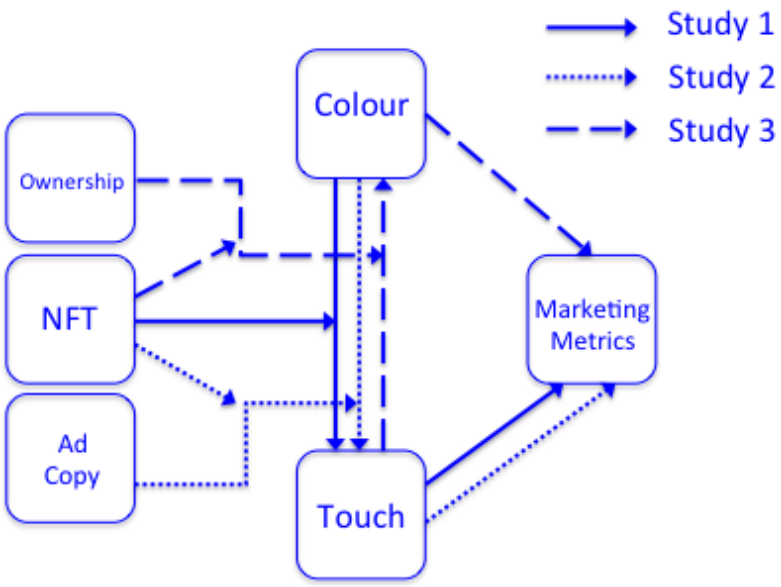
General Summary

Consumer decision-making is highly dependent on the different sensory modalities. Consumers want to look at, touch, taste, smell and listen to things they might bring into their lives. When they do, they will often integrate multiple sources of sensory information to create a single, unified, coherent and robust view of the external environment (Ernst and Bülthoff, 2004). Yet, existing evidence suggests the different sensory modalities do not necessarily operate independently in the integration process (Shimojo and Shams, 2001). Instead, each modality has the potential to influence perception in the other modalities, in what is known as cross-modal transfer (Rudel and Teuber, 1964; Hadjikhani and Roland, 1998). For example, the colour you see might influence the taste you experience, or what you hear might guide what you smell. This represents a critical challenge for marketers who dedicate vast resources to product development, packaging and marketing communications in a bid to engage consumers' senses. However, despite the fact in excess of US$40 billion is spent on market research around the world each year (ESOMAR, 2014), precious little is known about the potential cross-modal interactions between different sensory modalities, or their influence on consumer decision making. To address such gaps, this thesis set out to i) determine the presence of any cross-modal relationship between vision (colour) and touch ii) investigate the role of cross-modal colour-touch associations in an advertising context iii) examine the multidirectional nature of the relationship between touch and colour. Collectively, the three studies in this thesis allow the robustness of the cross-modal relationship to be examined in different contexts and provide scope to investigate the influence of different moderators and mediators in the decision-making process.

First, we identified existing theory involving cross-modal perception. Forming the theoretical underpinning of this thesis was the broad body of literature on

synaesthesia. Synaesthesia is a condition whereby a 'cross-modal' stimulus in one sensory modality (such as vision), results in a concurrent experience in another modality (such as touch) (Ramachandran and Hubbard, 2001; Ward and Mattingley, 2006). Typically, this condition was thought to affect a very small percentage of mankind. However, recent research points to a growing body of evidence that cross-modal correspondences are seen across the general population (e.g. Kayser and Logothetis, 2007; Sagiv and Ward, 2006). What is more, recent theory posits that we all lie somewhere on a cross-modal spectrum (Spence, 2011; Bien et al., 2012) and it is this that provided the scaffold upon which the conceptual framework was developed. As such, Study 1 investigated the influence of colour on the sense of touch. To assist the reader, Figure 18 is a full conceptual model outlining the key variables used in the three studies within this thesis. The primary research objectives throughout this thesis have involved the cross-modal associations between colour and touch. Thus, to remain concise, the following summary and discussion focuses on these two variables. The remaining variables are discussed in Key Contributions.

Figure 18: Summary of conceptual models for Studies 1, 2 and 3



The initial research design considered three factors - research context, colour manipulations, touch measures - that were fundamental to the study. In terms of research context, a review of extant literature shows that much of the research on cross-modal effects of colour is dominated by studies that involve food or consumption of food products. To be consistent with - and more easily link to - existing research, the focus of the study was to investigate the influence of colour in relation to food products. To determine the necessary colour manipulations, the three different components of colour (hue, saturation and brightness) were assessed in relation to their use in existing consumer research. Hue is defined as "that attribute of certain colors which permits them to be classed as red, yellow, green, blue and their intermediaries" (Judd, 1940; p543). Of the three components, hue was found to be the most commonly manipulated colour attribute in the extant literature. Moreover, there was a skew towards the use of red and blue hue as independent variables (IVs) throughout (Bellizzi and Hite, 1992). For this reason, and "due to their positions at opposite ends of the visual spectrum" (Study 1; p32) red and blue were used as the primary colour IVs. Finally, measures relating to the sense of touch in a food context were required. For many people, the most obvious way to describe a food is to comment on its flavour. Importantly, flavour is defined (ISO, 2008) as a combination of taste, smell and oral 'somatosensation' (touch), where oral somatosensation allows an individual to identify and assess food textures. Two of the more commonly discussed textures in the literature are creaminess and crunchiness (Szczesniak and Kahn, 1971). While vision may play a part in the initial identification of food texture, creaminess and crunchiness were chosen because they are independent dimensions that contribute to what is termed 'mouthfeel' (Guinard and Mazzucchelli, 1996) and typically link to evaluations of pleasantness (Antmann et al., 2011), importance (Szczesniak, 1971), appearance and flavour (Elmore et al., 1999). Key outcomes from Study 1 are presented in detail in the contribution section. However, the primary finding from this study was that colour (red

and blue) influences perceived creaminess and crunchiness when consuming a food product. This evidence provided the foundation for Study 2, in which the colour-touch associations were examined in a food advertising context

Food advertising is big business. The global food industry is valued in excess of US$7 trillion (IFC, 2014) and estimates provided in Study 2 based on US 'revenue-to-ad spend' ratios of 10% (Statista, 2015) indicate US$ 700 billion is spent around the world each year on food advertising. As such, it is likely that consumers are regularly evaluating food products and making purchase decisions in situations where consumption does not occur. In terms of print advertising, for example, this would mean situations where only visual cues are provided. Because fewer stimuli are provided for other sensory modalities, product colour will stand out and be attended to while viewing. When this happens, the same cross-modal effects of colour experienced during food consumption are likely to be experienced by consumers viewing an advertisement. The key finding from Study 2 confirmed cross-modal colour-texture effects are observed when consumers view print advertising. Together, Study 1 and 2 provide clear evidence of a (unidirectional) cross-modal association whereby colour (red/blue) influences what is perceived in the sense of touch (creaminess/crunchiness).

In Study 3, the research explored the possibility the cross-modal colour-touch effect is multidirectional. The human sense of touch is a powerful force in shaping perception. It has been shown to influence a person's liking for the product (Peck and Wiggins, 2006), the value they place on the product (Norton et al., 2012), their intention to purchase (Hultén, 2012) and how much they are willing to pay (Brasel and Gips, 2014). Yet, there appears to be a dearth of literature investigating the influence of touch on perception of colour. Such tactile-vision associations have been observed in cases of synaesthesia (Simner and Ludwig, 2012) but not in the broader population. However, both

synaesthetes and non-synaesthetes have been shown to share a range of mechanisms that may facilitate such multidirectional cross-modal effects involving colour (Simner et al., 2005). The synaesthetic tactile-vision associations investigated by Simner and Ludwig (2012) involved synaesthetes experiencing vivid, concurrent colours when touching an object, or observing others touching an object. These vivid, concurrent experiences are what Martino and Marks (2001) term 'strong' synaesthesia. Such vivid colour experiences were not anticipated, or observed, in the non-synaesthete population. Instead, a form of 'weak' synaesthesia was proposed whereby the act of touching a product would influence how much an individual also liked its colour. The key finding from Study 3, where the research was conducted without focusing on food or food consumption, is that under certain conditions (i.e. where legal ownership exists) touching and tactile manipulation of a product has a positive influence on an individual's likability of the product's colour. The following summary of key contributions presents the most important theoretical and managerial outcomes from this research.

Key Contributions

Theoretical Contributions

Perception, information processing and mental activity is grounded in sensory experience (Krishna and Schwarz, 2014). By extension, these sensory experiences are what shape consumer attitudes and behaviour. Because of this, it has been suggested that "products are sensual in nature" (Krishna, 2011; p1) and that marketers should use this to increase consumer engagement.

In many ways, this already occurs. Logo and brand design, product development, packaging and advertising rely on sensory stimuli to communicate information to the consumer. For example, repetitive exposure to brand colours lets consumers develop colour preferences and brand associations through a suite of experiences (Grossman

and Wisenblit, 1999). In a marketing context, such learned understanding of colour is an important consideration for manufacturers as it often links to consumer evaluations of brand and product. However, the effects of colour can be both learned and developmental. That is, the effects can be innate, biological, rather than learned through experience (Labrecque et al., 2013). This is particularly important in the modern global economic environment, where cultural and transnational influences (that are learned) are likely to shape consumer responses to colour. By contrast, the identification of embodied, biological responses to colour that transcend cultural or national boundaries will provide marketers valuable knowledge in global markets. Consequently, this research contributes to existing literature by examining the developmental, innate cross-modal effect of colour on the sense of touch. Previous research (Tom et al., 1987) has shown colour saturation influences perceived texture of food products. Specifically, that different 'shades' of brown custard influence perceived creaminess. However, the current research examined the role of different hue (red and blue) and found they correspond with perceived creaminess and crunchiness during consumption. The findings fit with the framework developed by Labrecque et al. (2013) and confirmed cross-modal interactions between colour and product texture are both embodied and automatic. According to current literature, this appears to be the first indication that hue has a cross-modal effect on the sense of touch. A number of important observations were also made in conducting the first stage of this research. First, the colours appear to have a bias towards the hedonic role of expected creaminess. That is, when actual product texture is more creamy, red appears to suppress the perceived crunchiness, rather than increase the perceived creaminess. However, when the actual product texture is crunchier, red food colour amplifies the perceived creaminess. Essentially, there appears to be a threshold at which point the colour and the actual texture of the food interact to guide perception of 'perceived' texture. These findings demonstrate the link between vision (colour) and touch

(perceived texture) is much closer than literature suggests. Moreover, they provided the basis for the second stage of the research where the cross-modal colour-touch effects are examined in an advertising context. Overall, the findings from the second stage of research extend theory and show that, in print advertising, red and blue product colouring link to product creaminess and crunchiness. Thus, the initial research identified the cross-modal effect and demonstrated the influence of product colour on 'perceived' creaminess and crunchiness when consuming food. The subsequent studies demonstrated the cross-modal effects are evident in advertising where colour influences 'expected' creaminess and crunchiness. Overall, the research has contributed to the knowledge on colour and its interaction with other senses. In addition, it has contributed to the body of knowledge involving the sense of touch.

For many people, "touch plays an important, if often under-acknowledged, role in our evaluation/appreciation of many different products" (Spence and Gallace, 2011). It can make people feel more positive about their environment (Burgoon et al., 1992; Goldman et al., 1985) or more positive and affectionate towards the people around them (Hornik, 1992; Mehrabian, 1981). In a consumer setting, it has been shown to positively influence confidence in product selection (Peck and Childers, 2003b), willingness to tip (Crusco and Wetzel, 1984), compliance (Hornik and Ellis, 1988), perceived product aroma (Cliff, 2001) and taste (Krishna and Morrin, 2008). Because of touch's importance in decision making, previous research by Peck and Childers (2003a) created the 'Need for Touch' (NFT) scale, which was developed to measure individual differences in preference for haptic (touch) information. The current research examined the role of NFT in relation to cross-modal perception. In situations where food products were consumed, NFT was found to amplify the interaction between colour and food texture. This is a key contribution to existing theory, in that it is the first indication haptic sensitivity (NFT) influences cross-modal transfer of information. What is more, while vision is considered the most important sense in

many situations (Schifferstein, 2006a), the current research suggests the sense of touch has a central role in receiving and processing sensory stimuli across other modalities. These findings were applied in a print advertising scenario, where NFT was shown to influence consumer expectations of product texture. When language (ad copy) components were included in the advertisements, it was found that apart from influencing the sensory effects of colour, NFT also moderated the influence of ad copy on the cross-modal effect. These effects are illustrated in Figure 19.

Figure 19: Three-way interactions between colour, ad copy and NFT

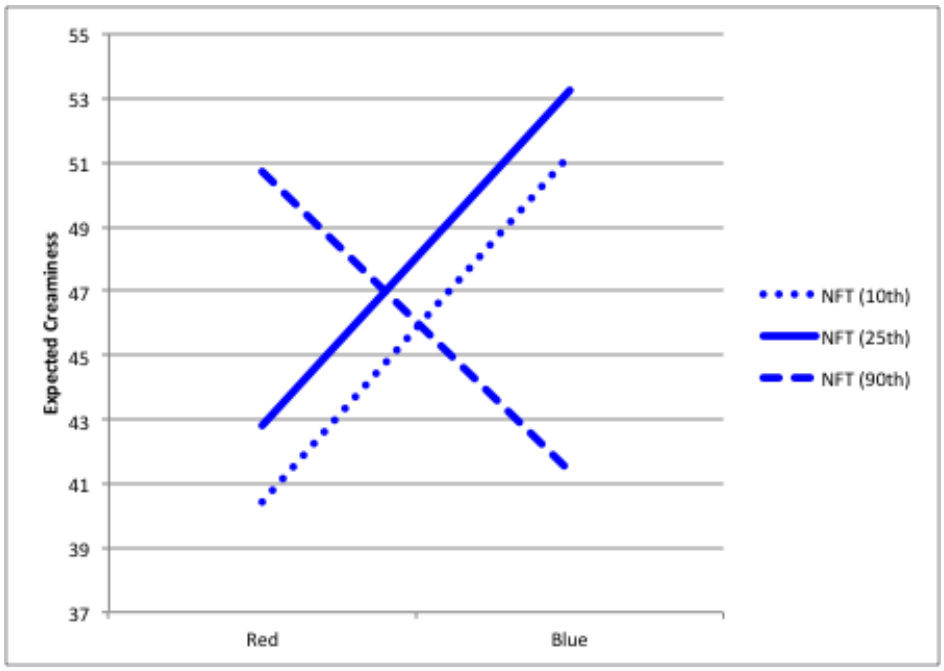


Figure 19 shows when low NFTs (10th & 25th percentiles) view ads with blue products, they report the product as having higher level of expected creaminess, compared to when viewing ads with red products. Conversely, high NFTs (90th percentile) who report red products as having a higher level of expected creaminess. This is a significant contribution to existing theory, in that the research demonstrates low NFTs are not necessarily any less sensitive to sensory stimuli, but they process the information in a way that creates a very different response. More specifically, the cross-modal effect of colour on expected creaminess is moderated by ad copy. We then see a

conditional three-way interaction between colour, ad Copy and NFT, whereby individuals at different ends of the NFT spectrum respond to colour cues in opposing fashion. The thesis also contributes to existing theory by examining the multidirectional nature of the relationship between colour and touch. There is some limited evidence of the multidirectional cross-modal effect, but this is primarily in research involving synaesthesia. Our findings show that both touch (tactile manipulation of a product) and a person's NFT influence their liking for a product's colour. In situations where an individual does not legally own the product, it is in fact NFT that differentiates responses to colour likability, rather than whether people can touch or not touch the product. However, when ownership is transferred to individuals, the ownership activates the cross-modal effect of physical touch on colour likability and this is more pronounced for those with a high haptic predisposition. This appears to be the first indication, according to current literature, that ownership moderates the cross-modal transfer of information.

Managerial Contributions

Sensory perception is the foundation for information gathering and decision-making. Because of this, it has been suggested the five human senses should be situated at the centre of a firm's marketing strategy and tactics (Hult et al., 2009). The premise is that "the more firms can create, accentuate, or highlight the sensuality of their products, the more appealing these products can be for consumers" (Krishna, 2011; p1). The direct effects of sensory stimuli on consumer attitudes and behaviours discussed throughout this thesis are clearly powerful. However, "from a managerial perspective, sensory marketing can be used to create subconscious triggers that characterise consumer perceptions of abstract notions of the product" (Krishna, 2012; p332). The studies in this thesis have demonstrated such 'subconscious triggers' involving interactions between sensory modalities, and it is these cross-modal effects that shape consumer perceptions of abstract notions relating to marketing outcomes. As such, colour has

been shown to influence both perceptions and expectations of (food) product texture. Colour also influences perception and expectations of product quality, purchase intent, pleasure and likability. However, for some people, their predisposition to using touch information (NFT) means colour has both a direct and indirect effect on such marketing metrics. In effect, when considering food products, both the perception and expectation of product texture, in particular creaminess, are key determinants for the marketing outcomes.

To allow for this, marketers need to ensure the meaning (both learned and developmental) conveyed by colour is considered in product development, packaging and marketing communications. Failure to do so may cause unintended consequences on consumer attitudes and decision-making if the interactions between colour and other sensory stimuli are not accounted for. For example, the role of colour must be considered at the very embryonic stage of product development to ensure the chosen colour palette is congruent with the learned and biological responses expected during product use. This is because the findings from the current research open the door for colour to be used more extensively as a cross-modal communication tool. For example, in situations where modality specific product attributes (such as texture) can be highlighted by altering product colour. Similarly, such considerations need to extend across the whole product suite of packaging and ancillary products to maintain consistency across the brand experience. At the same time, the role of colour and text (advertising copy) and the way these inputs interact to influence the target audience must be a focus in any communications plan. Finally, depending on the product category, the retail setting and the potential for any product testing or physical manipulation by clients must be front-of-mind for marketers, as this has been shown to influence consumer decision-making.

Limitations and Future Research Opportunities

Opportunities exist to expand on this research. One limitation was the use of a small selection of products. The objectives of the initial research (Study 1) meant products had to be suitable in small portions, stable during experimental conditions, and had to be conducive to colour manipulations. As such, products that had a semi-liquid base were used, such as custard, yoghurt, sour cream and mayonnaise. Two categories considered for this research but not used - ice cream and chocolate - hold promise for future studies. To some extent, this was addressed in Study 2, where food advertisements involved the use of more solid products, such as muffins and cakes. Effectively, both Study 1 and Study 2 could use the type of product from the other study. Thus, for future research, Study 1 could be run using more solid consumables (such as cakes or muffins), while Study 2 could be run using images of semi-solids, such as yoghurt and custard. In all, there appears to be a dearth of literature involving cross-modal effects in advertising in relation to most, if not all, of the five cardinal modalities. A large body of literature has been identified throughout this thesis that signals the effect of colour on taste and smell when consumption takes place. Studies that apply these findings to an advertising context would provide valuable insight into cross-modal sensory perception and its affect on sensory expectations and consumer decision-making. Similarly, there appears to be scope to further the understanding of cross-modal effects in relation to product packaging and point-of-sale collateral.

Further research may also consider the link between sensory marketing, social policy development and social marketing. The 'sensuality' of products that Krishna (2011) speaks of may be a potent mechanism that can be used to promote consumer wellbeing, for example in the promotion of organic foods and healthy eating, or to limit the negative consequences of consumption, as may be the case with alcohol and cigarettes. This last point is rather topical in social marketing. In the time it took to undertake the studies for this thesis, the results have been presented at various international

conferences. An interesting, common point in feedback received is whether this research involves anything to do with cigarette packaging or smoking cessation. Clearly, the role of colour and visual cues in cigarette advertising are well documented. However, initial investigation would suggest there is very limited research that covers cross-modal effects in tobacco advertising or the presence of any 'subconscious triggers' proposed by Krishna (2012).

Finally, as a complete body of work, this thesis provides scope to investigate current definitions of flavour. The existing definition (ISO, 2008) indicates taste, smell and touch (oral somatosensation) are combined to create a multisensory experience which we typically refer to as flavour. Of the three flavour components, colour has been shown to have a significant influence on both taste (e.g. Koch and Koch, 2005; Harrar et al., 2011; Van Doorn et al., 2014) and smell (Morrot et al., 2001). This thesis demonstrated colour also influences touch or oral somatosensation, the third flavour component. As such, additional research involving colour and touch in relation to food products would provide further evidence that colour may be included as the fourth dimension of flavour. This would have potential implications for food product development, packaging and food advertising.

In conclusion, together, the three studies within this thesis provide a comprehensive examination of the cross-modal associations between vision (colour) and touch. Essentially, clear evidence is provided that shows the cross-modal influence of colour on the sense of touch. The robust nature of the cross-modal association is demonstrated where these effects are shown to persist in an advertising context. Finally, the relationship between colour and touch was shown to be multidirectional and occur across a range of products outside the food category. Overall, the findings have provided greater understanding of sensory perception and an insight into the

mechanisms that shape consumer decision-making, in ways that can continue to be meaningfully researched.

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Appendices

Appendix 1: List of published papers

Journals

Chylinski, M., Northey, G., & Ngo, L. V. (2015). Cross-modal Interactions between Color and Texture of Food. *Psychology & Marketing, 32*(9), 950-966.

Note: The conceptual development, study design, data collection and writing was primarily handled by G.Northey. Assistance with the design and analysis was provided by M.Chylinski and L.V. Ngo.

Conference Proceedings

NORTHEY, G. & CHYLINSKI, M. 2012. Touching the Void – Satisfying the Consumer Need For Touch Through Auditory Stimuli. *In:* LEE, R. (ed.) *Australian and New Zealand Marketing Academy Conference.* Adelaide, Australia: Ehrenberg-Bass Institute for Marketing Science.

NORTHEY, G., CHYLINSKI, M. & NGO, L. 2013. What colour do you feel? Cross-modal interactions between colour and touch. *Australian and New Zealand Marketing Academy Conference.* Auckland: ANZMAC.

NORTHEY, G., CHYLINSKI, M. & NGO, L. 2014. Creamy red and crunchy blue? How colour interacts with perceptions of texture. *European Marketing Academy Conference - EMAC 2014.* Valencia, Spain.

NORTHEY, G., YOUNG, L., SPANJAARD, D. & CHYLINSKI, M. 2015. See, Feel, Do: The cross-modal effects of colour in food advertising. *Australian and New Zealand Marketing Academy Conference.* Sydney, Australia: ANZMAC.

Appendix 2: Study 1 - Ingredients and formulations

	Studies 1-2				Studies 3-4			
	Creamy Red	Crunchy Red	Creamy Blue	Crunchy Blue	Creamy Red	Crunchy Red	Creamy Blue	Crunchy Blue
Product A:								
Yoghurt (g)	1000g	1000g	1000g	1000g	1000g	1000g	1000g	1000g
Muesli (g)	100g	400g	100g	400g	100g	400g	100g	400g
Red (ml)	19ml	19ml	19ml	1.9ml	1.9ml	1.9ml	1.9ml	1.9ml
Blue (ml)								
Product B:								
Custard (g)	1000g	1000g	1000g	1000g	1000g	1000g	1000g	1000g
White Choc (g)	200g	400g	200g	400g	200g	400g	200g	400g
Red (ml)	19ml	19ml	19ml	19ml	1.9ml	1.9ml	1.9ml	1.9ml
Blue (ml)								
Product C:								
Mayonnaise (g)	1000g	1000g	1000g	1000g	1000g	1000g	1000g	1000g
Pine Nuts (g)	100g	300g	100g	300g	100g	300g	100g	300g
Red (ml)	19ml	19ml	19ml	19ml	1.9ml	1.9ml	1.9ml	1.9ml
Blue (ml)								
Product D:								
Sour Cream (g)	1000g		1000g		1000g		1000g	
Light Yogurt (g)		1000g		1000g		1000g		1000g
Almond Flakes (g)	300g	300g	300g	300g	300g	300g	300g	300g
Red (ml)	19ml	19ml	19ml	1.9ml	1.9ml	1.9ml		
Blue (ml)							1.9ml	1.9ml

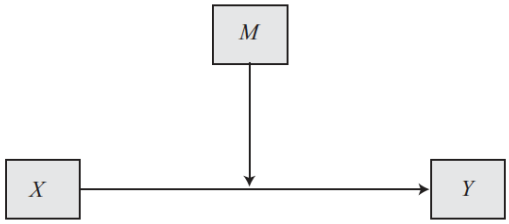
Appendix 3: Study 1 - Multivariate GLM on aspects of flavour

†Results show the mean estimate and the standard error in brackets.

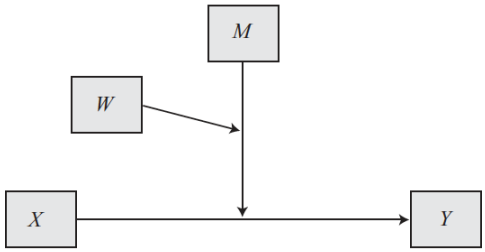
		Custard and Chocolate			Mayonnaise and Pine Nuts			Full Cream Yoghurt and Muesli			Lite Yoghurt and Muesli		
	Study	1	2	3	1	2	3	1b	2	3	1a	2	3
Taste	Salty		7.20	6.24		52.42	56.78	16.89		23.78	18.29		24.28
			(2.11)	(1.11)		(2.17)	(1.11)	(1.46)		(1.11)	(2.06)		(1.11)
	Sweet		83.14	85.66		18.37	12.28	30.27		16.17	21.19		15.08
			(1.97)	(0.94)		(2.03)	(0.94)	(1.64)		(0.94)	(1.97)		(0.94)
	Bitter		2.57	2.99		10.68	15.18	15.21		21.47	10.08		17.10
			(1.50)	(1.06)		(1.55)	(1.06)	(1.52)		(1.06)	(1.62)		(1.06)
	Sour		3.65	4.55		35.47	42.53	50.66		62.35	63.86		59.19
			(2.28)	(1.31)		(2.35)	(1.31)	(2.12)		(1.31)	(2.59)		(1.31)
Smell	Milky		59.58	59.07		23.72	22.09	37.87		28.79	37.01		35.62
			(2.37)	(1.26)		(2.44)	(1.26)	(1.91)		(1.26)	(2.62)		(1.26)
	Vanilla		61.41	61.51		10.32	10.56	21.03		16.12	17.93		15.43
			(2.14)	(1.05)		(2.21)	(1.05)	(1.56)		(1.05)	(2.06)		(1.05)
	Egg		18.06	19.21		32.40	29.84	13.26		14.39	12.22		17.67
			(2.53)	(1.10)		(2.60)	(1.10)	(1.25)		(1.10)	(1.59)		(1.10)
	Sour Cream		9.28	7.84		56.42	45.13	52.46		58.38	63.92		63.24
			(2.42)	(1.40)		(2.40)	(1.40)	(2.15)		(1.40)	(2.72)		(1.40)
	Nutty		14.75	17.28		46.04	49.76	44.76		42.25	39.88		54.27
			(2.46)	(1.41)		(2.53)	(1.41)	(2.04)		(1.41)	(2.93)		(1.41)
	Chocolate		49.23	46.81		2.56	3.12	4.92		3.26	2.46		3.33
			(2.42)	(0.93)		(2.50)	(0.93)	(0.73)		(0.93)	(0.42)		(0.93)
Texture	Hard		23.91	15.71		15.96	19.38	14.97		17.81	30.94		35.39
			(2.24)	(1.14)		(2.30)	(1.14)	(1.51)		(1.14)	(2.63)		(1.14)
	Soft		65.02	61.15		66.03	53.66	66.83		57.63	50.43		45.11
			(2.84)	(1.40)		(2.92)	(1.40)	(2.00)		(1.40)	(3.21)		(1.40)
	Oily		23.53	24.93		51.09	61.17	19.19		25.79	18.09		31.46
			(2.82)	(1.32)		(2.91)	(1.32)	(1.67)		(1.32)	(1.94)		(1.32)
	Watery		35.72	44.87		23.44	25.74	25.78		26.04	31.31		23.26
			(2.69)	(1.33)		(2.77)	(1.33)	(1.80)		(1.33)	(2.44)		(1.33)
	Gummy		23.34	23.73		22.56	26.01	37.69		34.69	21.49		25.49
			(2.63)	(1.37)		(2.71)	(1.37)	(1.90)		(1.37)	(2.56)		(1.37)

Appendix 4: Hayes Process Models

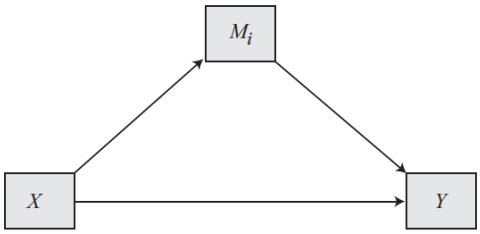
Model 1



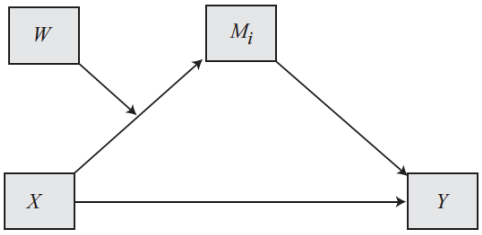
Model 3



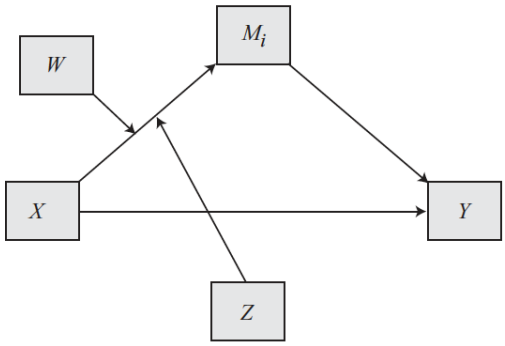
Model 4



Model 7



Model 9



Appendix 5: WSU Ethics Approval

Locked Bag 1797
Penrith NSW 2751 Australia

Office of Research Services

University of Western Sydney

Our Reference: 13/004233 | H10129

HUMAN RESEARCH ETHICS COMMITTEE

9 May 2013

Professor Louise Young
School of Business

Dear Louise

I wish to formally advise you that the Human Research Ethics Committee has approved your research proposal **H10129** *"Crossmodal Haptic Associations in Language, Vision and Audition"*, until 31 December 2013 with the provision of a progress report annually and a final report on completion.

Please quote the registration number and titled as indicated above in the subject line on all future correspondence related to this project.

This protocol covers the following researchers:
Louise Young, Daniela Spanjaard, Gavin Northey

Yours sincerely

Associate Professor Anne Abraham
Chair, Human Researcher Ethics Committee

Appendix 6: Scale items

Scale	Items
NFT (Peck & Childers, 2003)	When walking through stores, I can't help touching all kinds of products
	Touching products can be fun
	I place more trust in products that can be touched before purchased
	I feel more comfortable purchasing a product after physically examining it
	When browsing in stores, it is important for me to handle all kinds of products
	If I can't touch a product in the store, I am reluctant to purchase the product
	I like to touch products even if I have no intention of buying them
	I feel more confident making a purchase after touching a product
	When browsing in stores, I like to touch lots of products
	The only way to make sure a product is worth buying is to actually touch it
	There are many products that I would only buy if I could handle them before purchase
	I find myself touching all kinds of products in stores
Likability (Cox & Cox, 1998)	I like the product
	How pleasant is the product
	How likable is the product

Quality (Yoo, Donthu & Lee, 2000)	The product is of high quality
	The likely quality of the product is extremely high
	The likelihood that the product would be functional is very high
	The likelihood that the product is reliable is very high
	The product must be of good quality
	The product appears to be of very poor quality
Pleasure (Sweeny & Soutar, 2001)	This product is one that I would enjoy
	This product would make me want to (use) crave it
	This product is one that I would feel relaxed about (using) eating
	This product would make me feel good
	This product would give me pleasure
Purchase Intent (Baker & Churchill, 1977)	Would you like to try this product
	Would you buy this product if you happened to see it in a store
	Would you actively seek out this product (in a store in order to purchase it)