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Sensory marketing and the cross-modal correspondences: The effect of product colour on the perception of product odour

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Declaration

I hereby declare that this dissertation is the result of my own independent investigation and that all sources are duly acknowledged in the reference list/bibliography. It is not substantially the same work as any that I have submitted, or, is being concurrently submitted for a degree or diploma or other qualification at the University of Economics in Prague or any other University or similar institution except as declared in the Acknowledgements and specified in the text.

I further state that no substantial part of my dissertation has already been submitted or, is being concurrently submitted for any such degree, diploma or other qualification at the University of Economics in Prague or any other University or similar institution except as declared in the Acknowledgements and specified in the text. This dissertation contains fewer than 60,000 words excluding the appendices, bibliography, footnotes and tables.

In Prague, date:2019

Signature.....

Table of contents

Chapter 1	Introduction of the dissertation topic	10
1.1	Introduction	10
1.2	Dissertation Map.....	14
1.3	Aims and objectives of this research study	17
1.4	Research questions	18
1.5	Significance of the study	19
Chapter 2	The contextual background	22
2.1	Defining the terms	22
2.2	From experiential marketing to sensory marketing.....	26
2.3	The history of olfaction in marketing	29
2.4	An introduction to scent marketing	31
2.5	The odour classification.....	33
2.6	What affects the odour perception?	35
2.7	The Implications from the Chapter 2.....	37
Chapter 3	The origins of cross-modal correspondences and brain processing theories.....	39
3.1	The origin is in the brain.....	40
3.2	Emerging theories about brain information processing relevant for marketers.....	41
3.3	Embodied cognition.....	45
3.4	Memory and knowledge formation theories.....	46
3.5	Multi-sensory information processing.....	49
3.6	The Implications from the Chapter 3.....	50
Chapter 4	The principles behind consumer choices related to sensory perception	51
4.1	Perception	52
4.2	The role of priming in perception.....	54
4.3	How does priming work?	56
4.4	Classification of priming	58
4.5	Cross-modal priming classification	59
4.6	Priming and sensory marketing	62
4.7	The effect of colour and odour on human behaviour	62

4.8	Cross-modal correspondences between colour and odour.....	66
4.9	Expectations.....	70
4.10	The Implications from the Chapter 4.....	73
Chapter 5	Implications for the study	74
5.1	The introduction summary.....	74
5.2	Contextual background.....	75
5.3	Classification of odours – intensity and types	75
5.4	The factors affecting preference of odours.....	76
5.5	Origins of cross-modal correspondences.....	77
5.6	Sensory memory	77
5.7	The principles of perceptory bias	78
5.8	The effect of colour and odour on behaviour	78
5.9	Cross-modal correspondences – previous findings	80
5.10	Expectations.....	80
5.11	Conclusion and implications from the literature review.....	81
Chapter 6	Describing the Methods, Hypotheses and Ethics.....	82
6.1	Introduction	83
6.2	Adopted methodology	87
6.3	The hypotheses	89
6.4	Ethics	91
6.5	Proposition 1.....	93
6.5.1	Participants, procedure, stimuli and data analysis.....	93
6.6	Proposition 2.....	94
6.6.1	Participants	94
6.6.2	Ishihara colour blindness test, anosmia test and the procedure of sampling	94
6.6.3	Colour and odour characteristics	96
6.6.4	Stimuli	98
6.6.5	Proposition 2: The procedure	99
6.6.6	Statistical methods and collected data	99
6.7	Proposition 3.....	99
6.7.1	Participants, procedure, stimuli and data analysis.....	99
6.8	The experiment	100
6.9	Participants	100

6.10	Stimuli	101
6.11	Task and experiment procedure.....	102
6.12	Statistical methods	103
6.13	Summary of Chapter 6.....	104
Chapter 7	Empirical results and discussion.....	105
7.1.1	Proposition 1: The Results.....	105
7.1.2	Proposition 2: The Results.....	108
7.1.3	Proposition 3: The Results.....	112
7.1.4	Conclusions from the results of the first three propositions.....	115
7.2	The Experiment – The Results	116
7.2.1	The Preference ratings of Czech nationals	117
7.2.2	The Intensity ratings of Czech nationals	120
7.2.3	The Preference ratings of Czech and Slovak nationals together	122
7.2.4	The Intensity ratings of Czech and Slovak nationals	125
7.2.5	The Preference ratings of Slavic nationals	126
7.2.6	The Intensity ratings of Slavic nationals	129
7.2.7	Specific colour and odour combinations that increase or decrease the preference ratings.....	130
7.2.8	The factors that affect preference ratings	136
7.2.9	Which type of congruency had the highest score of preference ratings?	139
Chapter 8	Conclusions from the Proposition 1, 2 and 3 and the Experiment....	142
8.1	H1: Cross modal correspondences between colour and odour exist	143
8.2	H2a: The perceived fragrance preference ratings are affected by colour.....	144
8.3	H2 _b : The perceived fragrance intensity ratings are affected by colour	146
8.4	H3: Semantically congruent cross-modal correspondences increase perceived preference ratings	147
8.5	H4: One of the association models will predict the data results more precisely and therefore would be amenable to be used as a generalisation tool	148
8.6	H5a: Individual colour preference might affect the preference ratings significantly if applied to culturally consistent participants	149
8.7	H5 _b : Gender might affect the preference ratings significantly if applied to culturally consistent participants	149
8.8	Conclusion summary	150

Limitations and future directions of the research	153
Chapter 9 Limitations	153
9.1 Limitations of the experiments – participants, the environment and the procedures	153
9.2 Limitations of the data analysis	156
9.3 Future directions of the research	157
References.....	160
List of tables	178
List of figures.....	180
List of appendices.....	182
Appendix.....	183

The Topic of the Dissertation

Sensory marketing and the cross-modal correspondences: The effect of product colour on the perception of product odour

Abstract

The purpose of this dissertation is to investigate the role of colour on the perception of odour by measuring the a) preference and b) intensity of 16 possible combinations of 4 coloured bottles and 4 odours as rated by 297 participants (130 males and 167 females). The two-way ANOVA for preference revealed that the role of both – colour and odour is significant for Czech participants, but the significance increases with the cultural homogeneity as for Slavic nationals, the colour and odour did not play a significant role in their preference ratings. In contrary to previous research, the effect of colour and odour on intensity ratings was not significant. Linear regression analysis then showed that gender is also a significant factor and males are generally more prone to give higher preference scores by 5.58 % than females to colour and odour interactions. On the other hand, a choice of preferred colour did not affect the preference scores. In addition, several types of congruencies between colour and odour were proposed. It is argued that one of these types (perceptual, semantic, mixed) reflect the decision-making about preference levels more precisely. As a result, it has been demonstrated that intuitive congruent pairings of colours and odours (such as lemon and yellow) do not increase the preference ratings among consumers. Instead, the mixed semantical-perceptual congruency corresponds significantly to the collected data. This approach could simplify product testing methods where the colour and odour are deemed to be selected variables.

Keywords:

Sensory marketing, cross-modal correspondences, odour, colour, multi-sensory processing, preference

Chapter 1

Introduction of the dissertation topic

This part introduces the topic of sensory marketing and highlights its importance on real examples. The benefits and risks of so-called congruency of product characteristics are illustrated. The role of company in product innovation is stressed and explained in detail. The selected method of research is presented in a comprehensive manner.

1.1 Introduction

Taste, touch, olfaction, hearing and vision are the five senses that collectively form the perception. Some would claim that this is rather simplistic description since there are also other senses such as detection of balance or the ability to sense hot and cold. In any case, it is crucial to note that more than 90 % of all information is being processed on the subconscious level in the brain (Zurawicki, 2010). This is essentially why it is important to also know the concepts of sensory marketing and deriving concepts of customer expectations, priming, perception and theories which are still in the process of wider acceptance and verification about how our brains operate. The mechanisms behind cognitive processing, human behaviour and sensory perception remain heavily studied, but still relatively unexplored. Considering the total advertisement expenditure worldwide is forecasted around 500 billion dollars annually (Statista, 2018), the potential of a field that can inform companies about how to attract their customers based on their subconscious preferences is inconceivable. Unlocking at least some patterns that form decision-making about preference might be the key to better understanding of consumer behaviour.

This is where new approach of targeting customers comes into play in a form of sensory marketing, which is closely connected to a continuous trend towards shopping experience in which post materialist consumers look for more excitement and sensation in life (Datamonitor, 2008) through products. Some recent studies claim that the new generation Z (people born after the year 1995) prefer from 60 % rather cool products than cool experience (Walgrave, 2015), highlighting the product development importance in the future. If a company does not innovate the current portfolio, new

and more flexible companies might potentially decrease their market share or even endanger their existence.

Thus, it is crucial that marketers know the underpinnings that drive consumers' choices and which, unavoidably, force companies to adapt. An understanding of how our senses operate and how cognitive processing is related to marketing can largely affect the development of new products, redesigning of packaging, attempts to enter new markets or compete more effectively in current markets (Milotic, 2001). Therefore, it comes as no surprise that sensory marketing might serve as a tool to convey the correct message about a product by enhancing product characteristics, while at the same time managing to potentially mislead customers. Together with the advancement of new technologies, e.g. virtual reality, these tendencies will be probably increasing and the consumers will demand more sophisticated forms of communication and presentation of individual products.

Although brands have inconsiderable power over products, they also need to acknowledge that not all the products that pass through their process, are also successfully implemented into consumers lives and more importantly – minds. In fact, there is an ongoing myth in marketing that the product failure rate is around 80 %. However, relatively recent research suggests that the rate is lower, in fact somewhere around 40 % of failed, but launched products (Castellion & Markham, 2013). Despite this, when searching for unsuccessful products online, it is still possible to find an extensive portfolio of products. Among others, there are several examples of products from well-known companies that did not resonate well with their manufacturing brand.

The foremost examples include Facebook Phone or colourless Pepsi. Both examples have clearly something in common – the consumers possibly need some correspondence between the brand and the product. It seems that the Facebook brand is somehow associated with the lack of privacy and hence, a personal mobile phone branded by Facebook was not a success. Similarly, Pepsi was neither as healthy, nor coloured as water and it did not match the consumer expectations, so the product was discontinued within months from launching. Of course, there are alternative explanations such as low investment in marketing of the product, low quality of the product, the number of competitors in the market or price that could have resulted

or at least contributed towards the product's failure. While the classic marketing perspective generally supports rational arguments, and in the case of a glass of ultimate whisky, it should not matter whether it is served in sharp or rounded glass, numerous studies still show the opposite (Lintellè, 2014). It is suggested that some choices might not be a pure coincidence and there might exist scientific based explanations.

In principle, a company does not have a choice not to provide sensory aspects because they are always present. However, a company can pre-select those attributes or choose to ignore them. The reason to research the field more is that there is an entirely new wave of managers who are paying more attention to the role of sensory aspects and experiential factors when designing new marketing strategies due to mounting pressure on improving market share (Wirley-Birch, 2013). Corporations tend to invest substantial amounts to new ways of maintaining or enhancing profits. Key roles in this process are assigned to product innovation, unique ways of product sale and one of the greatest remaining challenges, i.e. to attract, satisfy and sustain customers.

There are multiple ways of attracting the attention of a customer utilising sensory stimulants such as scent. Initially, it can be distributed within a specific environment, inside the product or packaging or on the product or packaging itself. Interestingly, scent is being applied to the products which do not necessarily need to be scented (e.g. nail enamels). In the United States, California Milk Processor Board decided to launch a new campaign, where they accompanied the printed text "Got milk?" by artificial scent of cookies. The authors of the idea wanted to create emotions of nostalgia over this stereotypically childhood memory through scent that was emitted at 4 bus stops in San Francisco. However, people complained and the adverts had to be removed due to allergies, health concerns and some people even claimed that the advert is unethical because it might be experienced by homeless people who do not have the resources to purchase food (Cuneo, 2006). Despite the heavy criticism, due to numerous generated reactions the adverts have reached unintended press coverage. However, it also demonstrates that scent might be – at least in some cases – a source of negative consumer attitudes.

Wolfe & Busch (1991) created a hierarchy of importance of scent which indicates that scent importance is based on the product category. Scent is the most important factor for soft beverages, body lotions or skin care products and also household maintenance

and cleaning products. Furthermore, scent has been an effective way of differentiation of a product and also serves as an improvement for products that primarily do not possess any scent. It seems that, in practice, the role of scent has been acknowledged and it is now important to understand the role of scent for a consumer also in theory.

In a very general manner, this introduces the topic of the dissertation which aims to find out what is the effect of a certain combination of colour and odour on the product preference and whether those modalities can somehow correspond and result in greater favourability of the product. In other words, is the consumers' preference rating affected by the combined effect of colour and odour? For example – would lemon scent smell better in yellow packaging as opposed to green or purple one? Moreover, is there any pattern that can be identified and perhaps applied in marketing practice?

Although previous research studies have provided significant and extensive evidence to prove the so-called cross-modal correspondences (the term will be explained later in greater detail) between the senses, there is still a significant gap in the literature when it comes to the respective correspondences between vision and olfaction. Also, the effect of cross-modal correspondence on preference ratings has not yet been experimentally verified to the best knowledge of the author.

In order to investigate the colour-odour effect on preference and intensity ratings, an experimental methodology has been adopted. The independent variables (the colour and odour) are manipulated and the dependent variable (the effect on perceived preference or intensity) is measured; any extraneous variables are controlled (MacLeod, 2012). The physical settings of the experiment are controlled to allow for possible replication. Because of the outline of the experimental design, a quantitative approach appeared to be the most suitable for the data interpretation. In addition to experimental methodology, the research was accompanied by both, paper and online questionnaires similar to the Implicit Association Test (Greenwald et al., 1998) in order to define certain compatibility or congruency effect between colour and odour. Various propositions of certain combinations of colour and odour that resulted from the collected data were analysed and compared to the preference levels in the experiment.

The results of a set of propositions and an experiment presented in this study might be useful for brand managers, marketers, product designers and anyone interested in the aspects that affect the consumers attempting to make a purchase of a product (managers, executives, small entrepreneurs etc.). The results could potentially lead to increased sales and loyalty of specific product with colour and odour characteristics. In addition, the propositions and the models derived from them might have direct implications in product testing methodology.

The presented overview justifies the study of sensory marketing which provides a fresh perspective on the challenges that corporations face. Moreover, the research of consumer behaviour is a continuous process that is never ending much like the development of society and new emerging trends. The importance of understanding what drives consumers to a specific choice is crucial. The ability to predict some of these drivers might ease the decision-making process for the companies in what to invest in the future. An academic discussion on this topic is an essential starting point.

1.2 Dissertation Map

This overview summarises the content of the chapters and it could aid the navigation and orientation in the text. The findings are presented in the Chapter 7. Subsequently, Chapter 8 presents all the results in light of the hypotheses and formulated research questions.

Chapter 1 introduces the reader to the problem and explains in a general manner the field of the research and its potential. Moreover, the foremost examples of sensory marketing are provided. The introduction considers the justification of the benefits of the study, as well as defining all the key terms with an emphasis on practical examples. The aims and objectives of the study are clearly stated and research questions are formulated. The significance of the study is explained in greater detail and the groups or individuals of the society who might take advantage of the key study results are specified.

Chapter 2 starts with the literature review which consists of 4 sections, administered also as chapters for the ease of the reading. At first, the research outlines the background with an overview of the concept of experiential marketing and explains

how sensory marketing might be seen integrated in the concept of targeting and hence form one part of marketing strategy. Then, the focus of the thesis shifts towards scent and history of olfaction is briefly discussed. This is further supported by contemporary examples of scent marketing in practice. Furthermore, the existing systems of classifications for odours are introduced and the factors that could affect the perception of odour are debated.

In **Chapter 3**, the processes of brain functioning are expounded. The sense of smell is further described in light of neurophysiology and its close connection to memory and emotion is briefly discussed in the light of consumer behaviour. The role of brain processing is highlighted in relation to consumer behaviour and emerging theories about human perception are reviewed. In addition, the multi-sensory information processing is explained in a manner sufficient for marketers and the opposing views are presented together with the latest application of the Bayesian method; which partially explains the selective process of predominant use of certain sensory information.

Finally, **Chapter 4** provides an extensive review of certain principles that may affect human sensory perception. The effect of colour and odour on human behaviour provides a complex, but not exhaustive evidence of past research. The key concepts that form sensory marketing are explained such as perception, sensation, expectations, cross-modal correspondences and priming. All the former terms might play an important part in consumer behaviour and better understanding of the processes that underline overall perception forms the basis of the propositions and the experiment.

Chapter 5 summarises the findings from the literature review in light of their implications for marketers and for the study. The term congruency is introduced and the types of possible perceived congruencies between the colour and odour are identified. This should clarify the reasoning behind the first three propositions which will serve as minor results that help to prove the stated hypotheses.

Chapter 6 clarifies the research design. The methodology is divided into two parts – theoretical and practical. The theoretical part consists out of introduction and description of adopted methodology. Most of all, the hypotheses are explicitly stated. Last part describes the ethics procedures and the issues that resulted from risk assessment are discussed. This allowed to prevent the risks throughout the experiments in order to protect the participants' safety.

The practical part of Chapter 6 starts with section 6.5 and is subsequently dedicated to the description of the experimental procedures and forms the practical part of the methodology. The selection of the participants, the selection of colours and odours, the stimuli, the process of colour blindness identification and inability to smell (anosmia) are precisely described for each of the experiments as it slightly differs.

Chapter 7 finally focuses on the findings from the three propositions and the experiment. For each proposition, the results are presented (semantic, perceptual and mixed congruencies) in a form of frequency analysis. Chi-squared test (henceforth denoted as χ^2) and Cramer's V coefficients are stated in order to assess the dependency of the variables and their strength. The methods of data analysis are described in greater depth. Finally, the process of the experiment is conferred. The results are presented for Czech respondents; Czech and Slovak respondents together and all Slavic participants. Each time, ANOVA, frequency analysis and a graph are presented for both rated variables – preference and intensity. Then, linear regression model is used in order to show the exact combinations of colours and odours that either decreased or increased the preference ratings significantly. The factors such as gender and favourite colour are also analysed in terms of their importance in preference ratings tendencies. Finally, the collected data are compared to the data which were collected from the three propositions (semantic, perceptual and mixed) and to the statistical type (which occurs in the nature) and those 4 propositions are evaluated in terms of their reliability, i.e. their accuracy to predict consumer preference ratings.

Chapter 8 then summarises the key results from the three propositions and the experiment in order to point out the most applicable and important results for both -marketing science and the practitioners. These results are discussed in light of the literature review and answer the formulated research questions. Each hypothesis is discussed separately. Non-exhaustive conclusion offers a short overview of the raised issues and some recommendations for marketing science and practitioners are presented.

Finally, **Chapter 9** focuses on the limitations during the experiment procedures and offers some directions for future research.

Clearly, the very last sections consist of the list of cited literature, list of figures, list of tables and a list of appendices.

1.3 Aims and objectives of this research study

This section defines the key objectives of the research study. In the conclusion, the objectives will be evaluated in terms of their accomplishment.

The main purpose of this dissertation is to investigate the role of colour on the perception of odour by measuring the perceived preference and intensity ratings. Furthermore, the aim is to inspect the compatibility effect of specific odours and colours that affect the preference ratings positively and examine the pattern which might explain the higher preference ratings of certain colour and odour combinations. This is highly relevant to marketers who have to decide about a combination of certain odour and colour and would like to support their decision by research rather than rely on intuitive or affective choices. Furthermore, the best research method when it comes to estimations of the preference of product colour and odour might be suggested.

If we ask the respondents about the preference and intensity of odour in differently coloured perfume bottles, will the ratings differ when the same scent is packaged in green or yellow bottle? Will the respondents be affected by their perceived relation of orange colour and orange scent and rate for instance orange in purple bottle lower with regards to intensity and preference? Are there any cultural or gender differences that affect the results significantly? Given that product's scent is lately seen as an improvement on regularly odourless products, it appears adequate to research more consumers' behaviour and understand the role of different types of associations in relation to consumer preference. Which type of associations play a major role in possible prediction of the preference ratings – is it the ones that we perceive through sensory modality or the ones that we store in semantic form? The three propositions (minor results) will be compared to the data obtained from the main experiment in order to propose a model of congruency between colour and odour that describes the preference ratings data results more accurately.

In order to evaluate the accomplishment of the key objectives, they must be precisely defined. The first two objectives form an inherent part of the thesis by reviewing the current literature on the topic. However, the last two objectives are the key objectives of the research study.

The objectives of this study reflect the research questions as follows:

- I. Reviewing and synthesising existing knowledge on sensory marketing with the focus on understanding the consumer behaviour (resulting in review on deriving concepts of human brain processing, perception, expectations, priming, decision-making and cross-modal correspondences);
- II. Performing a distinct literature review to identify key factors that affect colour and odour perception;
- III. Investigating the role of a combined effect of colour and odour in relation to consumer preference and perceived intensity ratings;
- IV. Investigating different types of congruencies and explaining their respective role in preference ratings with regards to colour and odour.

1.4 Research questions

This section explicitly states 2 formulated research questions which will be further examined by the research in more detail by the verification of the hypotheses. Both research questions will be answered by the end of this thesis.

The primary motive behind this study is to examine the concept of cross-modal correspondences and their relation to preference. In total, 3 propositions and one experiment which will be described in detail in the methodology chapter were designed to answer the central research question (RQ):

RQ1: Does the colour of the packaging play a significant role in the consumers' perception of scent considering:

- a) Intensity?
- b) Preference?

Second research question resulted from the large amount of collected data which could be analysed and also interpreted through statistical software and the results might be potentially also beneficial for practitioners. This question is formulated as follows:

RQ2: Are there any significant factors that affect the perception of scent in differently coloured packaging (gender, nationality, preferred colour, association types) considering:

- a) Intensity
- b) Preference

1.5 Significance of the study

In essence, this section illustrates the importance of the verification of the hypotheses for all stakeholder groups. In addition, it illustrates the current directions of innovations in marketing that might increase the importance of this study in the future.

Possible implications of this study might affect the manner companies look at sensory marketing in general, increase the importance of marketers in the product development or innovation department and also help managers allocate their budget in a more informed way. From the theoretical point of view, the types of associations and their respective role with regards to consumer preferences might affect further research. Should the type of association classified as perceptual, mixed or semantic play an important role in determining consumer preference, it might simplify the consumer behaviour research methods due to possible predictions. In other words, it might be possible to deduct which type of associations modify describe the human decision-making process and impact preference ratings, at least applied to product colour and odour.

Moreover, the need to conduct further research in this field is highlighted by the fact that there are already some commercial laboratories exploring the possibility of designing universal tools that are able to transfer the olfactive experience (for instance the Nakamoto laboratory in Figure 1 or Sensonics International). In 2014, a company called ScentWorld organised a conference about the need of incorporation of scent to marketing strategies and attracted over 52 brand managers from brands such as Victoria's Secret, Hilton Worldwide, Bulgari or Disney (ScentWorld, 2014) declaring an interest in such innovations. The advancement of technologies would open a completely new dimension of internet commerce, in which the users would be able to smell the product when online and without leaving their home. There are also several

mobile phone applications in development (i.e. oPhone) which, although still awaiting mass-production, appear to be functional (Nelson, 2014). However, most of the tools have not yet reached commercial success due to the limited amounts of scents they are able to transmit to the user (Carulli, Bordegoni & Cugini, 2015). One of the already existing examples is the use of emitted scents in the cinema called 4DX™ technology that provides a sensory experience. Some companies manufacture commercial tools (e.g. AromaJet) that might include scent in gaming experience, can be used in market research or enhance the experience in e-commerce (MicroFab, 2018; Figure 2).

Should such solutions exist, would the use of certain colours of packaging with specific scents (for example when selling any unspecified product online) enhance preference ratings and would the choice of colour and odour play a role in consumer perceived preference? Similarly, is intensity of the fragrance enhanced by some colours? The application of the findings is not conditioned by the existence of high-tech solutions, but can be extended to every scented product with coloured packaging. First of all, and in order to answer all the questions, it is important to begin with outlining the previous research of cross-modal correspondences and summarise previous findings related to colour and odour.

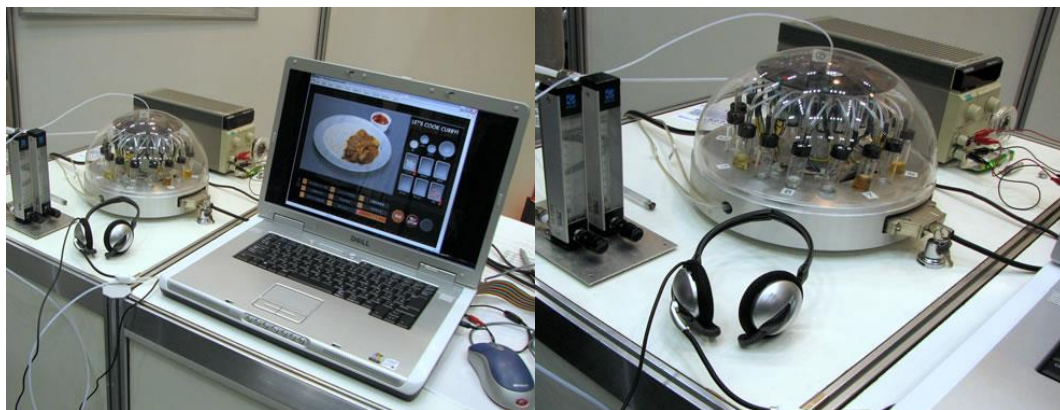


Figure 1: Nakamoto laboratory tool for digital transmission of scent

Source: Nakamoto lab (2013)



Figure 2: AromaJet tools for scent emission

Source: MicroFab Technologies, Inc. (2018)

Chapter 2

The contextual background

Before presenting the literature review, it is important to outline and define the terms used throughout this thesis. The terms cross-modal correspondences, cross-modal priming or sensual transference were defined in various fields and there are some differences in their understanding. Therefore, the terms are clarified as defined by their original creators from attributing fields. There are many other definitions formed in sociology, psychology or biology which all refer to similar effect when one percept affects in one way or another the other percept. An example might be a broader term Halo effect (Thorndike, 1920), which is sometimes also used in marketing and is described as a form of cognitive bias. However, the difference is that the effect used in the thesis refers only to the interaction between two sensory inputs and therefore other terms might be more suitable.

Subsequently, the theoretical trajectory of sensory marketing is outlined as it has originated from experiential marketing. The history of using scent in marketing is also presented. With some practical implications for the research, the section about odour classification demonstrates the lack of scientific approaches to measurement of odour characteristics. Then, the factors that affect odour perception are examined as found in the literature.

This section provides a more general overview of the topic before elaborating further on the brain processing theories and perception. Despite this, all the sections are highly relevant as the clarification of the terms in sensory marketing or odour classification are either missing or not heavily studied topics in the reviewed literature.

2.1 Defining the terms

Sensory marketing

Sensory marketing is a topic of emerging importance because of the high competitiveness in the current markets, product innovation requirements, and customer demand for sensational experiences. The term sensory marketing refers

to the characteristics of products, things or even services that might impact our further sensory input.

Krishna (2012, p.332) defines the term as "*Marketing that engages the consumers' senses and affects their perception, judgment and behaviour*". A much broader definition has been formulated by Filser (2003) who suggests that sensory marketing can play a fundamental role in meeting the needs and expectations of modern-day consumers:

"A group of key levers which are controlled by the producer and/or by the distributor to create a specific multi-sensory atmosphere around the product or the service either by focusing on sale outlet environment or product environment, and the communication or characteristics of the product itself."

As mentioned in the introduction, the examples of product sensory stimulation are countless. For instance, would the chocolate in golden packaging taste better? Is the size, weight, material or colour a significant factor in consumer selection, decision-making and repurchasing? More examples will be presented through this literature review.

Sensation transference

Professor Aradhna Krishna came up with the new term *sensation transference* in the field of marketing which means that "*one sense has the ability to impact another one, and hence is capable in some cases of affecting the sensation*". To understand this term, it is important to highlight the example of Pepsi and 7-up. When Pepsi decided to change the logo of 7-up cans from their traditional green logo to include slightly more yellow saturated components, customers who had a dedicated loyalty to this product began to complain that the taste of the new cans is lemonier, yet the product and its recipe of the new cans was identical to the taste and composition of the old version of 7-up (Lintellè, 2015). An additional example that demonstrates the power of sensational transference involves margarine (Zaki, 2013). Margarine is naturally white and not yellow, and this was the primary reason that margarine used to enjoy very low popularity in the 1940s. However, as soon as this product adopted a more yellow colour – that resembled butter – customers could not identify much difference in the taste between the product and butter. Subsequently, packaging

in foils – much like butter packs – enhanced the perceived quality of the product, thus rendering it commercially very successful. In conclusion, this term refers to the observation of the joined effect of the attributes of a product (Lintellè, 2014) that has the ability to affect perception.

Cross-modal correspondences

Alternatively, professor Charles Spence at Oxford University has begun to study the effects of *cross-modal correspondences* in psychology with some direct implications to food industry. It could be translated as the existence of certain sensory connectivity in human perception which can be commonly found and somehow corresponds with each other (for instance how shape affects the taste). The term *cross-modal correspondence* used in this study refers to a "*compatibility effect between attributes or dimensions of a stimulus (i.e., an object or event) in different sensory modalities (be they redundant or not)*" as defined by Spence (2011). Not all cross-modal correspondences can be explained purely by associative learning – such as the association of yellow packaging with lemon scent. The possible schemas of different types of associations behind cross-modal correspondences will be introduced later in this thesis. It could be summarised that the study of cross-modal correspondences are somehow more inclined to resolve the questions behind the effects (based on numerous studies confirming the effect), rather than focusing only on the description of the issue.

There is an extensive number of researchers that dedicated years to the investigation of both phenomena (for example Aradhna Krishna and Charles Spence). The only difference in both terms is that the former originated from marketing and focuses on how the product sensory attributes affect actual sensations. The second term originated more from psychology and covers broader scope of research, not limited only to products. Usually the papers about cross-modal correspondences originate from fields of neuroscience, psychology and information processing. Therefore, the literature review conducted in the following chapter intends to provide an up-to-date overview of these revelations that relate to the two senses which are the core subject of this study – vision and olfaction. Moreover, all the presented information was selected with an emphasis on deepening the understanding of consumer behaviour in relation to sensory processing.

Priming

Furthermore, there are other concepts which might influence human perception and subsequently, the perception and sensation of a product. One of these concepts is *priming*, which could be defined *as exposure to an initial stimulus becoming subsequently the trigger of a response to another stimulus in a process that occurs both subconsciously and unintentionally*. As will be explicitly explained further, priming and cross-modal correspondences and sensation transference might sometimes interfere, although the definitions of various researchers sometimes exhibit minor changes with regards to the extent of the effects. In this thesis, cross-modal correspondences may be viewed as sub-part of priming.

The concept of cross-modal correspondences originates from psychology; instead priming, despite being discussed also in marketing, rooted from language studies. In marketing, it is often linked to a product; in psychology to multi-sensory processing and in language it is commonly used to deduce brain functions, specifically related to memory. In order to illustrate the possible interchangeability, imagine a person inside a store who has the intention of purchasing a washing powder without any specific brand in mind. During this, the in-store radio plays an advertisement that a washing powder of a specific brand has launched new (and possibly better) packaging. The consumer might not even notice the advertisement consciously, but it might contribute to faster visual identification of the primed product on the shelf. The effect of priming on consumer behaviour (whether the product is finally purchased or not due to priming effect) is still a source of controversy (Bargh, 2006), although some researchers have come to positive results as will be demonstrated on examples later. This effect might be, more specifically, also grouped under the term *cross-modal priming* (Larsen & Scherer, 2011) since it involves auditory prime and this fastens the reaction time of finding adequate visual percept (here the product which was primed through auditory stimuli). Although there are many more definitions of priming, this example appears to be the most relevant for this thesis due to its connection to sensory modalities.

Other definitions consider priming effect to be purely the difference between reaction times with and without prime. For instance, cognition theorists defined priming

as *"the effect of changing the ability to identify or produce a word or an object after a previous exposure to the item"* (Schacter and Tulving, 1990).

Expectations

The second concept by which we are often influenced is expectations. As defined by Oliver (1980), *"expectations are a certain frame of reference based on which it is possible to make comparative judgments"*. Another simple definition when considering a product might be a strong belief that something has or should have certain attributes. This is highly relevant in relation to sensory aspects as it might affect the final perception and lead either to disappointment or arousal.

Novelty

In addition, the perceived *novelty* of sensory combination might also play a role in consumer decision-making. The exposure to previously unknown stimuli might result in both – favourable attitudes, but also the negative ones. The possible explanation will be discussed later in Chapter 3 as it is related to brain processing.

The links between all the aforementioned paradigms and how they affect consumer behaviour in relation to sensory processing (at least to the current knowledge) should be clearer by the end of the literature review. However, even between the researchers, there are no universal definitions and whilst one might agree that priming effect consists of more than accelerated reaction times, the others might not. All previously stated terms might be the key to understanding the complexity of consumer behaviour in relation to sensory perception.

2.2 From experiential marketing to sensory marketing

Experiential marketing (EM) is based upon customers becoming involved with a product through an experience created by the company (Mathurs, 1971). In the literature, it is often seen as one way of targeting; and sensory marketing forms an inseparable part, or perhaps a completely new direction, depending whether sensory input can be classified as a form of experience. Previous research also indicates that although sometimes it is hard to measure, experiential marketing enhances the positive experience by the added value provided to the consumer (Babin, Darden & Griffin 1994; Holbrook, 1999) and increases the potential for building loyalty (Pine & Gilmore,

1998; Gobé, 2001). There has been an evident shift towards EM in the past (Bowden, 2009; Grönroos, 2007; Hollebeek et al., 2011; Rust, Lemon, & Zeithaml, 2004; Schmitt, 1999) and it is of interest to overwrite the experience of competition in the most remarkable way through the audience's own engagement. Contrary to traditional marketing, it is suggested that EM targets customers' emotions and therefore generates a greater impact (Zaltman, 2003).

Achrol & Kotler (2012) summarised the key changes in the marketing paradigm (Table 1) which propose a completely new direction that focuses on understanding consumer behaviour and orientation towards senses. Rather than pure service delivery, companies are trying to amaze their customers by novel approaches and enriched experiences. Therefore, and instead of trying to satisfy customers, it appears essential to exceed customer's expectations by creating sensory stimulants. However, in most cases, the use of sensory stimulants adhered to products and advertising is still rather intuitive, and not based on experimental results.

Table 1: Key changes in the marketing paradigm according to Achrol & Kotler (2012)

Received paradigm	Emergent paradigm
Consumer satisfaction	Consumer sensations and sense-making
Cognitive psychology of behaviour	Neurophysiology of consumer behaviour and sensory experiences
Products as "delivered services"	Products and services as sensory experiences

Source: Achrol & Kotler (2012)

Additionally, the concepts of customer experience and also customer experience management are increasingly gaining attention (Pine & Gilmore; 1999). Schmitt (1999) specifies that EM can provide 5 different customer experiences and initiate potential actions (Table 2).

Table 2: Schmitt's (1999) 5 experiences that a company can provide

• SENSE – the provision of sensory experiences
• FEEL – provision of affective experiences
• THINK – provision of creative cognitive experiences
• ACT – physical experiences, behaviours and lifestyles
• RELATE – experience of relation to specific social group or culture

Source: Schmitt (1999)

This table suggests that sensory marketing should be viewed as one of the five EM aspects, instead of a completely distinct direction. EM protagonists explain that a company does not have the choice to not to provide any experience, but it has the choice to influence, or guide, this experience in a positive way (Homburg et al., 2007; Klaus & Maklan, 2007). Therefore, and based on this, it could be inferred that despite the company's low involvement in the process of their creation, sensory attributes are present. For instance, consider a product that does not give off any smell, yet the absence of scent can still affect consumer's experience in some way. An example of such product might be tomatoes. Scent is typically considered to be a distinct sign of their quality, ripeness and taste. Chebat & Michon (2003) confirm that a contribution to favourable perception is not the only aspect, but sensory cues can also affect product quality perception.

Hence, and provided that consumers intend to buy premium products, they would expect to sense this characteristic scent, which might also alter the taste. This example comes to demonstrate that sensory marketing is applicable to all companies and corporations regardless of their respective size or product type. Yet, the crucial question is whether the company is indeed aware of the notions that it provides to customers. Some foremost examples of companies and products that adopted sensory aspects can be seen on Figures 3 and 4. However, the outcomes are in contrast. While colourless Pepsi has not reached overall success, Orangina has built their brand around iconic orange shaped bottle. In simplistic instance, it is possible to deduce that appropriate sensory attributes might reinforce the acceptance and favourability of the product among consumers while inappropriate sensory attributes cause negative attitudes. On the other hand, and as will be demonstrated through the propositions

and the experiment, the selection of appropriateness of the sensory stimuli is in some cases not that intuitive and straight-forward. Moreover, the attitudes of the consumers might be also changing in time as new limited editions of Crystal Pepsi were reported as successful.



Figure 3: Orangina bottle

Source: Ridley, T. (2017)



Figure 4: Colourless Pepsi – Crystal Pepsi

Source: Sherman, E. (2017)

2.3 The history of olfaction in marketing

The history of olfaction is widely described by the Nobel Prize awarded scientist Richard Axel and Dulac (1995, pp.154) in the field of physiology and medicine, who claim that it is *"one of the greatest tools of human behaviour which provides intuitive favour or avoidance towards items such as food, flowers, predators or poisons"*. Axel was also the first to demonstrate how people distinguish different scents (Sherwood, 2016) by simultaneously identifying scent receptors. For the purpose of this study,

it is not necessary to describe olfaction in greater depth. However, there are some already published reviews by Ache & Young (2005) or Stevenson (2009) who summarised the olfactory system in relation to its function, including the description of some effects on behaviour that might be of interest.

It is not well documented what was the first case of commercially sold scented product. Based on written chronicles, it is possible to deduct that one of the oldest products ever sold with scent might have been a candle. The history of candle production can be traced back approximately to the 4th century B.C. in Egypt. However, the first evidence of scented candle might originate from India where the candles were produced using the wax from cinnamon (Telesco, 2001). It is safe to assume that the cinnamon scented candle might have also been a subject of trade and hence, the scent might have served as an additional reason to desire the specific product, thus forming the origins of what is today called sensory marketing. Again, around the same time, there are chronicles that declare an intentional addition of colour to the wax, assuming the very early demonstration of understanding of the concept of product differentiation. Strathern (2000) further explains that the history of the early perfumes can be traced back to 1200 B.C. when a woman called Tapputi from Mesopotamia formed the basic principles of scent extraction.

In principle, the sense of smell is critical to the perception of flavours (Herz, 2007; Morrin, 2010), as illustrated on the previous example with tomatoes. Moreover, and as supported by several studies in various fields including neurology, psychology and chemistry, smell can also affect our mood, promote products or position a brand (Martin et al., 2001); yet the impact of product scent in the context of consumer behaviour still remains relatively unexplored. This might be because the responsiveness of human senses to marketing has been widely neglected (Hultén et al., 2009), but it is now slowly changing with a stream of new research and interesting business implications.

Hence, it comes as no surprise that Hultén et al. (2009) suggest that companies should focus on optimal sensory stimulation since the fragmentation of markets, individualisation and uniqueness of products take the lead. However, the critical question is whether optimal means rather congruent (red colour and tomatoes)

or incongruent (white colour and tomatoes) and whether there is any possible way of determining the consumer preferences through careful selection of sensory aspects.

2.4 An introduction to scent marketing

The authors adopted various terms for the use of perfumes in marketing such as aroma marketing, aromatic marketing, olfactory marketing or more recent term - scent marketing.

As will be shown throughout this literature review on numerous cases, all the five senses have the ability to affect human behaviour. This is the underlying reason why many international corporations have chosen to implement sensory marketing strategies and actively try to stimulate consumers' senses (Blasor, 2009; Hodge, 2006; Krishna et al., 2010). Examples of scent marketing which might be noticed in practice and are publicly known include premium hotels signature perfumes (Forbes, 2012; The Independent, 2011; Krishna, 2012), Revlon's scented nail enamels (Figure 5) or Hollister.co using scents on clothing and within their store environment. Recently, companies have identified the importance of these tools as an effective way of communication (Hultén et al., 2009; Krishna et al., 2010).



Figure 5: An example of Revlon's scented enamel product line

Source: Desilets, A., Canadian Fashionista, 2013

In fact, there is even an authority called Scent Marketing Institute (2011) that confirms that across industries, businesses are increasingly adopting scent as part of their multi-sensory marketing strategies.

It is also widely described that sensory marketing allows firms to transmit their brand identity and values at a deeper, emotional level. However, and as opposed to this oscillating trend, Hollister Co. has recently decided to alter its marketing strategy – as a result of a profound decline in sales – by reducing their perfume presence in stores and on products by 25 % (Peterson, 2014). This might show that this strategy might not work in the long term on its own and there is much more research needed to reveal public attitudes towards scent marketing over time. Perhaps the element of novelty, as HollisterCo. was one of the first stores to use sensory stimulants in the United States, also plays a role. However, this finding underlines the fact that large companies are still willing to experiment with sensory stimulants. In fact, perfume is not the only sensory tool HollisterCo. uses in order to target customers. Less light inside the store and the design of the shop window resembles more a gate to a nightclub rather than a clothing shop (Figure 6).



Figure 6: Hollister Co.: The Front of the store in Texas, USA

Frisco Convention and Visitors Bureau, 2018

It is essential to state that this research focuses on two senses only – vision and olfaction. However, it may be crucial to perceive and investigate sensory marketing in a collective manner with other sensory expressions such as music, taste, design and texture; expressions that can equally form and clarify the brand identity (Hultén

et al., 2009; Krishna et al., 2010). As will be discussed later in Chapter 3, there is still an ongoing debate on the integration of the senses in perception. Therefore, the senses also probably do not work in isolation, but they create a representation of the reality all together. This is how the marketers might also want to view product sensory attributes in order to create favourable perception together rather than focusing on one sensory aspect and completely neglecting the others.

2.5 The odour classification

Currently, the classification of odours has not yet been resolved. The odour percepts could not be linked to measurable features of odorous compounds and therefore many studies used perception-based assessment methods. Some researchers tried to link odours to colours and to some extent create a usable colour-odour scheme (Harper, 1996; Harper et al., 1968; Chastrette, 1998; Haddad et al., 2008). However, their efforts have proven to be unsuccessful. This is because there is almost unlimited amount of perfumes and their mixtures and usually one perfume cannot be simply characterised by a singular colour, as it consists of many ingredients. Therefore, and not surprisingly, up to this date there is no reliable scheme or even a reliable consensus on how the odours should be classified.

The first attempts of odour classifications emerged in the 20th century (Kaeppeler and Mueller, 2012). Generally, one stream of research assumed that odour qualities could be linked to the function of olfactory receptors (Pierce et al., 1995), other assumed that the chemical structure of odours could be somehow detected and therefore categorised (Wright and Michels, 1964) and the third stream used verbal categorisation and hence – individual inputs for classification (Henning, 1916).

Since all the three methods have not reached either acceptance or some unification, the industry specialists have designed their own means of classification. For practitioners, each perfume is based on the olfactive family, dividing the perfumes to four main categories – floral, woody, fresh and oriental (Edwards, 2010; Figure 7). There are many alternatives to this classification and usually each company or perfume specialist customises it according to their subjective needs e.g. by adding gourmand perfumes to the woody family which are based on vanilla, chocolate, caramel, milk,

coffee, cognac etc. Therefore, the fragrance wheel and similar tools might serve as a base, but they are insufficient in terms of precise communication of odours.

One of the major problems when it comes to evaluation and classification of individual scents is also their intensity. In many odour studies, participants were asked to disregard the potential differences in intensity while evaluating them. The problem with this is that odour quality is often linked with the perception of intensity. Invasive odours might not be pleasant, but also light odours might mean lower quality perception. Gross-Isserhof and Lancet (1988) identified quality changes in perception of differently intense odours. The subjects were unable to identify the odours accurately given the lower concentrations. Moreover, Laing et al. (2003) assessed 5 scents at different levels of concentration. The evaluations differed with regards to their characteristics, including quality rating.

In other studies, the intensity of the odours was controlled for by means of a pre-test where the participants rated the solutions as equally intense (Berglund et al., 1973; Dalton et al., 2008). Kaeppler and Mueller (2012) suggests that scientists should not control only by presenting the subjects equally diluted solutions, but also consider that quality of some odours cannot be fully represented by their intensity level. In other words, the same type of ingredients in the same concentration levels should result in the same intensity, but in practice, some scents – despite the same concentration levels – might be perceived as more intense than other ones depending on their unique chemical compounds. In addition, humans may have specific types of loss of smell. Around 30 % of population is for example unable to detect androsterone, the primary compound of boar taint. Other 6 % has a specific anosmia to isovaleric acid, a component of body odour (Trimmer and Mainland, 2017). Unfortunately, the lowest detectable concentration of smell largely depends again on the chemical compounds and moreover can vary by several orders of magnitude in the population. Similarly, the threshold of changes detection related to concentration and intensity varies, but one source claims that humans are able to notice a change in approximately 25 % difference of concentration of an odour (Fontana and Mad'a, 2018).

In summary, it is very difficult to classify odours by their characteristics – by means of verbal description, intensity and even their lowest detectable thresholds.

All the discussed issues will be detailed in the description of the methodology as they are essential for this research.



Figure 7: Fragrance wheel

Edwards, M. (2018)

2.6 What affects the odour perception?

This study is specifically examining the preferences related to odours and colours. Thus, it is important to discuss the possible external factors that might affect odour preference. As claimed by Krishna et al. (2010), hedonic perception of an odour is an affective evaluation. The first immediate response to a scent is usually not analytical, but hedonic – thus whether we like the substance or not. It has been shown that pleasantness and familiarity are positively correlated (Moskowitz et al., 1976). This is also why most of the product fragrances resemble often something common, e.g. flowers, fresh laundry or ocean. Moreover, the genetic predispositions in terms of the number of olfactory receptors may influence individual sensitivity towards specific odours (Menashe et al., 2003) and therefore the perception of intensity can vary. With regards to the preference of odours, there is a long-term debate on whether the pleasantness is learned or innate (Herz, 2010). For example, children like the smell of feces and are usually indifferent to what adults consider bad or good smell (Herz, 2010). This would support the view that preference towards certain scent is based on our acquired emotional associations

(Engen, 1991; Herz et al., 2004). An opposing view suggests that for example rose is inherently a pleasant scent as opposed to the scent of skunk (Herz, 2010). Although new-born children tested with a drop of quinine on their tongue elicited a grimace as opposed to a drop of sucrose that elicited a smile (Herz, 2007), the same hypothesis with odours has not been empirically validated.

Also, the culture is an important factor affecting the odour perception. There is evidence in some cross-cultural studies that it is rather associative learning and the emotional memory that pre-determines odour preferences than responses present from birth (Herz in Krishna, 2010). No empirical data up to this date have shown a consensus in odour preference or even odour avoidance (Schleidt et al. 1981; Jacquot, 2016). One of the most explicit cross-cultural differences was demonstrated in a study by Moncrief (1966) and Cain & Johnson (1978) who both studied the preference of an odour called *wintergreen*, using different participants. In the first case, the odour was rated as the highest preferred odour among the American participants since the connotation is exclusively linked to a mint candy. This was in contrary to the findings of the British participants who rated wintergreen as the least preferred as in their culture it is linked to the scent of medicine, specifically to the scent of analgesics used during the World War II (Herz, 2007). These results might serve as evidence that olfactory perception is rooted in associative learning and when the odour is first experienced, also to the emotional connotation of that experience (Engen, 1982; Herz et al., 2004).

Despite little longitudinal research, several cross-sectional studies have also suggested a considerable influence of age on olfaction (Wysocki and Gilbert, 1989; Russel et al., 1993; Corvin et al., 1995; Larsson et al., 2000). Therefore, in order to reduce the impact of physiological impairments, a decision to select only relatively young participants in this study has been made. This is also supported by a study by Wysocki and Gilbert (1989) which used over 2,4 million panellists and the results showed that the identification of rose odour strongly declined from over 80 % to only 60 % for panellists aged 80 and more. Kaeppler and Mueller (2012) strongly suggest that odour researchers control for variables such as age, gender and culture since it may all affect olfactory and colour perception. Elderly participants might also be in some cases excluded from olfactory studies (Kaeppler and Mueller, 2012).

2.7 The Implications from the Chapter 2

The first section served as an extended introduction and clarified all the terms used in this thesis. The second section introduced the contextual background of sensory marketing and presented several views on its theoretical categorisation. This was followed by a short summary of the history of olfaction in marketing and then accompanied by contemporary examples of the use of scent marketing today. All these sections form the context of the study and they are more of a theoretical value to the reader.

However, the last two sections are of a particular interest, as they represent up to date knowledge about odour classification systems and the factors that might affect the perception of odour. Up to this date, there is no unified scheme for measuring odour intensity and some chemical compounds might result in higher intensity perception while others in lower intensity perception. Therefore, it is not only about unified mixtures of ingredients, but also about the type of the ingredient. Moreover, it was identified that some percentage of population may have specific types of loss of smell. On the other hand, the threshold of concentration detection of perfume in humans is not very sensitive and therefore minor deviation should not play a role. In addition, there is no unified scheme for odour distinction by its type. Across practitioners, there are several proposed types of classification with some minor amendments. All these findings need to be reflected in the research design.

The factors that were identified that could affect the odour perception led to the debate whether the preference or avoidance towards scents is learned or innate. It seems that more research supports the argument that it is learned through associative learning. In addition, the evidence shows that culture affects the perception of scent. Furthermore, the preference or avoidance towards scents is not binary as there are always individuals that find a particular smell attractive while others do not. Empirical data also showed that familiar and pleasant scents might be correlates.

If the preference or avoidance is learned through associative learning and also familiar scents are evaluated as more pleasant, the familiar and learned combinations of colours and odours might be also preferable. All the findings should be accounted for in the research design by selection of the odours and the participants. It should be controlled for the culture of the participants or their nationality as this might affect

the results. Also, as recommended, the researchers should control for variables such as age and gender, since it may all affect olfactory and colour perception. Elderly participants might also be in some cases excluded from olfactory studies (Kaepler and Mueller, 2012), which will be the case in this study.

Chapter 3

The origins of cross-modal correspondences and brain processing theories

The main contribution of the following sections to the research is to illustrate that there is an extensive debate of the origin of cross-modal correspondences and it is speculated that it might be derived from the brain physiology or processing. First of all, the process of olfactory information storing and its connection to memory and emotions is described. Then, empirical results demonstrate that sensory aspects might affect human judgment. Moreover, there are some studies that show contradicting results about the effect of sensory percepts on bodily states.

Next section introduces the existing theory formulated by Stach (2015) that consumers create concepts instead of single percepts and are able to store any information, including the sensory ones. It is speculated that the more the consumer is exposed to certain combination of the stimuli, the stronger the relationship becomes and the association will be more automated. This is of a particular importance to the study of cross-modal correspondences. Albeit, this is still only a theory which is yet to be verified.

In order to illustrate the current understanding of the functions of the brain that could explain the origin and the effect of cross-modal correspondences, the neuroscientific studies are discussed.

Next section focuses on the previously mentioned theory of embodied cognition and tries to elaborate on whether bodily states may impact our judgment. Although there are many empirical studies that demonstrate that certain associations might have an effect, the cause remains a source of debates and it might as well be the processes in the brain that guide the body actions or judgement.

The penultimate section reviews memory in relation to sensory processing, specifically to odours. Then the section proceeds to discuss further details of how the information is stored and in which form.

The last section then introduces the problem of multi-sensory processing and the recent theories on how the sensory information is integrated. All this provides the background for the research of cross-modal correspondences.

3.1 The origin is in the brain

Already the writer Marcel Proust (2003) reflected that *"the smell and taste of things remain poised a long time, ready to remind us... the immense edifice of memory"*. Now, this might apply when considering food, experiences or people, but what about products?

For instance, previous studies confirmed that scents diffused within an environment are an alternative way of approaching customers in an appealing way through the formation of memories with certain types of fragrances. The process of targeting emotions through sensory stimulants has been described in neuroscience. Krishna (2012) proposes that subconscious triggers can be created through sensory marketing and these can characterise consumer perceptions of abstract notions of the product (e.g., its natural sourcing or quality). The explanation of the scent power can be again traced back to neuroscience because there are only two synapses that lie between the olfactory nerve and the amygdala, which is commonly recognised for its role in emotion and plays a large role in determining emotional memory (Cahill et al., 1995). In addition, the hippocampus is involved in the process of storing information related to emotions (Eichenbaum, 1996) and again there are only three synapses that lie between the olfactory nerves and the hippocampus, thus rendering them as very closely connected. Similarly, Soars (2009) highlights that the sense of smell has the highest emotional connection that connects emotions to memory by sending a fast signal to the limbic system. Therefore, the transfer of olfactory information is distinctly different compared to all the other sensory inputs and it can be concluded that scent has a more direct link with feelings, which makes scent marketing a powerful tool for marketers.

Hoch (2002) and Klein (2003) confirms that sensory enhanced products become memorable and customers tend to create their own beliefs and attitudes about the product. Krishna (2012) proposes that these individual beliefs can be manipulated because the way we form assumptions is through our senses, and hence

we are more likely to be influenced. One example might be the experiment introduced by Williams & Bargh (2008) who showed that participants who briefly held a cup of hot (versus iced) coffee judged a target person as having a "warmer" personality such as more generous and caring. It is speculated that this result might be because of the involvement of the insular lobe of the brain in the processing of both physical temperature and interpersonal warmth information (William & Bargh, 2008). This conclusion should be inspected in greater depth since there is no empirical support for such claim.

Other research showed that red colour slightly increases heart rate (Gerard, 1958). However, this was followed by a study of Jacobs & Hustmyer (1974) which contradicted this hypothesis demonstrating no effect on blood pressure or heart action. Furthermore, Rickard (2004) and Panksepp (1995) came to positive results when they studied the effect of emotionally powerful music which elicited significantly greater increases in skin conductance and number of chills than other treatments. There are many similar situations with a spectrum of conclusions that in some cases suggest that there might exist some connection between physical setting (and information processing) in human brain, or perhaps bodily state, sensory sensation and judgement. On the other hand, numerous studies also show fallacy of this connectivity and therefore it remains a source of debate.

The theories will be reviewed in this chapter more precisely as it is essential in order to unlock the so-called black box of a consumer (Koudelka, 2006).

3.2 Emerging theories about brain information processing relevant for marketers

It appears valid to describe the current state of knowledge of brain functions and introduce the reader to some established concepts of how cognitive function processes are relevant for marketing research. The knowledge about the functions is fragmented in various fields such as chemistry, physiology and neuroscience. Moreover, it is not easy to find these concepts in marketing research in order to support or reject existing theories about consumer behaviour. One of the theories found in marketing literature and elaborated further is the one described by Stach (2015) that clarifies how the brain functions when exposed to a marketing stimuli and brand

concepts in time. In order to describe the brand and advertising effects, he has adopted a long-established theory of association networks that originates already in famous Pavlov's experiment when he taught the dogs that the bell is a pre-sign of food and they started generating saliva as the bell rang, thus classical conditioning learning theory. Some trace the beginning of the theory even earlier, when similar concept originated from the thoughts of Plato and Aristotle. Likewise, according to Stach (2015), consumers create certain concepts in their brain. For instance, a specific melody might activate this concept and instantly provide other connected information (for example the classical ring tone of Nokia). Now, of course – humans are much more complex and it is not possible to condense human behaviour in such simplistic manner. Hence, this theory is applicable only to memory processing and has been adapted from psychology.

Based on the same principles of creating concepts, in computer sciences, there are algorithms called artificial neural networks that attempt to simulate the processes in the brain using a set of examples and simple learning methods. Despite considerable development in this field during recent years, the artificial network has not been yet at the stage of biological perfectionism of a human brain and it is safe to declare that the research has not yet come to justifiable agreement of how these processes entirely work. Therefore, classical learning theory appears to be insufficient also in the attempts of explaining human behaviour related to sensory processes.

In addition, there is another approach to studying human brain. In marketing field, some subfields such as neuromarketing, have somewhat adopted an existing theory that our brain is divided to various parts and each of them has specific role and is responsible for various functions. Unfortunately, some commercial books are even claiming that there might be a "buy button" in the brain, putting the whole field in question by such unsupported claims (Dooley, 2012).

One of the first famous studies that involved neuromarketing tools and provided results relevant to marketing practice was the McClure et al. (2004) study published in *Neuron*. Making the use of fMRI (functional Magnetic Resonance Imaging¹), the study has examined the consumers' response to the Pepsi and Coca-Cola beverages. If a consumer

¹ A tool that measures brain activity by detecting changes associated with blood flow (Huettel, Song and McCarthy, 2009)

was not aware of the brand currently consumed, but drank their favourite type of cola, the fMRI showed an increased activity in the ventral putamen which is supposedly associated with reward. However, when the volunteers were told what brand they are drinking, the fMRI showed an increased activity in prefrontal cortex presumably associated with higher cognitive processes. The study has been conducted on small sample of participants and hence requires further validity confirmation; however, it showed that sensory information might play only a part in determining consumers' behaviour (McClure et al., 2004) and the difference of brain imaging with a prior knowledge of brand in contrary to unknown brand might elucidate the effects of advertising on the brain functions. Moreover, this study resulted in a great wave of criticism mainly due to ethical reasons (Morin, 2011) and generated concerns over personal privacy. One of the problems of neuro-imaging today is that although we might deduct where the physical activity occurs in time, we are still short of explanation of the complexity of the processes in human brain. This means that today most neuromarketing companies offer results that still need further verification and understanding of such processes. An example of this might be a controversial product that generates discussions, and subsequently increased sales despite the evaluations through the use of neuromarketing tools being too abrupt. Also, relatively recent neurophysiological study suggests that patients with damage to the angular gyrus (which lies within the temporo-parieto-occipital region) are not able to match stimuli cross-modally. However, this was only tested by using shape and sound stimuli (Ramachandran & Hubbard, 2003), and therefore this might not demonstrate the physical location of interconnectivity of the senses as it might differ for each two modality combinations. Also, it is still uncertain, what is exactly the role of the angular gyrus in matching the stimuli cross-modally.

Nonetheless, the technical development and advancement of the methods might result in interesting discoveries. Together with the development of more affordable, portable and available technical solutions, the results could be more generalisable and subsequently lead to an interesting research stream.

Up to date, it is speculated that our higher cognitive functions are probably executed by extensive neural networks in the brain instead of being attributed to specialised areas of the brain, similarly to the neural networks theory (Stach, 2015). One of the previously mentioned theories that are relevant for marketing practice

is the associative networks theory that describes brand awareness as dense networks in the minds of consumers (Stach, 2015). These networks form further neural nodes that are able to store any kind of information – such as emotions, visual representation, semantic association and sensory product aspects or brand characteristics (Stach, 2015). Here, it is important to note that semantics refer to the meaning, not only words. Information nodes are connected when similar cognitive functions occur (Collins et al., 1975; Supphellen, 2000; Stach, 2015). The relative strength of such connections depends on various factors – the intensity and frequency of their pairing, already existing networks and congruence between network and activation stimuli (Stach, 2015). Hence, it is possible to theorise that when the brain often perceives some stimuli such as certain shape of a bottle, it makes greater connection and forms nodes based on other perceived information. An individual should be able to retain these concepts and activate them through correspondent stimuli once they reach certain level (Bower, 1981) and this will further widen their activity. Krishnan (1996) concludes that the more associations are connected to a concept; the probability of activation, strengthening or formation of new concepts would be higher.

This theory might explain the effects of advertising and suggests that the key to success is mainly repetition and usage of various forms of communication with repeated positive stimuli, albeit could the human information processing be this simple? This could potentially also apply to sensory enhanced products where the repetition of sensory attributes that somehow integrate in one scheme (such as orange flavoured drink in Orangina shaped bottle coloured as orange) might lead to more memorable product and more favourable attitudes.

The associative network theory could be also classified as certain form of connectionism, firstly noted by Donald Hebb in 1940 (Elman et al., 2001). It is a set of approaches in fields such as artificial intelligence, cognitive psychology, neuroscience and even philosophy. There are also other paradigms that claim that for instance animals acquire not associations, but symbolic knowledge of quantifiable properties of their experience (Gallistel & Gibbon, 2002) and view this model as simplistic because according to them it rejects acquired beliefs about the world. Instead, they support a model similar to computationalism (firstly noted by McCulloch & Pitts, 1943) which views brain as information processing system able to store any form of information.

As illustrated, it is evident that there are many existing views and theories about the processes that occur in the brain. Some studies deduce the functionality of specific brain areas from temporary or permanent brain injuries. While this might be valid, it is also possible that at least to some extent the functionality may be restored through the use of other brain areas instead. Other way of forming assumptions about the brain processing is to use brain imaging tools. However, this is often linked with high costs of the equipment, ethical concerns and relatively small samples of participants. In conclusion, up to this date, there are only theories supported by fragments of truth about brain processing related to marketing and consumer behaviour. Whilst the general biological construction of the brain has been described, the processes occurring between the environment and the human brain remain relatively unexplored. In conclusion, it is highly improbable that the consumer brain could be well understood (even partially, much less fully) without good underlying general models of the human brain, the processes that form and decide human behaviour, advancement of technology, excellent understanding of the measurement methods, and most importantly a valid data analysis.

3.3 Embodied cognition

On the top of the disputes on many theories of how brain stores and processes the information, there are also deriving paradigms about how cognition works. Cognition is in essence the active process of accumulation of knowledge through thoughts, experiences and senses. It is important to outline the theories in order to understand the possible links and origins of the cross-modal correspondences better.

The previously discussed impact of sensory input on body resulted in direction of beliefs that cognition is embodied and therefore the states of the body may affect the states of mind (Wilson & Golonka, 2013). For instance, the perception of weather might be affected by the mood and it might seem even colder when the person is not feeling well. There are many experiments that confirm that cognition can be influenced and manipulated by the states of the body (Eerland et al., 2011) and the environment (Adam & Galinsky, 2012). The theorists suggest that cognition is not an isolated process that occurs in human brain, but is also grounded in our body (Lakoff and Johnson, 1999; Miles et al., 2010). An example has been demonstrated on the use of metaphors as we usually, and in most cultures, connect power with being

up, and hence say: "I have control over him" or "I am on top of the situation" (McNerney, 2011). Both examples, according to the proponents of embodied cognition, suggest that the word power has some ground in physical sensation of being seemingly up. Alternative explanation might be that the metaphors originate from historical hierarchy of the society where the emperor usually lived above (up) the ordinary people, thus are a consequence of formed assumptions inherited through language from past generations.

Another example illustrating the effect of mind impacting the body was shown by Miles et al. (2010) who told the participants to think about either future or past and this affected their standing posture causing to lean either forward or backwards (depending on the corresponding semantic stimulus). This example suggests that when the participants activate some concept, or perhaps even prime themselves, they might be inclined to behave in a certain way. However, even in this case the causality that this is caused by bodily states affecting the cognition might not be entirely correct. Mahon (2015) alternatively proposes that the effect on behaviour might be explained by the interaction and information exchange between amodal conceptual representations (thinking of future) and peripheral input/output of sensorimotor systems and therefore resulting from the brain processes. Until today, there is an ongoing debate between the researchers and the theory of embodied cognition has its supporters, but also opponents.

3.4 Memory and knowledge formation theories

Since it was already established that there is some disagreement over theories on brain functioning and deriving cognition theories, and therefore it is unclear what are the psychophysiological causes of the previously mentioned results of the presented studies where one sensory stimulus affects the other one, it might be beneficial to also review a smaller unit, namely memory.

According to Schacter & Tulving (1990) there are three types of memory systems – explicit memory, implicit memory and also working memory. The explicit memory acquires knowledge semantically. A part of explicit memory is also episodic memory that recalls events that are connected to particular time and space. Explicit memory creates our perception of the external world. On the other hand, there is implicit

memory that is restricted to learn responses to stimuli. An example of implicit memory might be to finish the lyrics of a song after hearing the first words. Applied to scent, the often-experienced difficulties with recalling scent information might be due to their storing in implicit memory. However, if the scent is already diffused in the environment, this might accelerate the recall of a corresponding event, suggesting implicit memory in operation (Rouby et al., 2002; Campana & Kristhnsen, 2010). While the explicit memory can be to certain extent consciously controlled, the implicit memory has to be triggered by external stimuli in order to retrieve the concept. This is why it is hard to remember a particular scent, but when the odour is present, we are able to remember more detailed information on when or where we have encountered the scent. Explicit memories of odours include information which might later be recalled in order to group similar odours or for description purposes (Wilson, 2006). Third type is working memory (Sternberg & Sternberg, 2010) which stores new information and also accesses concepts from the long-term memory systems which are further restored.

Other distinguished type is sensory memory, which represents the gateway to memory system and it is a part of short-term memory. It might be defined as any memory that preserves the characteristics of a particular sensory modality: the way an item looks, sounds, feels, etc. (Cowan, 2015). It contains relatively unprocessed memory traces, which last only slightly longer than the stimulus itself (Goddard, 2012). The process why some sensory information are stored in long-term memory, while others vanish has not been entirely described.

Sensory memory appears to be modality specific: information is believed to be stored in the modality by which it entered. This was summarised early by Helmholtz (1878) as:

"For example, one cannot ask whether sweet is more like red or more like blue ... Comparisons are possible only within each modality; we can cross over from blue through violet and carmine to scarlet, for example, and we can say that yellow is more like orange than like blue!"

This early notion is very interesting with regards to the study of cross-modal correspondences as the new studies suggest that there is some connectivity between the modalities. However, an input from one modality together with an input from

another modality does not equal two single percepts, but a completely new one instead. The contemporary studies suggest that the majority of people in fact do have an answer to the question of whether sweet is rather red or blue and the choice appears not to be assigned at random. This will be also tested by the experiment in this thesis and it should be verified whether the majority of the population has some colours linked to odours.

Sensory memory, or perhaps some connected system, although being selective, helps humans to detect unusual, potentially hazardous events or subjects in the external environment. In order to do so, the memory system has to be able to detect any possible violations against the established model (Tiitinen et al., 1994). This is why there is a greater chance to consciously register somehow changed, but familiar product, as opposed to the one that remains still the same. The effect of more attention to novelty could be therefore explained by a constant effort of human brain to compare the sensory perception to subconscious predictions of the externalities. Should there be a stimulus that is different to the model, it will require further inspection and hence, a signal to draw closer attention might be sent.

Although there are many contradicting views about the knowledge formation, the essential question is whether information is memorised in the form of separate, modality or domain specific representation (Baddeley & Hitch, 1974; Schneider & Detweiler, 1988), or rather as integrated representations (Atkinson & Shiffrin, 1968; Cowan, 2001). Brunel et al. (2009) further hypothesise that knowledge can be viewed as an abstract phenomenon that might be activated through perceptual stimulus which sends signal to the semantic memory, but in fact is stored amodally. Again, the studies about cross-modal correspondences could form the basis for proving one of the theories of knowledge formation since the literature claims that human perceive rather integrated representations when it comes to sensory perception.

For the purpose of this study, the proposed theories and concepts must suffice, since the role of the information provided is mainly to demonstrate that the level of scientific knowledge about these processes is still incomplete, and hence the concepts behind the functionality of branding, advertising and even sensory marketing might not be extracted from sufficient scientific basis and our understanding of the processes is still restrained by relatively difficult obstacles in quantitative verification

of the theories. Moreover, the cause and origins of the cross-modal correspondences could not be explained without further information about these processes.

3.5 Multi-sensory information processing

Multi-sensory information processing refers to the interaction of signals that are perceived simultaneously or nearly simultaneously. There have been extensive debates about whether individuals tend to process some sensory information predominantly than others. For instance, from a neuroscientific point of view, Greenfield (in Henry, 2007) claims that *"humans have evolved to build a picture of the world through their senses working in unison, exploiting the immense interconnectivity that exists in the brain."* This quote clearly suggests that senses mostly do not operate in isolation and it summarises the most prominent contemporary view.

In contrary, there is an earlier view that was supported by Berkeley (1709). This is why the science usually adopted the approach of studying only one sense at the time in relation to sensory memory processing:

"It is nevertheless certain, the ideas intromitted by each sense are widely different, and distinct from each other; but having been observed constantly to go together, they are spoken of as one and the same thing."

Whilst it is possible to agree that the sensation of touch is entirely distinct from the sensation of scent (Held et al., 2011), it is still not entirely clear how the senses exactly integrate and form a unified perception. As we get exposed to multisensory stimuli, we might learn that certain sensory inputs often come together (Connolly, 2014), and as Stach (2015) suggested, form mental constructs which may be modal or amodal through associative learning. However, this does not explain why certain form of associations can be displayed already at birth as claimed by Spence (2011).

There are also other opposing views, which are being largely criticised by academics as they lack neuroscientific substance, such as the neuro-linguistic programming (Tosey, 2006). Nevertheless, the proponents agree that we filter information but tend to trust one sense more than others on individual basis (Bandler & Grinder, 1979). Equivalently to this view, there are many similar theories that, for example, claim that individuals tend to process some form of information better than the others (Honey & Mumford, 1982) and each person has different learning style such as visual, audio

etc., suggesting that each individual might operate on different underlying principle. In marketing literature, there are published studies which recommend balanced forms of communication (Mainwaring, Skinner, 2009). Although there might exist some individual differences, it is unlikely that healthy person is unable to process certain form of information at all. Therefore, in quantitative terms, it should be possible to identify an average consumer who should be able to decode all the messages in any form instead of trying to segment the consumers by their preferred means of communication.

The most recent theories argue that the brain integrates multisensory information by weighting each modality in proportion to its reliability, compatible with a statistical optimal scheme (Van Beers & Haggard, 2002; Knill & Saunders, 2003; Hillis et al., 2004; Stein & Stanford, 2008; Fetsch et al., 2012). More about this method can be found under the term Bayesian or maximum-likelihood estimation (Knill & Pouget, 2004; Angelaki et al., 2009; Fetsch et al., 2013). In the very essence and with consideration of the relevance of this information for this thesis, there is still a very limited knowledge about the physiological process how human brain translates the sensory signals and how exactly they are stored. More specifically, how the neurons code information about sensory uncertainty (Knill & Pouget, 2004). However, there are proposed models that might be supported or rejected due to increasing scientific knowledge. More about the multi-sensory information processing will be described in light of cross-modal correspondences.

3.6 The Implications from the Chapter 3

This chapter tried to point out the contemporary debates about brain processes that are relevant to sensory perception and could potentially clarify the origins of cross-modal correspondences. However, the current knowledge of the brain functions is limited and the quantitative verification of the presented theories is difficult. Some of the issues that resulted from this chapter might be clarified by the results of this research. Again, this section provided some useful insights that should be reflected in the research design such as how the memory stores odour information.

Chapter 4

The principles behind consumer choices related to sensory perception

Perception is a concept that is integral to marketing and it essentially establishes the meaning regarding a given product or brand following consumers' initial exposure and contact. The following chapter is dedicated to the effects known to affect human behaviour through perception of certain stimuli. This is all linked to the central question if there are any organisational patterns of perception that group colour and odour characteristics together.

First of all, the process of perception is defined and the stages of perception with regards to the product are described. It is important to mention that perception is selective due to the number of stimuli surrounding us. Moreover, the process is highly subjective.

Then, the next section discusses the priming effect and explains how priming is related to cross-modal correspondences. In section 4.5, the different forms of cross-modal correspondences are unfolded. There are 3 types identified from the literature and those will be essential in order to contribute to the verification of the hypotheses. There is statistical, structural and semantic-mediated cross-modal correspondence. It is speculated that all three types impact the information processing differently, which means that they may have also different impact on the preference and intensity ratings.

Finally, the effect of colour and odour on human behaviour is illustrated and discussed by presenting an up-to-date literature review. Furthermore, the specific cross-modal correspondences are also reviewed and discussed. The research of Gilbert et al. (1996) presents some interesting results that confirms the existence of some colour and odour correspondences which were consistent over time. The results of this research are specifically pointed out and will be compared to the results in the findings section.

Finally, the role of expectations is stressed as this concept might also influence human perception. It is important to account for all the factors that might affect the preference and intensity ratings of colour and odour combinations.

4.1 Perception

Perception underlines the processes in which individuals, or consumers, select, organise, and interpret sensory stimuli to generate a subjective, yet meaningful, picture of their world (Lantos, 2011). Furthermore, it is essential to state here that there is a difference between the words: “sensation” and “perception”, although they are sometimes used interchangeably in the thesis. Sensation and perception play two complimentary but different roles in how humans interpret the reality. Sensation refers to the process of sensing the surrounding environment through the senses. This information is sent to the brain in raw form. Only then, the human brain processes all the information inputs and makes sense of it, hence forming perception which is affected by cognitive states such as knowledge, assumptions and attitudes (Lintellè, 2014).

In principle, and according to Kazmi & Batra (2008), there are four distinct stages of perception that highly influence consumers’ information processing:

- *Exposure*, which involves the direct response stemming from sensory organs to a given external stimulus. Hence, the integration of all these five senses i.e. taste, sounds, smell, sight, and haptics into the products offered to the consumer will stimulate a distinct consumer-product relationship that facilitates an emotional connection and, ultimately, leads to consumer loyalty (Thompson, 2005);
- *Attention*, which comes as a result of a person’s capability to mentally process the external stimuli from a given product, a process that leads the consumer to allocate substantial information-processing capacity to allow the external stimuli to enter the brain for further information processing. In fact, this stage is particularly important to marketers because it is correlated with the degree of motivation triggered to process the information that the consumer receives; in other words, attention is the concept that propels and establishes consumer’s involvement;
- *Interpretation*, which involves the process of organising, categorising, interpreting and, ultimately, evaluating the information (stimulus) that entered the brain. In general, interpretation is synonymous to the attachment of meaning to given stimuli. Hence, interpretation, is a purely subjective term that depends

on personal factors, refers to the processes that individual use – consciously or subconsciously – in order to represent and understand stimuli that affect them;

- *Retention*, which is practically the concluding part of perception. This stage involves storing given information in both short and long-term memory. Hence, and from the marketer's point of view, the principal objective of sensory marketing is to provide positive stimuli in the previous information processing stages of perception that will trigger positive retention with respect to the long-term memory of the consumer.

In any case, and as stated by Bachmann (2011), perception is a highly selective process. Consumers are bound to consciously and subconsciously evaluate and determine the sensory stimuli that they wish to attend and retain. For instance, the crunchy sound of Kellogg's cornflake was designed in laboratories in order to subconsciously associate the product itself with a sound that is directly related to a sign of distinct quality (Spence, 2017). As further noted by Shaed et al. (2015), it is also possible to enhance and create a harmonious environment that increases the respective sales. As first noticed in the 1950s by Muzak who used an unobtrusive background music that was played in supermarkets, hotel lobbies or other public places to cause an increase of 10 % in the sales of supermarkets, as it allowed consumers to focus uninterruptedly and without losing their concentration on shopping (Lindstrom, 2011). Similarly, to previous examples, in priming studies, Chambaron et al. (2013) found that odour prime of a fruit – pear encouraged more choices of fruit desserts. All the examples suggest that there is an effect of sensory information on human perception and some studies confirmed that even subtle cues might subsequently affect behaviour and decision-making.

However, perception is simultaneously a profound subjective process – as explained earlier – because each individual consumer will interpret and understand things and stimuli in a somewhat different manner (Randhir et al., 2016). Perception will also depend on personal experiences and formed individual expectations. This is exactly why the effectiveness and efficiency of a selling or marketing environment is intertwined with its respective capacity to manage the subjectivity of the potential customer (Garrido-Morgado et al., 2016). Keeping in mind that the average person is exposed to more than 1500 advertisements per day, it is impossible to pay attention to all these external stimuli (Durmaz & Diyarbakirlioglu, 2011). This is why perception is linked

with the notions of cognition and selective attention. After all, the excitement that a customer will receive – or associate with – a given product, is related to the product experience, a rather hedonistic perspective. Despite this, the thesis is trying to answer if there is any pattern which could be observed in relation to colour and odour cross-modal preference by means of quantitative data analysis.

This might be also seemingly related to the view of perception of the proponents of Gestalt psychology as one of the foremost questions is not only the odour preference itself, but actually a degree of similarity or degree to which the odour is perceived as thematically congruent to specific colour within the retail environment or on the product itself. In this sense, the study is trying to investigate – similarly to Gestalt psychology – the law behind the ability to acquire and group specific information such as colour and odour of a product and discover which combinations lead to greater preference levels. Is there any law behind the organisation of the stimuli that affects hedonic perception?

4.2 The role of priming in perception

The idea stems from linguistics and cognitive science. Priming is a technique which has been extensively studied, debated and also criticised in academic circles, in which exposure to an initial stimulus will subsequently trigger a response to another stimulus in a process that occurs both subconsciously and unintentionally. In fact, and just before carrying out a specific action or decision, priming will activate representations or associations in memory that will highly influence the subsequent course of action. Therefore, it comes as no surprise that priming has a significant impact on people, yet people are usually unaware of existence and its profound levels of operations.

The effect of priming might sometimes not be clearly distinct from the studies of the effect of cross-modal correspondences. It appears that while priming encompasses any percept (be it an object, semantic representation, person, environment or modality specific percept) and studies consequent effect on behaviour, cross-modal correspondences focus purely on studying the interaction between two sensory modalities and semantic representations may not be always necessary in order to show this effect. In essence, the definitions of such effects are not fixed and different fields would name the same phenomenon by various terms. For instance, a very prominent

example that clearly demonstrates the strength, but also the interchangeability of priming and cross-modal correspondences is the Stroop Effect: a psychological test in which individuals need to state the colour of a word but not the name of the word as depicted in Figure 8.

1	2	3	4
red	red	xxx	yellow
yellow	yellow	xxxxxx	blue
green	green	xxxxx	red
red	red	xxx	yellow
blue	blue	xxxx	red
green	green	xxxxx	blue
yellow	yellow	xxxxxx	green
blue	blue	xxxx	green
green	green	xxxxx	red
red	red	xxx	blue
blue	blue	xxxx	yellow
yellow	yellow	xxxxxx	green

Figure 8: An Illustration of the Stroop effect

Source: MacLeod, 2015

In Columns 1 and 2 the task is to read the word while ignoring its respective colour. In columns 3 and 4 the task is to name the colour of each word while ignoring the word itself.

Results indicate that people will typically spend a longer time reading a word that reads a different colour than the one that is printed because of their intrinsic association between specific colours and specific words. In other words, reaction times are longer once the prime is semantically related to the target (Hoedemaker & Gordon, 2014). Despite the fact that this example is by default very simplistic, it can represent the profound effect that priming has on the congruence of the information presented to an individual.

Velasco et al. (2015) demonstrated a Stroop-alike effect in product search. When researching the consumer reaction times, congruent combinations of product packaging would decrease the time of searching. For example, when searching for tomato flavour, it was easier for the participants to find the product when it was packaged in red coloured packaging as opposed to yellow packaging. This could already be grouped

under the cross-modal correspondences term since the visualisation of tomato flavour somehow resulted in intuitive search for red packaging. Friden & Olsen (2001) and Lintellè (2014) conclude that priming effects were found also in-between other modalities such as audition, touch and olfaction.

4.3 How does priming work?

Priming is a notion that has been explored throughout the years by psychologists and the greater understanding of this concept coincides with the idea that information is stored in schemas located in long term memory (Jones, 1989). Alike to Stach's theory (2015), it is believed that these schemas can be perceived as the brain's general expectations regarding the nature of information that needs to be retrieved but also the order in which it should emerge. However, the consequent activation of schemas, and their entering consciousness and direct behaviour, can be increased or decreased, and hence can become more or less accessible. In any case, once these schemas are collectively activated, they can form networks in the brain, thus allowing interconnections between seemingly unrelated schemas. This is exactly why the activation of "neighbouring" schemas is a very essential tool in subconscious processes – and of course in sensory marketing – because it can facilitate possible encounters of what is bound to come next. For instance, the activation of a "sky" schema will subconsciously activate all the sky related patterns such as "blue" or "fresh" (air). Hence, the information stemming from corresponding schemas become more accessible. This concept is also not entirely invaluable, because it allows individuals to behave in an appropriate manner instantly if for example in danger.

From the physiological perspective, it has been shown that priming is usually associated with a profoundly reduced activity in the cortical areas that are typically involved in the initial process and understanding of external stimuli (Stark & Squire, 2000). Therefore, findings have suggested that the neuronal basis of priming involves an increase in the efficiency, but also the respective bias, in the direction of cortical sensory processes that are related to perceptual identification. This illustrates that similarly to cross-modal correspondences, perceptual identification is integral to priming effect.

Nevertheless, and to evaluate the effect of priming on perception it is very important to understand that the longer the prime is presented – or alternatively, the longer the individual is exposed to a given priming process – the effect of priming is highly decreased (Solomon, Bennett, & Previte, 2013). This is because longer exposure to priming is bound to activate cognitive but also conscious interferences. However, the word "longer" does not necessarily restrict the implementation of priming to short-term or temporary motivational orientations. In fact, and as suggested by Lisjak, Molden, & Lee (2012), temporarily primed motivational orientations have practically the same impact on how people pursue their goals as their chronic orientations: the stronger the effects, the stronger the priming effect – both temporary and chronic.

Furthermore, literature has identified that semantic priming effects have the capacity to highlight and reflect the fundamental mechanisms of retrieval from memory but also the real relations of meaning within the organisation of semantic knowledge (McNamara, 2004; Plaut & Booth, 2000). For example, a response to a given target (e.g. yellow) is significantly faster provided it is preceded by a semantically related prime (e.g. lemon) compared to an unrelated or less related prime (e.g. dog). Therefore, semantic priming indicates that the prime facilitates and activates related words or ideas for subsequent processing or recognition.

A prominent experiment that highlights the effect of priming strategies on working memory processes was performed by Heyman, Hutchinson, & Deyne (2015). Test subjects were shown two distinct dots patterns that were either placed in line or in random places. The underlying task was to remember these patterns while undertaking and completing a lexical task. During the lexical task, each subject was presented with a prime-target pair (reflecting the retrospective or prospective processes) and individuals had to state whether that target was a simple word or non-word as fast as they could. Results indicated that semantic priming might depend on the working memory capacity and subsequently, might not be entirely automatic, but require attention (Stolz & Besner, 1999).

However, it is speculated that priming can have even greater and more powerful effects because it can activate concepts – or schemas – that have a much stronger influence than improving linguistic effects and categories as explained in the upcoming sections.

4.4 Classification of priming

Literature has classified priming into several categories, each one having an abundance of priming paradigms and subcategories. For the purpose of the thesis, it would be practically pointless to state and unfold all the categories. Instead, there are three prevalent types of priming that can provide the reader with a greater understanding and assess the similarities of both concepts – cross-modal correspondences and priming.

- *Repetition or direct priming.* According to Sternberg (2009), this type of priming refers to the exposure to a given stimulus that facilitates its later retrieval. Going back to the ‘schemas’ interpretation, repetition priming suggests that once a given schema is activated it takes significantly less energy to activate a neighbouring schema, and thus to reactivate the construct of subsequent occasion (Gotts, Chow, & Martin, 2012). Repetition priming, especially when it comes to threshold identification, has been shown to have many similarities and results to the classic memory illusion proposed by Jacoby and Whitehouse (1989) in which the probability to identify new words as old (false recognition) is profoundly biased by context words – long-duration primes propelled a bias against endorsing a primed test word (Joordens S. & Merikle, 1991). However, it should be mentioned that in repetition priming, both the prime and the target are similar, if not identical; and this has generated the perceptual or associative priming classification;
- *Perceptual priming.* Perceptual priming refers to stimuli that belong to the same modality and which can reduce the time needed for the activation of neighbouring schemas (Bargh, & Chartrand, 2000). In other words, for instance an auditory prime will enhance the reaction time needed to identify a visual target such as in the paradigm of a siren and a police car. Therefore, individuals are bound to recognise stimuli that they have been previously exposed to much faster and more accurately compared to individuals that are exposed to the same stimuli for the first time.
- *Associative priming.* Priming is classified as perceptual when it facilitates or enhances the activation of associated knowledge (Plaut, 1995). Hence, both the target and the prime are not directly related, yet they share common association. For example, they are commonly observed by individuals together,

allowing their association with one another. For instance, an example of associative priming can involve "fish" priming the word "chips". Both words do not have any common features, yet individuals are prone to connecting one word with another. This effect will be also discussed later under the term *associative pairing*.

Moreover, priming might be also divided based on its effect – *positive and negative priming*. It was previously mentioned that stimuli can either increase or decrease the respective reaction time needed to associate a given prime with a target. Therefore, positive and negative priming revolve around the processing speed, and hence with the activation of concepts and actions related to a prime. For instance, a negative prime will decrease the activation of particular schema due to disruption effect on attention. This competition translates into a situation in which the primary concept (typically the most highly activated one) will tend to decrease or inhibit the activation of a competing concept e.g. the concept of coffee may inhibit the concept of milk.

The concept of *negative priming* can also be exhibited and understood when the same individual belongs to two different stereotypic categories that are characterised by distinct competing information and properties. For instance, a woman who is a 'mother' (specific priming traits such as caring and warm) and a lawyer (with perhaps opposite priming traits). Therefore, in such cases, negative priming can trigger selective attention depending on the prevalent or primary stereotype and can evaluate the ability to maintain an active attention on a given task while inhibiting and limiting information that are either secondary or irrelevant (Frings, Schneider, & Fox, 2015).

However, an additional distinction can be made with respect how priming is delivered or presented to the individual. For instance, in subliminal priming the prime is delivered to individuals without them actively noticing its presence or its effect. In fact, subliminal priming can influence detection and pattern recognition (Neumann & Klotz, 1994), thus rendering human behaviour dependable on sensory information that they are practically unaware of (Jaskowski & Verleger, 2007).

4.5 Cross-modal priming classification

Baudelaire has in 1857 already formed the thought that became studied across the fields when he mentioned that: "*Perfumes, sounds, and colours correspond.*" Thus,

cross-modal priming involves a multisensory integration regarding how different senses can interact with one another to produce an end result that will structure and formulate consumers' perception. In other words, cross-modal priming is the effect which is also known as cross-modal correspondence. In principle, there are three distinct cross-modal correspondences that can be used in priming: *structural*, *statistical* and *semantically mediated* correspondences, each one having a different developmental trajectory but also consequences on consumer perception and behaviour (Spence, 2011).

The first type of cross-modal correspondence happens to be connected together in nature such as the natural correlation of lemon fruit with yellow colour and the citrusy scent. Due to its numerous occurrences, and the consequent frequent exposure to humans, is therefore named statistical. This form of correspondence could be explained by associative learning. An example might be that individuals tend to associate brighter lights with louder sounds, and dimmed lights with softer sounds. These effects are attributed to the respective adaptations to a given environment. For instance, the impact of dimensions (such as loudness and size or itch and size) is perceived in a very similar manner by the human brain. In fact, and as noted by Brunel, Carvalho, & Goldstone (2015): "*Larger, louder, and lower pitched values are all perceived as having greater magnitudes than their opposing smaller, quieter, and higher pitched values*" (p. 361).

The second type is called structural and it may be caused by neural connections in the brain. Those connections are seemingly present at birth and past research has shown evidence of existence of such early correspondences (Mondloch & Maurer, 2004; see also Marks, 1987a; Wagner & Dobkins, 2009). The origin is hypothesised to be somehow integrated in the formation of perceptual system (Marks et al., 1978b). This phenomenon cannot be simply explained by associative learning. In order to be certain that cross-modal correspondence is structural, it is necessary to test the hypothesis on both – new-borns and adults.

The third type is semantically mediated and occurs when people use semantic terms to describe a stimulus that overlap in two dimensions, or modalities. An example might be the words "low" and "high", which could be both used to describe the elevation of a visual stimulus and the pitch of a sound (Spence, 2011). Thus, this type results from semantic similarities of terms relating to stimulus utilising different modality (vision,

hearing). Furthermore, semantic cross-modal correspondences have been shown to emerge and be prevalent following language development. In fact, it is language development that allows the conscious – but also unconscious – association between two or more perceptual modes. This is exactly why semantic correspondences are suggested to be exclusively contextually determined (there are no absolute matches between stimuli and the modalities) and could be classified also as cross-modal correspondences.

Spence (2011) further claims that these three kinds of cross-modal correspondences may impact human information processing in a different way. This categorisation is by no means all-encompassing and other ways of categorisation might be as well proposed.

While some cross-modal correspondences may be deduced from certain statistical regularities which are observable in the nature, environment and society (in consistency with the Bayesian integration theory mentioned earlier in the literature review), others may be the result of the sensory information coding process (see Marks, 1987a; Mondloch & Maurer, 2004; S. S. Stevens, 1957; Walsh, 2003). Many cross-modal correspondences are shared across cultures, some are different across cultures, while some would be seemingly global (Bremner et al., 2013; Dolscheid et al., 2014).

It has been demonstrated that cross-modal correspondences might influence the speed (see Stroop effect) and in the case of olfactory stimuli also the accuracy of information retrieval (Spence, 2011). In addition, Kovic et al. (2009) and Seo et al. (2010) have demonstrated in their electrophysiological studies that congruent cross-modal correspondence may speed up the neural response effect and also enhance the amplitude (Spence, 2011).

This leads us to the next question posed by Spence (2011) who states that the summarised findings on cross-modal correspondences do not necessarily suggest that they are somehow grounded at the perceptual level, but in fact might originate in the decision-making process or response selection (Marks et al., 2003). Moreover, Spence (2011) concludes that the process, at least in some cases, might occur automatically, hence without the contribution of higher cognitive processes.

4.6 Priming and sensory marketing

Sensory marketing is the one that affects our senses and influences behaviour through subconscious notions. As such, priming, similarly to cross-modal correspondences is a concept that is well-explored in the literature and is known to affect human behaviour through perception of certain stimuli. However, activation of a response tendency in consumers usually occurs through a priming task in which customers are engaged in an ostensibly unrelated activity that ‘masks’ the real concepts that will subsequently influence their judgment and selection (Janiszewski & Wyer Jr., 2014). Subtle cues within the consumer’s environment can have a profound impact on how consumers will react to a given marketing message. For instance, playing German or French music can highly influence the consumer’s decision and choice to buy wine (North, Hargreaves, & McKendrick, 1999). Therefore, sensory marketers can utilise the power of such concepts in order to not only control but also to enhance the media context within which the true brand message is ‘encased’. This can be, by all means, applied as well to the product marketing.

In other words, priming can shape what marketers want people to do because priming can have a profound impact on behaviour. Therefore, and owing to its distinct connection to cognition, sensory marketing can also be used to shape everything we do or think. For instance, Doyen et al. (2012), demonstrated that priming can be extended to reinforce good behaviour, whereas De Lucia (2015) states that priming can also be used to convey and enhance confidence, especially to people that need motivation.

4.7 The effect of colour and odour on human behaviour

The oldest studies of smell can be traced back to psychology and fundamental sciences. Many papers have been published on odour recognition (Crowder & Schab, 1995; de Wijk, Schab, & Cain, 1995; Lawless & Engen, 1977) and its impact on memory. More specifically, Herz (2007) concluded that memories associated with scent retrieval cues were regarded as more emotional than those evoked by the other senses. Other researchers found (Krishna et al., 2010) that scent enhances the recall of verbal information presented with the product. Furthermore, it has been documented that pleasant scents can enhance customer experience and also favourably influence store

and product evaluations (Bosmans, 2006; Herz, 2007; Spangenberg, Crowley & Henderson, 1996; Bitner 1992; Gulas & Bloch, 1995; Gorn, Pham, & Sin 2001; Zeithaml & Bitner 2000), encouraging a visit to the store or affect the decision to return to it (Bone & Ellen, 1999). Previous work has identified that humans often experience problems when assigning verbal attributes to scents (de Wijk et al., 1995; Lawless & Engen, 1977). However, the human memory can preserve extensive information about them (Crowder & Schab, 1995). An interesting study conducted by Engen & Ross (1973) showed that the recognition of various scents lasts longer compared to visual stimulants. Even earlier, Ebbinghaus (1913) claimed that the memories gathered by other senses than smell tend to disappear quicker which is somehow contradicted by the claim by Carlson (2010) where the sensory information are stored in sensory memory only long-enough to be transferred to short-term memory. It seems that the evidence of the exact functions of sensory memory is rather scarce and the criteria why some olfactory information are preserved in long-term memory remain to be unknown. Moreover, Chu & Downes (2002) discovered that autobiographical information accompanied by incongruent olfactory cues are more detailed, followed by Willander & Larsson (2006) who studied the effect of different cues (visual, semantic and olfactory) on recall of autobiographical information in elderlies. Their result demonstrated that the memory where olfactory information is stored might work differently than the other types, since the memories associated with olfactory cues were much older than the other ones.

More recent research suggests that the sense of smell is critical to the perception of flavours; can affect our mood, promote products or position a brand (Herz, 2007; Morrin, 2010). Interestingly, not only the type of sensory input plays a role, but also the order of sampled products. An examination of the orders of product testing has been studied by Biswas et al. (2014) and the study concluded that when two sampled products have similar sensory cues (e.g., olfactory and visual), the vast majority of the participants would prefer the product sampled first. On the other hand, when the sequentially sampled products have dissimilar sensory cues, there will be greater preference for the product sampled last.

According to Hultén et al. (2009), sensory marketing, and therefore also singular aspects such as colour and odour, can contribute to an individual's final purchase as well as consumption experience. Despite this, few studies that focused on the effect

of scented environment showed mixed results. Knasko et al. (1990) found that customers stayed longer in the store with fragrance presence, but this did not impair their purchase intentions. It was argued that the settings of the experiments were within a jewellery store and therefore the expenditure would have to be relatively high. Hirsch (1995) conducted the same research within a casino and results showed that players stayed longer and subsequently spent more when the fragrance was present in the environment. This might show that if the consumer forms an intention to purchase a product a prior entering the store, scent might favourably affect the final decision. However, if there are other important aspects such as functionality or cost, sensory attributes are not that powerful. This further suggests that sensory cues might work the best when it comes to cheaper products, for example in the FMCG (Fast moving consumer goods) sector. Moreover, the selection of the scent (and individual favourability) probably also played a key role in both experiments.

Despite relatively many studies on scent in the store environment, the ones concerning product scent are relatively scarce. Gatti, Bordegoni, & Spence (2014) examined the effect of product's weight (in this case a liquid bath soap), colour and different perfume concentrations on perceived intensity and efficacy. The perceived fragrance intensity was significantly enhanced when the soap was coloured. The perceived efficacy was also enhanced when the soap weighted more. However, the research was conducted on very small sample of participants (20) and hence requires further validation.

Another research conducted by Van Doorn et al. (2014) showed that colour of the mug affects the perception of taste, thus the ratings of a hot beverage. Café latté was served in transparent and white mug and showed significant differences when it comes to evaluating the intensity. When consumed from the white mug, the intensity ratings were higher as opposed to coffee served in transparent mug. This suggests, due to similarity of taste and smell, that colour might play a role in perceived intensity ratings of both – taste and scent.

Elaborating further on the effect of colour and odour, it has been shown that colour cues can bias odour judgments (Engen, 1972; Zellner & Kautz, 1990). In the first case, Engen (1972) found that adding colour increases the inaccuracy of odour recognition.

In the second case, the authors found again that coloured solutions were rated as more intensive than the transparent ones.

Moreover, there is evidence suggesting that the appropriateness of the colour-odour pairing determines whether the bias aids or impairs performance (Burghardt, 1977; Davis, 1981; Zellner, Bartoli & Eckard, 1991). Appropriate colours increase and inappropriate colours reduce the accuracy of odour identification. These findings suggest that there might exist such correct associations of colours for odours and it might at least help the consumer to recognise the given scent.

There are many early studies on the effect of colour on food, such as the one by Gormley (1992) who found that consumers regardless of their ethnicity or sex prefer more orange colour of salmon. In fact, there are many every day examples of artificial colouring in food in order to increase the sensation (special editions of green beer for St. Patrick's day in the UK), but they are usually carefully marketed for certain occasions where the consumers are prone to experiment. In Czech context, one of the foremost examples is the yellow coloured chicken called "golden". Here, the colour is determined by nutriment and the colour serves as a source of differentiation and a sign of better quality (e.g. it is claimed that the chicken has more space and longer life). A study by Carpenter, Cornforth & Whittier (2001) shown that colour or packaging does not affect taste scores, but Piqueras-Fiszman & Spence (2012) later demonstrated that the colour of packaging has an effect on overall evaluation of the consumption experience.

In addition, research into food liking among children has shown the importance of colour as a variable (Léon, Couronne, Marcuz, & Köster, 1999). Marshall, Stuart, & Bell (2006) investigated this further and the results showed a high correlation between favourite colour and choice of product across the total sample of pre-school children. They were also able to identify the most popular colour choices. It seems that the concept of colour favourability is more important for children, perhaps due to their attempt to define themselves and less important to adults who have already defined themselves by other means. Alternative explanation might be that children still form established concepts (and cross-modal correspondences) and therefore are more inclined to pay greater attention to them.

This is further supported by study of the effect of colour on purchase decisions by Yu et al. (2018), who found that personal colour preferences affect intended product-colour purchase decisions but that the extent of this varies from one product category to the next and moreover that personal colour preferences are secondary to colour functionality and colour performance in adults.

Hultén, et al. (2009) summarise that our senses play a crucial role in the emotional, aesthetic and sensory aspects in selection of a product, but there are also functional aspects that should not be overlooked and possibly play a more important role. Despite this, firms should try to influence their customers in new, original ways and sensory marketing might be the tool. Krishna (2012) also reveals core aspects of sensory marketing as today when potential customers are being overwhelmed by hundreds of advertisements every day, the approach of companies like Orangina might be much more trustworthy and generate positive deductions over brand (Sengupta & Gorn, 2012). The novelty might also be an important aspect and it might enhance attention towards the product.

There are many other studies that focus on cross-modal correspondences (for example see Mattila & Wirtz, 2001; Spangenberg et al., 2003; Spence, 2011) which demonstrate a link between other senses than only olfaction and vision. For instance, what we see in a room might be also influenced by what we smell or what we listen to at the time (Demattè, Osterbauer, & Spence, 2007; Spence, 2011).

The literature review illustrates that there is a growing body of research on both – the cross-modal correspondences, but also the singular effect of colour and odour. However, up to date and to the best knowledge of the author, there is no evidence showing the combined effect of product colour and odour on consumer preference ratings, and more essentially, the effect of congruence in relation to preference.

4.8 Cross-modal correspondences between colour and odour

Here, it is important to highlight the effect of cross-modal correspondences, in which different senses interact with each other. In other words, cross-modal correspondences try to investigate and illustrate how two sensory percepts are integrated to form sensation. For example, a scented paper will feel (will be perceived as) much softer and attractive when it has a feminine smell compared to a masculine one to both sexes

(Lintellè, 2014). The psychologists have known about cross-modal correspondences for many years now (Fox, 1935; Jespersen, 1922; Köhler, 1929; Newman, 1933; Sapir, 1929; Wertheimer, 1958), but used various terms to describe it such as cross-modal associations. Moreover, there are other terms which refer to the similar effect used in the literature review (*cross-modal priming*, *sensory transference*) that could be classified in the same manner, although there are some differences as identified earlier.

Despite many studies that support and document the immense interconnectivity between perception of odours and perception of colours, the science is still awaiting a sufficient explanation of the cause. Generally, three aforementioned different mechanisms have been postulated to account for cross-modal correspondences (Schifferstein & Tanudjaja, 2004, Spence, 2011; see page 52 for classification).

The effect of culture was not extensively studied, but Jacquot et al. (2016) demonstrate that although they have been able to find some common patterns between British and French participants, some colour-odour correspondences differ. Whilst some cross-modal correspondences might have quite straight-forward explanation (such as associative learning where strawberry is usually red), it does not provide a sufficient basis to other cross-modal correspondences such as people connecting certain odours with high pitch sounds (Crisinel & Spence, 2012). It might be hypothesised that specifically odours elicit some sort of emotional response and it is not possible to explain the effect purely by associative learning.

Furthermore, and as demonstrated in this literature review, the physiological properties of the brain might cause the effect somewhere in the process of encoding an information due to its physical proximity. Alternative, and much more complex view, is offered by Bayesian or maximum-likelihood estimation method as mentioned earlier. This view is also supported by Klemen & Chambers (2012) who claim that spatial relations do not affect the earliest sensory processing components.

In fact, and as noted by Chen & Spence (2010), humans are far more capable of recognising and categorising multisensory events as opposed to single sense ones. More interestingly, it has also been shown that individuals are more prone to spontaneously collectively associate sensory components from distinct modalities in a consistent, yet specific manner e.g. shape and word sound i.e. *Bouda* is perceived

as a round object, whereas *kiki* is perceived as an angular one (Ramachandran & Hubbard, 2001). For marketing purposes, it is substantial to know about the existence of such phenomena and find out how the current knowledge might be applicable to product marketing or perhaps advertising.

One of the most prominent examples is McGurk's effect where the visual and auditory perception together create a multisensory illusion (McGurk & Macdonald, 1976) in the same manner as optical illusions are created. The cross-modal correspondences have been proven to exist between various sensory modalities, such as between vision and touch; audition and touch or tastes and sounds (see Spence, 2011 for full review). However, there are very few articles dedicated to cross-modal correspondences between olfaction and vision, specifically focusing on colour and odour perception.

Some early research by Marks (1978a) points out a thin line between a known condition and cross-modal correspondences: *"Whereas coloured hearing synaesthesia is dominated by regular and systematic correlations between visual and auditory dimensions of sensory experience, other forms of synaesthesia are generally much more erratic and idiosyncratic, in that they rarely reveal common patterns or dimensions"* (pp. 98-99). Synaesthesia is an ability to, for example, see numbers by means of colours. It is a neurological condition where the senses that are not normally connected, merge together. Those with this type of condition exhibit the same pattern of connections during their life. In contrast to the quote, there have been many types of synaesthesia identified which appear consistent over time (for example between taste, sound and colours). However, and despite being similar in nature, cross-modal correspondences may be observed in the entire population, whilst it does not mean that all people have synaesthesia. The fundamental difference is that while cross-modal correspondences result in an altered perception as one sense affects the other, synaesthesia means perception from one sense that triggers an experience in another sense (it is really possible to feel the taste of a sound in mouth).

Moreover, Ehrlichman & Bastone (1992) argued that widely held view is that odour associations, preferences, and memories originate from idiosyncratic personal experience. This view was opposed by Gilbert et al. (1996) who showed the evidence that common colour-odour correspondences exist and show a similar degree of consistency over time (Figure 9). Due to high relevance and some degree

of similarity of this study with the research questions, it is important to explicitly show the results of the study and explaining the procedures.

Although this research study managed to confirm certain significant common patterns between colour and odour, the effect of congruent colour to an odour on preference still remains unexplored. The procedure of the experiments differed because the participants had to select a colour chip appropriate to the smelled odour. Moreover, the study was conducted on 94 participants, leaving room for further validation.

Still, some interesting combinations of corresponding colours and odours that deserve discussion resulted from this study. For example, lavender oil was evaluated mostly as yellow. Pine Yarnor Oil, possibly the most similar to the bracken scent, was mostly evaluated as green. Bergamot oil, which is similar to lemon or orange, was mostly evaluated as yellow; followed by orange and green. The scent of bracken, lemon, orange and lavender will be a subject of further testing. This is why the explicit notions of the results might be interesting in comparison with the actual results of the research. In any case, the existence of cross-modal correspondences which are consistent and according to Gilbert et al. (1996) are distinct from synaesthesia, were verified.

Since the potential of a system which communicates fragrances through colours and not semantically is desirable by companies, there were also several attempts to design one (Cooper & Branthwaite 2002; Mensing & Beck 1988). However, there is still some criticism as Schifferstein & Tanudjaja (2004) propose that there is still a lack of empirical evidence and the basis are not sufficient.

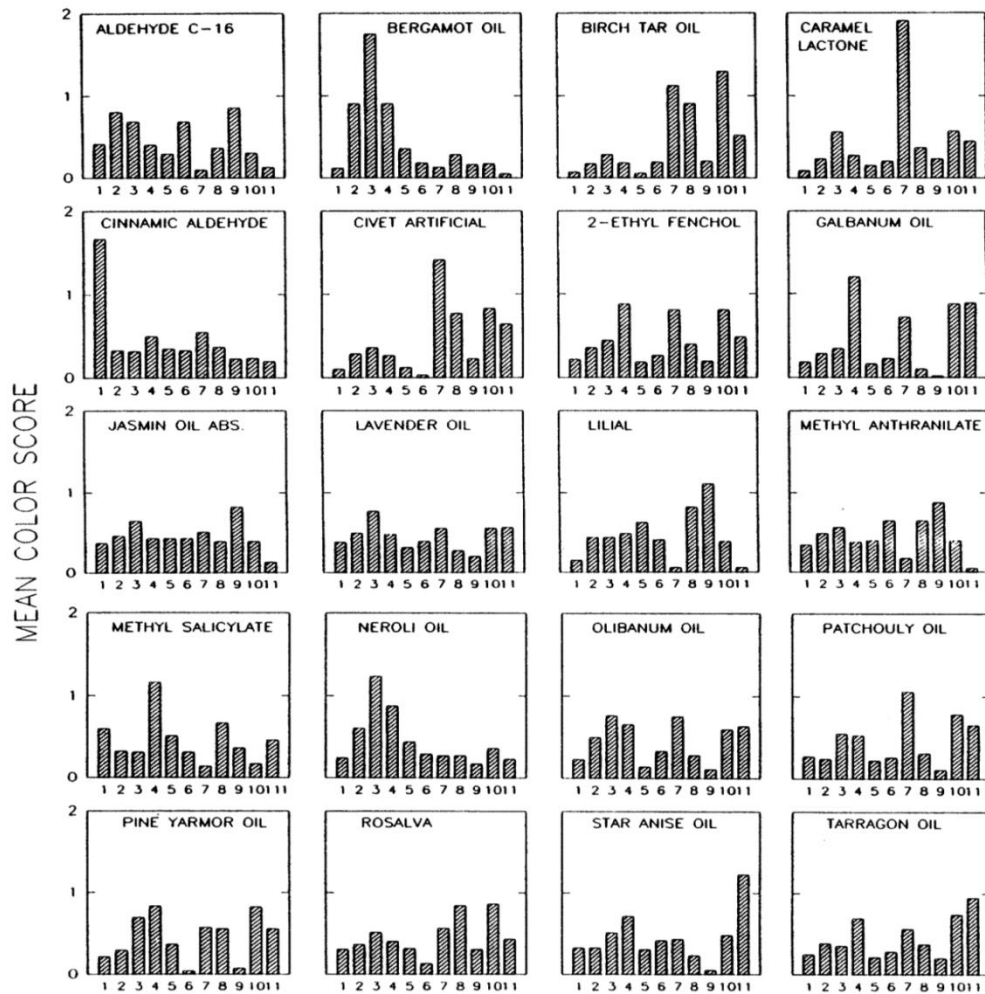


Figure 9: Experiment results: Colour-odour cross-modal correspondences

Gilbert et al., 1996, p.341

Figure 9 shows graphs of mean colour scores for odour stimuli as specified. The key is 1 = red, 2 = orange, 3 = yellow, 4 = green, 5 = blue, 6 = purple, 7 = brown, 8 = white, 9 = pink, 10 = grey, 11 = black colour.

4.9 Expectations

The human information processing is affected by more than the aforementioned concepts of sensory perception and sensation, cross-modal correspondences, sensation transference and priming. There are also consciously established concepts which might subconsciously affect human judgement – formed expectation about product characteristics. However, the question is how can these formed expectations affect perception?

Daily interactions with the world around us make individuals form expectations regarding stimuli that they may encounter in their lives. There is a plethora of studies highlighting that people's sensory experiences are not solely affected by bottom-up processes (i.e. processes defined by external stimuli) but also by top-down processes such as expectations and prior desires (Stokes, Matthen, & Biggs, 2015).

In marketing, there is a famous anecdote that has been replicated many times later with various products (such as Coca-Cola vs Pepsi, Heinz vs Tesco ketchup etc.). which illustrates how perception interacts with formed expectations. A prominent example demonstrating the effect of expectations is the famous Pepsi-Cola case. In this experiment described by Kuhn S. & Gallinat (2013), people were asked to rate the taste of Coke and Pepsi. In principle, Coke will usually promote the higher ratings; yet, this is true only provided that it is consumed from the correctly labelled cup i.e. Coke from a Coke cup and Pepsi from a Pepsi cup. However, if the labelled cups are switched (e.g. label the Pepsi content as Coke), then Pepsi is the brand that gets the better gustatory feedback. This example illustrates that perception is not an isolated process and emotional or cognitive processing might affect human judgments. Moreover, this research is about evaluation of preference and intensity and it is important to point out all the factors that might affect the ratings.

An additional example demonstrating the effect of top-down processes was performed by Friedman & Dipple (1978), in which male participants were found to enjoy smoking cigarettes that had a masculine name as opposed to female participants that enjoyed smoking cigarettes with a feminine name – despite the fact that all cigarettes used in this research study were identical. Moreover, there are many more examples such as film enjoyment (Geers & Lassiter, 2005), assessments of a person's ability (Darley & Gross, 1983), nutrition bars (Wansink et al., 2000), vanilla ice cream (Bowen et al., 1992), etc., which all demonstrate the same effect.

Interestingly, it appears that visual variables are probably central to forming an expectation of a food's flavour (Stevenson, 2009). While small deviations may not be noticed, large deviations are attention demanding and generally aversive. For example, participants told to expect an ice cream, but who were in fact given a savoury salmon flavoured mousse resembling strawberry ice cream, reported significantly more negative evaluations when they tasted it, compared to participants

who received no information or those who were told to expect salmon flavoured mousse (Yeomans et al. 2008). The consequences for marketing products are easy to identify – when there is some kind of sensory deviation (such as previously used example of transparent Pepsi), it is important to notify the customers ahead of the launch. Moreover, it is essential to effectively inform the consumers about the unchanged ingredients. In this way, the marketer might help towards favourable perception of changed attributes of a product. In addition, it is possible to launch the product as limited or seasonal edition and test the attitudes without significant risks.

In any case, it comes as no surprise that perception is far from an isolated process and that the process of simply changing information about a product will generate a different perception by the audience, a fact that underlines the power of expectations. In fact, and as noted by Kanwisher, & Wojciulik (2000), expectations facilitate distinct behavioural changes and norms that are accompanied by increases in neural activity in order to more efficiently process the subsequent stimuli containing related attributes.

Expectations in literature are most often associated with food, thus they can be distinguished into hedonic and sensory based expectations. The first category involves the perception that a given food or product contains certain sensory attributes that satisfy individuals, whereas the second one involves the belief that a product or food will be liked or disliked to a certain degree. Both categories highlight the concept of perceived quality that combines experience (as a result of already using a given product) and expected quality. Going back to the nutritional bars example that was stated earlier, customers are bound to select a product if it advertises itself as "low-calories" or "great energy bar" even if its content is identical with a nutritional bar that does not have these indications on its cover. Therefore, perceived quality cannot be objectively determined because it involves the concept of perception but it is connected with judgments regarding what is important to the customers involved (Marakanon & Panjakajornsak, 2017).

Another concept which is well-known in marketing is the previously mentioned pairing by association (Deese, 1967), that could be also described as the reverse effect of expectations or perhaps as a form of association learning. Earlier in this thesis, this effect has been also described as associative priming. In order to give an example, beautiful women are often paired with cars in advertising. If this pairing is observed

often, it might form expectations that translate into simple conditioning – if a man has a car, he would also have a beautiful woman. Now this does not ultimately mean that every man would purchase a car because he thinks that it would guarantee that he has a beautiful woman, but it would trigger desires which is, in essence, the point of advertising. From the studies of cross-modal correspondences, it might as well be that this effect equally occurs in our sensory perception. For example, if a blanket is often perceived as soft, this characteristic would be also expected when touching similar products and other perception might result in disappointment, and of course, lower sales. This is why it is important to account for expectations also in cross-modal studies, especially when it comes to evaluations of sensory characteristics.

In summary, all these previously stated studies have simply developed experiments and research protocols in order to register the effect of expectations on perception but they fail to identify how exactly top-down processes change individuals' observations and/or judgments, so they are limited to pure illustration of such phenomenon and confirmation of its existence. On the other hand, it is safe to claim that expectations also play a role in human judgement and they may be somehow linked to the phenomenon of cross-modal correspondences.

4.10 The Implications from the Chapter 4

The concept of perception is integral to sensory marketing as it forms the meaning about the external stimuli. The priming and cross-modal correspondences together with expectations all affect human perception and subsequently also judgment and behaviour.

The section 4.5 summarised all the types of cross-modal correspondences which will be elaborated further in the next section and the types of propositions will be based on these types as they may impact information processing differently.

The studies that focused on the effect of singular aspects of colour and odour were presented. In addition, the findings of the studies that focused on cross-modal correspondences were summarised. They will be later compared to the findings from this research. At the end of the thesis, it should be also possible to conclude if expectations play a role in determining preference and intensity levels.

Chapter 5

Implications for the study

This is a condensed summary of the previous chapters and it is presented with an emphasis on a) the non-academic stakeholders with a focus on the product creation, innovation and design and b) implications for the subsequent propositions and the experiment.

5.1 The introduction summary

The literature review introduced the concepts that have been proven to affect the consumer behaviour in some way. Due to their profound impact on human senses, all these effects (*sensation transference*, *cross-modal correspondences*, *priming*, *expectations* and *novelty*) might be considered as essential principles that form the basis of sensory marketing. While some of these concepts occur consciously, some of them are automatic (Spence, 2011).

Given that the study focuses on olfaction and vision, and scent is the most important factor for soft beverages, body lotions, skin care products, household maintenance and cleaning products (Wolfe & Busch (1991), the results will be the most beneficial for manufacturers of such products, where colour and odour selection plays an important role. In the future, technical advancements might also add the olfactory or haptic perceptory dimension to our virtual experiences, and therefore – online shopping. The distribution channels might also affect and alter the perceived characteristics of the products. The direct effect of simultaneously perceived choice of colour and odour on preference and intensity ratings might potentially increase or decrease the sales due to their potential impact on decision-making process. Now, the choice of colour and odour combination might not overall significantly impact the increased preferences in terms of percentage. However, even for example 1 % of increased preference ratings might play an important role for revenues, especially when it comes to sales of relatively cheap and widely available products.

The first chapter served as an extended introduction and clarified all the terms used in this thesis as they can be sometimes used interchangeably, but there are also some

minor differences. It is important to understand the term cross-modal correspondences, which could be defined as the existence of certain sensory connectivity in human perception which can be commonly found and somehow corresponds with each other (for instance how shape affects the taste). It could be also summarised as certain compatibility effect between two dimensions or two dimensions and a stimulus (Spence, 2011). In this thesis, the effect of colour on the perception of odour will be studied, and the effect will be measured by perceived a) intensity and b) preference ratings. In the literature, priming subcategories also include cross-modal priming, that might be therefore viewed as a sub-part of priming. Since the sources about cross-modal correspondences are limited, it appeared beneficial to include the theory on priming as it might as well be the same effect; at least according to some researchers.

5.2 Contextual background

The second chapter introduced the contextual background of sensory marketing and presented several views on its theoretical categorisation. Sensory marketing could be seen as one part of experiential marketing. Also, some tendencies in approaches to studies of consumer behaviour were identified – such as the shift to neurophysiological approaches to consumer behaviour. This was followed by a brief summary of the history of olfaction in relation to marketing. One of the greatest discoveries of recent years was the one of olfactory receptors. However, for the purposes of the dissertation, it was not necessary to include all the details about the physiological processes. Despite this, some well-written reviews are suggested. In addition, it was demonstrated that the understanding of product differentiation by adding colour and scent appeared already in the 4th century B.C. in Egypt. It appeared valuable to illustrate how contemporary companies use scent in order to influence a consumer and stress the importance of company's involvement by the next section that focused on numerous examples of scent marketing in practice. All these sections are of more theoretical value to the reader, but they also provide sufficient context of the study.

5.3 Classification of odours – intensity and types

However, the last two sections of the second chapter are of a particular interest because the findings need to be accounted for in the research methodology. It was identified that

up to this date, there is no unified scheme for measuring odour intensity and some chemical compounds might result in higher intensity perception while others in lower intensity perception. Therefore, it is not only about unified mixtures of ingredients, but also about the type of the ingredient. This will be reflected by the specific design of the experiment where the higher or lower intensity rating of a specific odour does not play a major role.

Moreover, it was identified that some percentage of population may have specific types of loss of smell. It is necessary to control for the loss of smell (anosmia), but it is practically impossible to control for individual chemical compounds impairments. Still, the scents selected should not contain any typical ingredients that are known to not to be perceived by large group of population. On the other hand, the threshold of concentration detection of perfume in humans is not very sensitive and therefore minor deviations in concentration should not play a role. In other words, some errors with regards to concentration of the fragrance (e.g. caused by the manufacturing process or human factor) is acceptable. In addition, there is no unified scheme for odour distinction by its type. Across practitioners, there are several proposed types of classification with some minor amendments. Therefore, the types of fragrances might be communicated as suggested by the fragrance wheel, but it will serve only as a basis to describe the odour types and they are unable to represent the complexity of the odour.

5.4 The factors affecting preference of odours

The factors that were identified that could affect the odour perception led to the debate whether the preference or avoidance towards scents is learned or innate. It seems that more research supports the argument that it is learned through associative learning.

In addition, the evidence shows that culture affects the perception of scent and its preference. Furthermore, the preference or avoidance towards scents is not binary as there are always individuals that find a particular smell attractive while others do not. Empirical data also showed that familiar and pleasant scents might be correlates. If the preference or avoidance is learned through associative learning and also familiar scents are evaluated as more pleasant, the familiar and learned combinations of colours and odours might be also preferable. These findings again illustrate the importance of controlling the participants for their culture or their nationality as this might affect

the results with regards to perception. It is also recommended that researchers control for variables such as age and gender, since it may all affect olfactory and colour perception. Elderly participants might also be in some cases excluded from olfactory studies (Kaeppeler and Mueller, 2012), which is the case in this study. The reason behind this is that it might lower the effect of cross-modal correspondences due to decreased ability to see and smell.

5.5 Origins of cross-modal correspondences

The third chapter focuses on possible explanation of the existence and origins of cross-modal correspondences. Although, cross-modal correspondences might differ in their origin (semantically-mediated, statistical, structural), their existence has not been fully explained due to presented limitations in neuroscience and limited knowledge about human information processing. The effect on preference ratings and thus the higher cognitive processes including decision-making has not been previously examined. The obvious barriers to researching consumer mind are the limitations in knowledge of the good underlying general models of the human brain, the processes that form and decide human behaviour, advancement of technology, excellent understanding of the brain activity or brain imaging measurement methods, and most importantly a valid data analysis. This is why a considerable part of the review focused primarily on discussion and attempted to provide a comprehensive overview of the most relevant theories to human information processing, brain functions, memory processing, knowledge formation, multi-sensory information processing and embodied cognition that might clarify the existence of cross-modal correspondences.

5.6 Sensory memory

The review further identified already existing knowledge in biology that is applicable to the explanation of the effect of novelty in marketing. Sensory memory, or perhaps some connected system, although being selective, helps humans to detect unusual, potentially hazardous events or subjects in the external environment. In order to do so, the memory system has to be able to detect any possible violations against the established model (Tiitinen et al., 1994). This essentially describes why an increased attention is usually given to new or changed products. Unfortunately, this explanation does not provide an answer to why some sensory deviations are accepted positively,

while others are not. Furthermore, three established concepts of memory have been described – and these differ in terms of information storing (Schacter & Tulving, 1990). If the concept is correct, then olfactory information is probably retained in implicit memory, rather than explicit, and hence, it provides an explanation to difficult recall of olfactory information as opposed to when it is triggered by external stimuli and easily retrieved from implicit memory. In any case, the difficulty with recalling the odours should be acknowledged in the methodology.

This third chapter might be useful for marketers or scientists should they wish to understand the current level of scientific knowledge and look for the underlining principles that form the basis of sensory marketing. In addition, it provides numerous examples of conducted research on cross-modal correspondences through the text. Some of the theories presented in this section might be discussed again in the conclusions. While it is not possible to verify them with certainty, the findings of this research might contribute to sensory marketing.

5.7 The principles of perceptory bias

Finally, due to the profound impact of sensory information on human perception, the fourth chapter focused on the examination of all the previously defined terms such as priming, cross-modal priming, expectations and novelty and how they can affect perception, and subsequently also judgment and behaviour. The concept of perception is integral to sensory marketing as it forms the meaning about the external stimuli. The chapter starts with general overview of the role of perception in relation to sensory marketing and discusses how priming affects perception. The theoretical framework is provided by classification of priming.

The section 4.5 summarised all the types of cross-modal correspondences which will be elaborated further in the next section and the types of propositions will be based on these types as they may impact information processing differently. The three identified types include *structural*, *statistical* and *semantic mediated* correspondences.

5.8 The effect of colour and odour on behaviour

The studies that focused on the effect of singular aspects of colour and odour were also presented in the section 4.7. In addition, the findings of the studies that focused

on cross-modal correspondences were summarised in section 4.8. They will be later compared to the findings from this research, so it is essential to present the most relevant ones also in this summary. It was identified that the sense of smell alone is critical to the perception of flavours, can also affect our mood, promote products or position a brand (Herz, 2007; Morrin, 2010; Martin et al., 2001). Olfactory cues might allow the brand to transmit the values at deeper, emotional level. Scent also facilitates intuitive favour or avoidance towards items such as food, flowers, predators or poisons (Dulac & Axel, 1995). In addition, scent might affect the perceived quality or natural sourcing (Krishna, 2012). Sensory aspects might also enhance positive experience by the added value provided to the consumer (Babin, Darden & Griffin, 1994; Holbrook, 1999). Olfactory cues have been proven to reinforce the recall of verbal information presented simultaneously with the product (Krishna et al., 2010). The effect of scent on behaviour has been also identified – the present scent of pear increased the selection of fruit desserts (Chambaron et al., 2013). However, other studies demonstrated that in order to observe such an effect, there has to be preceding intention to purchase unspecified product (Hirsch, 1995; Knasko et al., 1990), although the precise characteristics might be manipulated. All these results from existing research studies can be instantly applied in marketing practice when branding products and this paragraph also serves as a comprehensive summary of the effects.

Resulting from the findings of the section 4.8, it has been shown that colour might play a role in perceived fragrance intensity ratings (Gatti et al., 2014) and affect perceived taste intensity (Van Doorn et al., 2014). However, both studies were conducted on very small number of participants and used transparent vs. coloured items and therefore may require further validation. Also, both studies wanted to verify similar hypothesis, so the research results will be compared to these two studies. Interesting findings might be also obtained with regards to the examination of different colours and perceived fragrance intensity ratings. While Carpenter, Cornforth & Whittier (2001) have shown that colour or packaging does not affect taste scores, other research by Piqueras-Fiszman & Spence (2012) found that colour alone might affect the overall evaluation of consumption experience. This is of a particular interest when posing the question if colour and odour (and perceived appropriateness or congruency) affects the preference ratings. Again, these findings will be reflected in the final discussion.

5.9 Cross-modal correspondences – previous findings

The cross-modal correspondences between colour and odour have been proven to exist in multiple small-scale studies (Gilbert et al., 1996) and other examples that demonstrate their existence also between other modalities were presented. In other words, the participants were not assigning the colour to an odour at random, but it was possible to find some pattern on which the respondents based their selection. These patterns appeared to be stable over time. Moreover, Velasco et al. (2015) demonstrated Stroop-alike effect in product search which illustrated that the congruent colour of a semantic percept accelerated the product search inside a store. This is valuable notion, since it demonstrates the ratio behind the vastly intuitive selection of implicitly associated semantic description on the product and packaging colour, which can be often observed on regularly sold products. With regards to scent, it has been found that appropriate colours increase and inappropriate colours reduce the accuracy of odour identification (Burghardt, 1977; Davis, 1981; Zellner, Bartoli & Eckard, 1991). The findings demonstrate the Stroop-alike effect, but in this case, it is demonstrated that the same also applies to odour and colour interaction.

It might be proposed that similarly to scent alone being culturally dependant, also colour and odour cross-modal correspondences might be highly affected by the environment. Jacquot et al. (2016) identified that while some colour and odour cross-modal correspondences are the same among British and French participants, others differ. It would be interesting to obtain enough data in order to analyse the possible cultural differences.

5.10 Expectations

An important role is also contributed to expectations. From previously illustrated studies, it can be concluded that if there is some kind of sensory deviation, it is important to notify the customers well prior to launching. Moreover, it is essential to inform the consumers about the unchanged content. In this way, a favourable acceptance of changed sensory attributes of a product might be reinforced. This might be related to the possible negative effects of sensory marketing where the consumer feels mistreated by the company that led him to false beliefs. Semantic descriptions on previously unknown products enhance the choice – semantic terms "low-calories"

or "great energy bar" resulted in more sales as opposed to bars where the information was missing, but they contained equal ingredients. This also illustrates the effect of sensory information that are able to manipulate the beliefs of the consumers. This is why the role of expectations form an inseparable part of sensory marketing.

5.11 Conclusion and implications from the literature review

In conclusion, the first chapter aimed to introduce the dissertation and the methodology. The dissertation map was summarised in order to ease the navigation for the reader. The key aims and objectives were identified and the research questions were posed. The significance of the study and the stakeholder groups that might benefit from this study were clarified. The second chapter then provided more context to the study of sensory marketing. The understanding of the classification of odours and the factors that affect odour perception were identified and will be accounted in the upcoming methodology chapter.

Therefore, the established objectives of the study were accomplished. First of all, the review of existing knowledge on sensory marketing with the focus of understanding the consumer behaviour (1.) was conducted. Also, the key factors that affect colour and odour perception were identified (2.). Moreover, the role of combined effect of colour and odour in relation to consumer preference and perceived intensity ratings was examined, at least in the theoretical perspective by summarising the existing findings (3.). Clearly, this objective will be examined further by the experiment and the set of propositions. The two formulated research questions still remain to be answered.

Although all the summarised concepts are relatively well documented in the literature as separate entities, it appeared necessary to revise the contemporary concepts and knowledge that might be relevant for consumer behaviour and better understanding of sensory marketing concepts.

Chapter 6

Describing the Methods, Hypotheses and Ethics

This section consists of an introduction where the different types of congruencies are defined based on the findings from the literature review. Then, the adopted methodology and the settings of the experiment are outlined. Finally, the hypotheses are precisely defined. The ethics of the experiment are also considered. The Ethics application form is attached in the Appendix (1), but the most important considerations resulting from the experiment procedures with an emphasis on the risk assessment are further discussed. These sections of the chapter form the theoretical part of the methodology.

Then, the practical design of the methodology is described. For each proposition, the selection of participants, method of testing, stimuli and where applicable also the colour blindness test and anosmia test procedures are presented in a great detail. For the experiment, the method is explained separately, although some procedures are the same as for the propositions.

At first, due to the nature of the study of subconscious consumer behaviour, the use of biometric tools appeared to be beneficial. When mapping the aforementioned techniques, some research problems discouraged the author to adopt such methodology. In practical terms, the use of some tools was not recommended because it is necessary to apply liquid on the head of the participant and therefore it is difficult to find participants who are willing to undertake this procedure at the University settings and without financial compensation. Other tools were relatively new and some of them face extensive criticism in academic circles either due to their commercial nature or disputable results. There are also significant ethical concerns or potential health risks. Furthermore, the availability of such tools for experiments was booked up-front for about 2-3 months in advance.

In addition, and as resulted from the literature review, it seems that these methods are not well understood with regards to consumer science and the information that could have been obtained might not always reflect causality, hence the explanation of the effects would be still scarce. Secondly, financial and time-related constraints did not allow to use a combination of at least two tools which are recommended to provide

more objective data results. Moreover, the number of participants due to availability of such tools and financial constraints is often not representative. For example, only 10 to 20 participants are often used to test the hypothesis using fMRI. This is a source of extensive criticism because the results of such studies might not be conclusive and need further replications. Due to perceived vulnerability and limited practical implications of data, the author decided to adopt more conservative methodology based on standard methods for data collection and analysis. The description of the selected methods will be the subject of the following pages.

6.1 Introduction

First of all, the hypothesis should be clearly stated. In order to do so, it is important to define congruent (appropriate) and incongruent (inappropriate) pairings of odour and colour. The importance of this distinction is that while it is possible to experimentally measure which combinations of odour and colour are perceived as preferable and more intense by the correspondents, the results will not be amenable to generalisation and any new combination of colour and odour of interest will have to be measured anew. This issue can be mediated by identification of which (if any) associations models fits the experimentally determined preferences and intensities and subsequently generalised using this model. Regarding this task, it is worth reviewing the association models used by other authors in the field.

Some authors have used appropriate (Burghardt, 1977; Davis, 1981; Zellner, Bartoli & Eckard, 1991) pairings in their research; however, for instance Davis (1981) used quite broad definitions. He defined the congruency of colour for an odour as "*the odour sources in ecologically valid situations*", meaning that for the scent of a banana he used yellow colour cues. Congruent semantic cues were described as the ones that "*contacted the semantic level at which name identification occurs*" (Davis, 1981) without any further clarification. Zellner et al. (1991) assessed the appropriateness from a questionnaire which was distributed to 34 participants. This determined the appropriate vs. inappropriate colour and odour pairings in their experiment. While these results are not valid for the entire population, they could be potentially significant if tested on people sharing the same cultural background.

Gilbert et al. (1996) has identified the most frequent pairings of colour and odour. However, these findings could not be replicated since those might be dependant on culture, the environment, the types of selected essences or even time and therefore may not be entirely valid for the participants mostly from the Czech Republic. While this might not play an important role in the investigation of the effect of cross-modal correspondences on preference and intensity ratings, it could be an important distinction when it comes to the comparison of the models.

In the literature, it is possible to find several groupings of associations which all relate in some way to memory functions. Johnson et al. (1993) classified at least two types of associations as *semantic* and *perceptual*. Clearly, semantic associations refer to the colour of yellow which subsequently activates the association (or concept) of a banana. The *perceptual* associations are the ones that we perceive through senses and hence those that form a *sensation*. However, for the purpose of the study, this explanation is still limited. It is argued that the aforementioned studies could benefit from a clearer definition of congruency between colour and odour. The reason for this claim is that unless the associations model correctly represents the corresponding association frequencies, the results will be affected by the disparity between the model and the reality. Furthermore, by identifying the most fitting association model, it would be possible to identify the best way to deduce the preference when testing any new colour and odour combinations, for example for the commercial products in practice of selecting the colour and odour characteristics most beneficial for selling the product through stimulation of preference ratings.

The first type of association between odour and colour might be simply the one that is based on natural ingredients of the perfumes as used by Davis (1981). Hence, the lavender scent might be usually associated with purple, lemon with yellow, bracken with green and orange scent with orange colour due to their observable pairings in nature. This is similar to the term that explains the origin of cross-modal priming (as defined by Spence, 2011), so the type of this association will be named *statistical*.

Then, it might be simply an instant association of a colour with certain odour depicted by words. For the purpose of this study, this type of association will be named a *semantic association*. No modality (vision or olfaction) should play a role in recalling such connection, but language (and meaning of the words) would be the determining

factor. This form of association might be experimentally tested in different order. For example, if the participants are asked what colour is appropriate pairing for the lemon scent, would they answer the same way if they are asked to answer what is the appropriate scent for yellow colour? This is why there is further distinction needed. Therefore, semantic association might be *odour-colour semantic association* or *colour-odour semantic association* depending on the primary percept. In a complex world, the participants can provide countless answers. However, the focus of the test is only on colour and odour and hence, the participants are forced to operate in restrained conditions and the choice of answers in the questionnaires is pre-determined as a result.

Then, there is other form of congruency, for example showing to a respondent differentially coloured cards and some types of odours where the respondent is required to match pairs that seem the most appropriate (visual modality interacts with the percept first, followed by olfactory modality, thus forming a connection). This involves an interaction of two modalities, and hence, it could be named *perceptual* association. Furthermore, this testing might be done also vice versa – giving the respondent a selection of odours to smell first and then asking to choose one most appropriate colour card for each scent (olfactory modality interacts with the percept first, followed by the visual percept, thus forming a connection). The names for such congruency used in this thesis will be *colour-odour perceptual* and *odour-colour perceptual* associations.

The congruency could be also mixed – for instance giving a participant a choice of written colours (*semantic*) and asking the participant to pair the most appropriate smelled odour (*perceptual*). With the opposite example (seeing first colour and then describing the scent semantically), the limited amount of semantic terms describing various scents would impose extreme difficulties in practice when asking the participants to think of scent that resembles certain colour the most. Therefore, the only applicable form for the purpose of the proposition could be defined as *mixed* or more specifically, *semantically-perceptual associations*.

This introduction forms the basis of the experiment by defining the terms and clarifying the methodology of other authors. It has been argued that there are at least four identified different types of perceived congruency between odour and colour – *statistical*, *semantic*, *perceptual* and *mixed*. The ones that were used in previous studies

might have not been properly defined. They can be further divided with regards to the order of the interaction. It is not known if the reversed effect generates the same end result (first odour and second colour or first colour and second odour), but Gilbert et al. (1996) argued that for perceptual congruency, his results were almost identical. Table 3 summarises the terms and the forms of assessment presented in the introduction for clarity.

Because the goal is to investigate the effect of colour on the perception of odour and, if possible, to identify the appropriate association model, the association models that the propositions will be covering are the following:

- 1) The effect of *statistical* congruency on the prediction of preference and intensity ratings. The appropriate combinations are already defined in this introduction due to possible observation in nature;
- 2) The effect of *perceptual* congruency (*colour-odour perceptual*) on the prediction of preference ratings – this will be assessed through giving the respondents colour chips and then perfume to smell, asking them to assign a congruent colour chip to an odour;
- 3) The effect of *semantic* congruency (*colour-odour semantic*) on the prediction of preference and intensity ratings – this will be assessed by simple online questionnaire where the participants will match colour to appropriate odour in a form of words;
- 4) The effect of *mixed* congruency – this will be assessed by asking the respondents to match written colour to perceived odour (*semantic-perceptual*).

Table 3: Types of assessment of various congruencies between colour and odour

Name of congruency	Distinction by primary percept	Form of Assessment	Result
statistical	Defined in nature	Defined in nature	Defined in nature
perceptual	Colour-odour perceptual	Colour perceived – smelling odour	Will be defined in Proposition 3
	Odour-colour perceptual	Smelling odour-colour chip	Expected to be the same as Proposition 3
semantic	Colour-odour semantic	Colour description-odour description	Will be defined in Proposition 1
	Odour-colour semantic	Odour description-colour description	Expected to be the same as Proposition 1
mixed	Semantic-perceptual	Colour description-odour to smell	Will be defined in Proposition 2
	Perceptual-semantic	Odour description – colour perceived	Expected to be the same as Proposition 2

Source: Author

6.2 Adopted methodology

As mentioned in the introduction of the thesis, in order to investigate the colour-odour effect on preference and intensity ratings, a quantitative approach has been adopted. The data were obtained through a set of propositions. In total, 3 propositions

and an experiment were designed to test the hypotheses. All the procedures that involved scent as a variable were conducted in controlled environment according to the protocol ISO/IEC 8589: "Sensory analysis – General guidance for the design of test rooms". The appropriate room was chosen with a limitation that it had to be within the University of Economics in Prague due to accessibility of the participants. A large lecture hall (Likešova aula, Figure 10) was well-ventilated prior and during all the tests. This allowed to establish a strong cause and effect relationship. However, the limitation of the study is that the results might not be replicable if applied to the real-life settings (such as in a store) because usually there is a spectrum of extraneous variables that cannot be all controlled in the same time.



Figure 10: Picture of the lecture hall where the experiment took place

Source: Author

In an experiment, an independent variable (the cause) is manipulated and the dependent variable (the effect) is measured; any extraneous variables are controlled (MacLeod, 2012). In this experiment, the colour was the independent variable and the dependent variables were the intensity and preference ratings of the scent. The controlled extraneous variables were for example shape, size, texture or perfume concentration. One of the propositions did not involve the variable of scent and that is why it could have been assessed in digital form through the simple semantic association test.

The independent variable in this case is the written colour whilst the dependent variable is a selection of four written odours. Here, the studied effect is the semantic relation between the colour and odour from a set of close ended options. The choices of colours and odours were pre-selected and limited to four options of colours and four options of odours because of resulting 16 possible combinations that needed to be equally distributed across the pool of participants in order to obtain representable data set. Clearly, the more colour and odour options, the more participants would have to take part in the experiment. In total, 421 students of the University of Economics acted as respondents (301 students took part in the experiment and 120 participated in the 3 types of propositions). More participants would not be possible due to limitations in terms of given time frame and financial constraints. Despite this, the design of the experiment allowed to analyse 996 single observations (after clearing the data from those who had either smell deficiency or were partially colour blind) which are considered to be sufficient and way surpassing the number of observations justified in the existing studies in the field of cross-modal correspondences.

6.3 The hypotheses

After defining the possible congruencies, it is possible to define precise hypotheses (Table 4) which will be tested through 3 propositions and, subsequently, the experiment. In general, the H1, H2 and H3 are linked to the previously identified third objective of the study to investigate the role of a combined effect of colour and odour in relation to consumer preference and perceived intensity ratings; followed by the H4 which focuses on the fourth objective of the study that aims to investigate different types of congruencies and their role in estimation of preference and intensity ratings of differently coloured product with different odours. The hypothesis H5_a and H5_b then tests the additional effect of gender and preferred colour, which is precisely the second research question. Through carefully selected research design and the statistical methods, it should be possible to support or reject the formed hypothesis and answer both main research questions.

First hypothesis (H1) will be verified as previous research identified the existence of cross-modal correspondences between colour and odour already (Gilbert et al, 1996). The experiment showed that specific colour has corresponding odour and these results are not, at least in some cases, assigned at random and they are significant.

Table 4: Formulated Hypotheses

H1: Cross-modal correspondences between colour and odour exist.
H2_a: The perceived fragrance preference ratings are affected by colour.
H2_b: The perceived fragrance intensity ratings are affected by colour.
H3: Semantically congruent cross-modal correspondences increase perceived preference ratings.
H4: One of the association models will predict the data results more precisely and therefore would be amenable to be used as a generalisation tool.
H5_a: Individual colour preference might affect the preference ratings significantly if applied to culturally consistent participants.
H5_b: Gender might affect the preference ratings significantly if applied to culturally consistent participants.

Source: Author

Moreover, there are other research papers that demonstrated that vision modality somehow affects the perception of olfactory modality and described the effect. In other words, what we see might manipulate what we smell. However, the specific combinations might be subordinated by culture belonging, the environment, experience and other internal processes such as expectations. The effects of cross-modal correspondences that were examined is that the colour might play a role in perceived fragrance intensity ratings (Gatti et al., 2014) and affects perceived taste intensity (Van Doorn et al., 2014). Unfortunately, both studies were conducted on very small number of participants and therefore require further validation. It would be also interesting to see the colours that increase or decrease the perceived intensity specifically, but both studies used a comparison between transparent and coloured objects. Piqueras-Fiszman & Spence (2012) found that colour alone might affect the overall evaluation of consumption experience which lead to an addition of preference to the concept. There is no research up to this date, at least to the author's knowledge, which studied the effect of colour and odour combination on preference ratings. This is surprising as the effect

of cross-modal correspondences on preference ratings is a valuable notion for marketers and product manufacturers. This is the reason behind the second hypothesis (H2_{a,b}).

The third hypothesis (H3) is based on previous research of those authors that used appropriate (Burghardt, 1977; Davis, 1981; Zellner, Bartoli & Eckard, 1991) pairings in their research. Here, it is argued that the appropriate (congruent) vs. inappropriate (incongruent) pairings were not examined as a whole. Therefore, this led to the necessity of further classification and definition of congruency effect between two modalities or one modality and a word which could be tested. The theory is that somehow congruent cross-modal correspondences increase and incongruent cross-modal correspondences decrease preference ratings, but unlike the previously mentioned studies, the congruency is precisely defined by the first three propositions. Those were designed in order to test the fourth hypothesis (H4) and the results will be interpreted as different operational models (statistical, perceptual, semantic and mixed) for colour and odour congruency. Because the collected data will allow to analyse frequencies of a) preference and b) intensity for different colour and odour combinations, it should be also possible to compare the validity of the 4 operational models. In other words, it would be possible to discover which form of congruency (if any) has the most significant effect on preference ratings and intensity ratings. The last hypothesis was designed to complement the cross-modal correspondence effect by elaborating further on what factors play an important role in the preference ratings of assessed combination effect of colour and odour. Therefore, if proven significant, marketers should account and control for these effects in their sensory characteristics' product testing involving human participants.

6.4 Ethics

Every research that involves human subjects or participants might potentially raise ethical, legal, social and political issues. Although the potential risks within academic marketing research are usually not as high as, for instance, in medicine, it is still necessary to account for the protection of the 421 participants that were involved in this research. Thus, the foremost objective is to not to expose the subjects to any objective danger. Subsequently, the ethics policy advocates to conduct a research that is meaningful for the society as a whole or at least covers the interests of individuals or groups. All the stakeholders of this research were explicitly stated in the first chapter.

Finally, it is recommended and at some institutions also compulsory to undertake the risk assessment, protect the confidentiality of the information provided by the participants and obtain a written consent with the research.

Therefore, all the participants had to sign a consent with the research (Appendix 6). The confidentiality of the information provided was not applicable as the data were completely anonymous and no identity could have been connected to the information provided. Where applicable, the participants agreed with the experiment in a digital form by continuing (no physical signature was obtained) and this was explicitly stated in the on-screen instructions. The participants had the right to withdraw from the study at any time. Moreover, they were allowed to take breaks in between the tasks.

The experiment should have originally taken place at the Anglia Ruskin University in Cambridge, UK, during summer exchange programme. In order to process to the experimental stage, an extensive research ethics application form had to be submitted and evaluated by Research Ethics Committee in order to comply with the Anglia Ruskin University Ethics code. Appendix 1 summarises the issues that were identified during the application stages. The experiment was finally approved with minor revisions, but the application has been withdrawn and the experiment finally took place at the University of Economics due to the end of the funding for the summer programme. Despite this, some valuable insights were applied during the experimental procedure.

One of the risk assessment points resulted in checks whether the participant has identified any allergies to the components of the fragrances. So if confirmed, the scents could have been tailored to each participant accordingly in order to avoid any allergy symptoms. In practice, there was no participant that had stated any known allergies to any of the ingredients. In addition, the chemical compounds of the scents were analysed to not to impose any particular risks to the participants. They were sourced from a well-known French brand and it could be assumed that they were tested on humans prior to launching on the market.

Also, the participants were tested for their ability to smell and recognise colours which might be potentially sensitive issue in terms of revealing some information regarding their health status and therefore, the students took part anonymously in all the studies.

In conclusion, all the care has been given to not to expose the subjects to any potential risks. All the studies were conducted within the rules applied at the University of Economics where the experiment took place.

The Propositions 1, 2 and 3

This part of the methodology describes the process of hypotheses testing through the set of propositions which are minor results that help to prove the hypothesis. The pilot studies were conducted prior to each of the propositions. All the questionnaires were tested on at least five participants. The participants also had to evaluate the clarity of the questions in order to optimise the data collection for statistical analysis. None of the participants of this preliminary study missed an answer to a question or exhibited significant difficulties in understanding the tasks. Therefore, the form of the questionnaires did not require amendments and the research progressed further. Three simple propositions were designed in order to assess the frequencies of different association pairings in population. Out of these propositions, four different models of association pairings (including the statistical one) between colour and odour are proposed. These models are then compared to the experimentally confirmed values in the experiment that is primarily designed to examine the effect of colour and odour combination on the preference and intensity ratings. The results will be presented in more detail in the Empirical results section (Chapter 7) where further explanation of the analysis will be presented.

6.5 Proposition 1

6.5.1 Participants, procedure, stimuli and data analysis

At first, simply designed semantic associations test was distributed to 40 students of the University of Economics in a digital form. The data collection was limited to participants with Czech nationality and the age group between 18 and 24 years. The participants were controlled for their gender, so the proportion of males and females was balanced with only minor deviations (+-3). The justification of the selection of the participants will follow in the experiment. The test was designed to test the semantic associations between the four selected odours and colours (the selection process is further described in section (6.6.3)); more specifically

the lavender, bracken, lemon and orange odours and the yellow, purple, green and orange colours. Therefore, the participants were asked to match a colour to an odour (both in a form of a written word concept). The data were analysed through Microsoft® Excel Package. The results are presented in graphs for each colour in the chapter 7. In addition, Chi-squared test and Cramer's V were calculated.

6.6 Proposition 2

The second proposition was designed in order to assess the *mixed semantic-perceptual colour-odour* congruency. The participants were given a questionnaire and 4 fragrance samples packaged in transparent bottles. The task was to choose one out of 4 written colours (green, yellow, orange and purple) that mostly match each of the subsequently smelled odours (the questionnaire is available in Appendix 2). Moreover, the participants were asked to write the most appropriate association when smelling the fragrance in order to inspect how many participants were knowledgeable of the natural ingredients of the fragrances and recognised the scent.

6.6.1 Participants

In total 40 students from The University of Economics participated in this proposition. Again, the data did not contain participants other than of the Czech nationality. The participants were controlled for their gender, so the proportion of males and females was balanced with only minor deviations (+3). All the participants were in the age group between 18 and 24 years of age. All the participants were tested for anosmia and had to undertake Ishihara colour recognition test; the description of both procedures follows in the section 6.6.2. In total 7 participants were excluded from the data results due to not passing one or both of the tests.

6.6.2 Ishihara colour blindness test, anosmia test and the procedure of sampling

Approximately 8 % of men suffer from colour blindness and 4.5 % women of the entire population (Colour blind awareness, 2018). This is why all the participants were tested for colour blindness (Ishihara colour blindness test, 1917- a screening method for colour recognition) and anosmia test prior to the task. The participants were shown pictures

(see Figure 11) which were pre-selected with an emphasis on the deficiency of colours used in the test. The original test consists out of 10 pictures, but due to the length of the procedure, presenting in total three pictures appeared to be sufficient. The participants had to answer correctly what number they see on the picture. Only the participants with at least any two correct answers were included in the data analysis. One mistake was allowed due to possible errors when viewing the screen from an obtuse angle.

Moreover, the participants had to smell one out of two possible scents – either vinegar or cinnamon oil solution and note the correct answer. Unfortunately, this method also excluded the participants who noted less exact and more emotional answer from the testing (i.e. "Christmas baking" for cinnamon oil solution or "cleaning" for vinegar), despite clear instruction to avoid trans-literal descriptions. Although some researchers included emotional answers in their data analysis, it is argued that it increases the bias as the final data set then might depend on the knowledge or culture of the researcher. The test for anosmia was conducted in accordance with the standard ISO/IEC 8589: "Sensory analysis – General guidance for the design of test rooms". The participants were requested to spray (through an applicator) the solutions twice on the provided white perfume testing stripes. They also obtained coffee beans and were instructed to smell them in between in order to neutralise the scent from the previous sample.

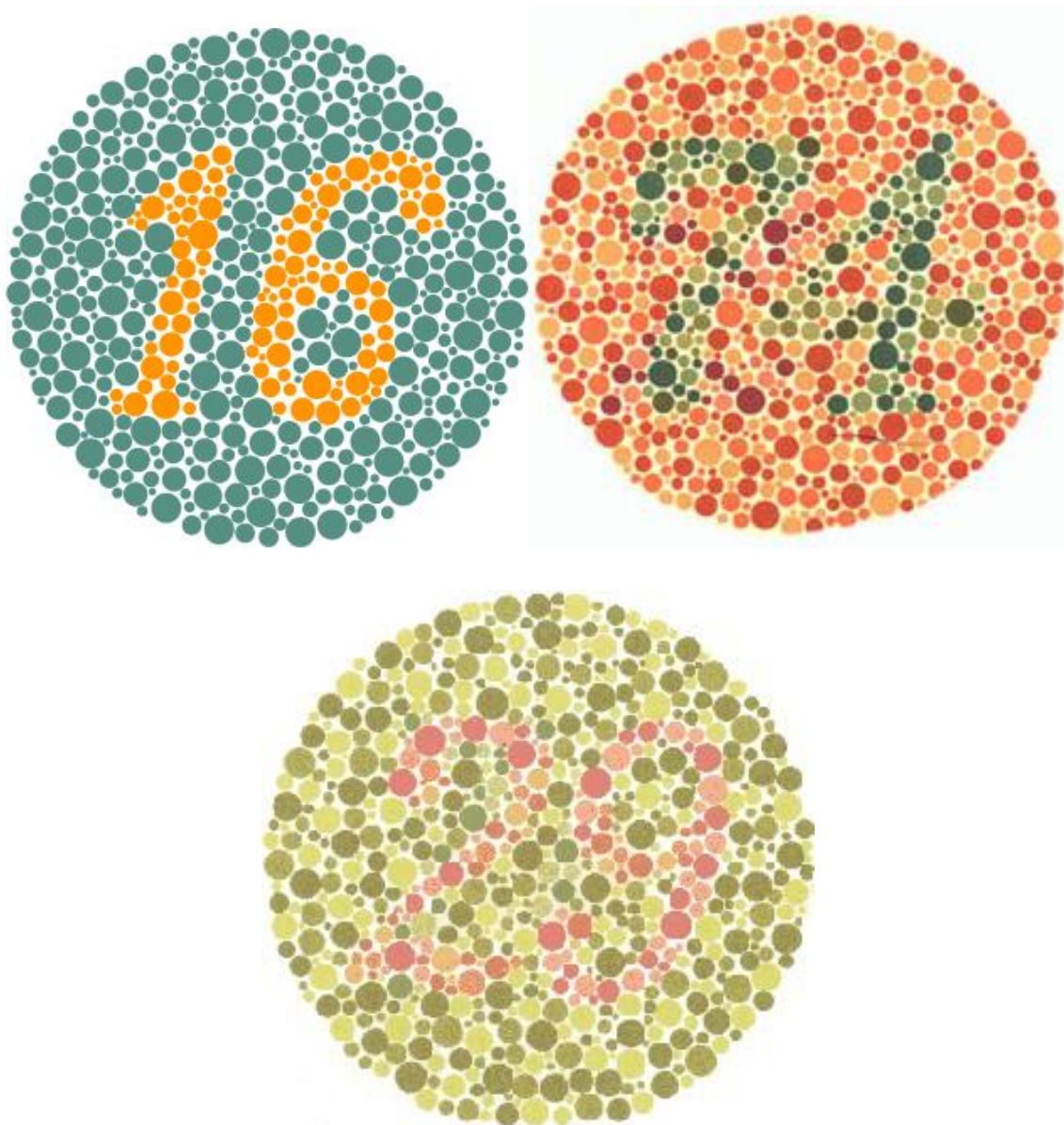


Figure 11: The Ishihara test: a test that is used to diagnose colour vision deficiencies

Source: Ishihara colour blindness test, 1917 – The exact pictures used in propositions (2,3) and Experiment

6.6.3 Colour and odour characteristics

The fragrance types were selected after a preliminary research and interviews with the local perfumers. Their general recommendation was to use more natural scents originating from France, since they are more likely to contain the original essences of true lemon, lavender, orange and bracken due to generally higher perfume industry standards. This means that the selected scents had to contain naturally sourced essential oils due to higher probability of the relative olfactive similarity to the source. With

the chemically sourced compounds, the probability that the final scent resembles the e.g. real lemon scent is much lower. After sampling many perfume samples and careful consideration of the ingredients, fragrances from a manufacturer "Provence et nature" were selected (Figure 12). All 4 fragrance types were transparent in colour and they are sold under the term *Eau de toilette* with the original names: *Lavande*, *Orange Blossom*, *Citron Doux* (sweet lemon) and *Fougère* (Bracken). The concentration of the perfume was the same – between 5 to 9 % as described by the manufacturer. The exact perfume concentration in *Eau de toilette* differs across the countries due to various regulations. This was controlled for as the supplier and country of production of the scents remained the same for the whole duration of the study. The perfumes were purchased from the same retailer in the Czech Republic.

The 4 scents were selected with an emphasis on their occurrence in the retail environment in order to be highly relevant for marketers. The classical combinations of coloured and scented products usually sold within stores that belonged to FMCG sectors were fresh scents (such as lemon), floral scents (such as orange blossom), herbal scents (such as lavender) and a specific type of fragrance called *Fougère*, which is a blend of fragrances. Usually these perfumes are marketed for males and bracken is representative for this type of olfactive family.

Two fragrances used for anosmia test were selected to be very common and easily recognised by most people. Moreover, affordability of such solutions also played a role. Regularly sold vinegar was used for the first anosmia test. As second sample fragrance, cinnamon oil solution has been made from cinnamon oil, denatured alcohol (96 %) and distilled water.

The coloured flasks were ordered online directly from Chinese manufacturer and the colours were selected to correspond semantically to the odours. The exact colour codes were sent to the manufacture with an emphasis on the same colour hue.



Figure 12: Illustration of the fragrances from the perfume brand "Provence et Nature"

6.6.4 Stimuli

All the participants were given 4 transparent perfume bottles which were all identical with regards to shape and texture. Each bottle had a spray applicator and contained exactly 2 ml (within the standard deviation of 0.25) of one out of possible 4 fragrances. The bottles were marked at the bottom with letters A-D which were invisible to the participants. The key was as shown in Table 5.

Table 5: The key to recognise fragrances in transparent perfume bottles

A – Orange fragrance
B – Lavender fragrance
C – Bracken fragrance
D – Lemon fragrance

6.6.5 Proposition 2: The procedure

The participants received a questionnaire where they had clear instructions on how to manipulate with the fragrances. All of them received also white odourless sampling stripes. First, they had to fill the questions about gender, age group, nationality, their preferred colour (out of 4 options) and whether they have lived in another country for more than 5 years. Once they answered both test questions (anosmia and colour blindness) and read the colour options, they could continue towards sampling the fragrances. The task was to spray each fragrance twice on the testing stripe, wait for approximately 1 minute and then smell the perfume. The participants had to match colour to an odour.

6.6.6 Statistical methods and collected data

The data were collected in a form of paper questionnaires and prescribed to Microsoft® Excel. This was followed by a simple analysis of the frequencies. The *mixed semantic-perceptual congruency* were assessed through this test. In addition, Chi-squared test and Cramer's V were calculated.

6.7 Proposition 3

6.7.1 Participants, procedure, stimuli and data analysis

Last proposition was designed to assess the *perceptual colour-odour congruency*. In total, 40 responses of the students from The University of Economics were analysed, but 2 respondents were excluded due to not passing the colour deficiency or anosmia test. The data contained only respondents of the Czech nationality. All the participants were in the age group category between 18 to 24 years. The participants were controlled for their gender, and also the proportion of males and females was balanced with only minor deviations (+-3). They were all tested for anosmia and had to undertake Ishihara colour recognition test as described above. Then they were given a questionnaire that contained differentially coloured cards that were of the same colour as used for the packaging of bottles in the experiment. Although all the care has been given, it is possible that the abilities of the printer caused minor differences between the colours of the bottles and the actual printed colour cards. The questionnaire

is attached in Appendix 7. In addition, the participants received 4 samples of odours in transparent bottles and they had to draw a tick to one colour card that mostly matched the perceived odour. Data were processed again in a form of simple frequency analysis. In addition, Chi-squared test and Cramer's V were calculated. The key to fragrances was the same as in the previously shown Table 5.

6.8 The experiment

The main experiment was designed to examine the combined effect of colour and odour on the preference and intensity ratings. The participants were given 4 differently coloured bottles with 4 fragrances (plus the anosmia test fragrance) which belonged to A-H groups in order to randomise the colour/odour combinations. Each participant had to rate a) preference and b) intensity on a scale from 1 to 10. The questionnaire is available in Appendix 4.

6.9 Participants

In total 301 participants, mostly students between 18 to 24 years agreed to voluntarily participate in an experiment conducted at the University of Economics in Prague. The reason for selecting younger participants is that odour ratings may be less reliable due to age-related changes in odour perception as supported in the literature review in the section 2.6, where it is claimed that elderly participants might also be in some cases excluded from olfactory studies (Kaepler and Mueller, 2012). The same reasoning was used in the proposition testing as the study of olfaction requires the ability to smell with the least possible impairments.

The sample cleared from respondents who left some columns blank (4), contained in total 130 males and 167 females. The participants were tested for their ability to recognise the colours used in the experiment and tested for their ability to smell, which further decreased the final data set. The sample size appeared to be adequate since every participant had to rate the preference of 4 colour and odour combinations which were distributed randomly, but equally to the respondents; making it for example 996 single observations for nationals from the Slavic countries. The data were further classified based on the nationality of the participants (Czech Republic only, Czech and Slovak Republic; and Slavic respondents all together). The exact method

of clustering the data will be described in the results before presenting the findings of the analysis.

6.10 Stimuli

The participants were given 4 differently coloured fragrance bottles, all of which had the same shape (Figure 13). The coloured flasks were ordered online directly from a Chinese manufacturer and the colours were selected with an emphasis on the same hue. The fragrance bottles contained each 2 ml of one out of the 4 possible types of fragrances. In addition, each participant obtained one transparent fragrance bottle with 2 possible options of fragrance test based on their group. The transparent bottles contained 2 ml of testing sample fragrance – either cinnamon oil solution or vinegar was selected to test the participants for anosmia. All the fragrances had the same concentration level and the liquids were naturally transparent in colour, except for cinnamon oil solution and vinegar anosmia testing samples, which were naturally yellow in colour. The 4 possible colours of the fragrance bottles were purple, orange, yellow and green. The experiment procedure was simplified by using a rubber band, which ensured that each time the respondent received a total of 5 (4 scents and 1 sample scent) differently coloured bottles with various scents. The colours and odours were selected as described in section 6.6.3. All the participants were tested for colour blindness and anosmia test prior to the experiment. The procedure of testing was the same as described in Proposition 2.

Table 6: The possible combinations of colours and odours given to the respondents (A-H group)

Group	Fragrance bottle	Fragrance bottle	Fragrance bottle	Fragrance bottle	Anosmia test sample
A	A1	B3	C4	D2	Vinegar
B	A1	B3	C4	D2	Cinnamon
C	A4	B2	C1	D3	Vinegar
D	A4	B2	C1	D3	Cinnamon
E	A2	B4	C3	D1	Vinegar
F	A2	B4	C3	D1	Cinnamon
G	A3	B1	C2	D4	Vinegar
H	A3	B1	C2	D4	Cinnamon

Scent: 1 = Bracken; 2 = Orange; 3 = Lemon; 4 = Lavender

Colour: A = Green; B = Orange; C = Yellow; D = Purple

Source: Author



Figure 13: Pictures of the preparatory stages – group H coloured bottles filled with perfumes

Source: Author

6.11 Task and experiment procedure

The participants received a questionnaire where they had clear instructions on how to manipulate with the fragrances. First, they had to fill the questions about gender, age group, self-assigned cultural belonging, their preferred colour (out of 4 options) and whether they have lived in another country for more than 5 years. Once they

answered both tests (anosmia and colour blindness), they could continue towards sampling the fragrances. Each participant was assigned randomly one of the groups (A-H) to sample and had to evaluate the fragrance a) intensity and b) preference on a scale from 1 to 10. The possible combinations are summarised in Table 6.

6.12 Statistical methods

Preference and intensity rankings were assessed as a discrete numerical variable. Equidistance of scale points is assumed. Besides the rankings, data also contained records of cultural belonging, nationality, age group, gender and preferred colour as already mentioned.

Two complementary approaches were adopted to analyse the results – ANOVA and linear regression. Two main simplifying assumptions were made. For ANOVA and linear regression, it was assumed that both scales are normally distributed and that observations are independent and have identical variance in each group considered. As the scales are in fact discrete on the range 1-10 and four observations are collected for each respondent, these assumptions are not fully valid in the experiment and the tails of the distribution are heavier than the normal distribution. Therefore, statistical significance is interpreted with this limitation and focus is put on descriptive outputs of the statistical tools applied.

Standard univariate and two-variate exploratory analysis was applied and difference in group means was studied in order to reveal the standard relation between the preference and intensity ratings of different fragrances and bottle colours. Statistical significance of the differences was then tested using the two-way ANOVA test.

Subsequently, specific combinations of colours and odours were analysed in terms of their significance by using linear regression. This approach can determine the increasing or decreasing tendency of preference.

Then, the different factors that might affect the ratings were explored. The linear regression focused on analysing age, gender and preferred colour and its impact on the ratings. In addition, the results from the main experiment were compared to the values obtained in the three propositions, again by using linear regression. In this way, it is possible to see which proposition can predict the real data results obtained

from the experiment more precisely compared to the other propositions. All the analyses were performed in statistical software R².

6.13 Summary of Chapter 6

The first theoretical part of the methodology expounded further on the term congruency. This was previously neglected in the studies that involve cross-modal correspondences and the authors found sufficient using term “appropriate” and “inappropriate”. However, this approach is quite simplistic as there might exist several combinations of congruencies and for the purpose of the research, it was important to define these relationships. Therefore, 4 types of congruencies were extracted from the literature based on the findings and added to the terminology – statistical, perceptual, semantic and mixed.

Then, the adopted methodology was outlined and the hypotheses were clearly stated. In addition, the ethics section offered a short overview of the risk assessment undertaken in order to progress to the experiment.

From section 6.5 to 6.7.1, the methodology of the propositions is presented with an emphasis on the selection of the participants, the characteristics of the odours and colours selected for the research purposes and the screening tests. The purpose of the screening tests was to exclude the participants that have sight or olfactory impairments. The procedure of testing is also detailed.

The main statistical methods used in order to analyse the results are frequency analysis, Chi-squared test and Cramer’s V, ANOVA and linear regression analysis. All the analyses were performed in Microsoft® Excel Package and statistical software R.

² Available to download: <https://www.r-project.org/> (©The R Foundation, 2018)

Chapter 7

Empirical results and discussion

Finally, the results of the three propositions and the main experiment will be presented in this section. First of all, the frequency analysis and the χ^2 test accompanied by Cramer's V coefficient will be presented for each of the propositions. Subsequently, the results of the main experiment will be presented for each nationality segment. The preference and intensity ratings will be illustrated in graphs and then assessed by two-way ANOVA. This is also accompanied by linear regression, which will reveal the specific combinations of colour and odour that significantly increased or decreased the preference. In addition, the factors such as age, gender and preferred colour will be analysed in their respective role in preference ratings. Thereafter, the results of the three propositions will be compared to the data obtained from the main experiment, and the type of congruency that estimates the most efficiently the preference ratings will be revealed.

It is important to once again note that while the experiment also included foreign participants, the nationality of the respondents of the propositions was strictly limited to the Czech nationals. Therefore, the character of the answers might vary and show significant differences when replicated in other countries in respect of specific colour choices for different odours. To illustrate this, consider the following example – the association of lavender might elucidate purple in some countries while in others rather green. Despite this, there is no reason to believe that the classification of the types of associations (or congruencies) should be somehow different when confined only to Czech culture. As a result, the specific colours which are congruent with certain odours might vary based on surrounding culture. However, the significant differences in between the types of associations should be valid disregarding the cultural peculiarities. This is why the last comparison of the proposition results compared to the data obtained, should be valid for the entire population.

7.1.1 Proposition 1: The Results

The graphs (Figures 14-17) all demonstrate that lemon fragrance is more semantically congruent to yellow colour, lavender fragrance is more semantically congruent to purple

colour, orange fragrance is more semantically congruent to orange colour and bracken scent is more semantically congruent to green according to the participants (horizontal axis shows the number of the participants). Some percentage of the participants also selected a different colour-odour combination, but with much lower frequencies. The results from the first proposition will be later compared to the results obtained of the main experiment. More specifically, the preference ratings will be analysed whether they more precisely reflect one of the congruency types. The frequency analysis forms the basis for the first comparative model (thereafter referenced as Proposition 1). The frequency distribution in percentage will be used in order to reach the comparison. Again, the data analysis will be described in greater detail together with the results from the linear regression.

Table 7: Likelihood Ratio and Pearson's coefficient

	χ^2	df	P(> χ^2)
Likelihood Ratio	318.14	9	0
Pearson	362.87	9	0

Source: Author

Table 8: Cramer's V

Contingency Coeff.	0.833
Cramer's V	0.869

Source: Author

Moreover, in order to support the representativeness of the results, statistical analysis of the results was conducted in a form of χ^2 test. However, the condition for χ^2 test is to have at least 5 observations for each variable which was not confined in some cases which follow. Despite this, the p-value demonstrates that one type of colour clearly associates one type of odour (Table 7). The strength of such connection is then supported by Cramer's V (Table 8) which suggests relatively strong correlation. In conclusion, the number of observations used for the first proposition, based on χ^2 test and Cramer's V appears to be sufficient.

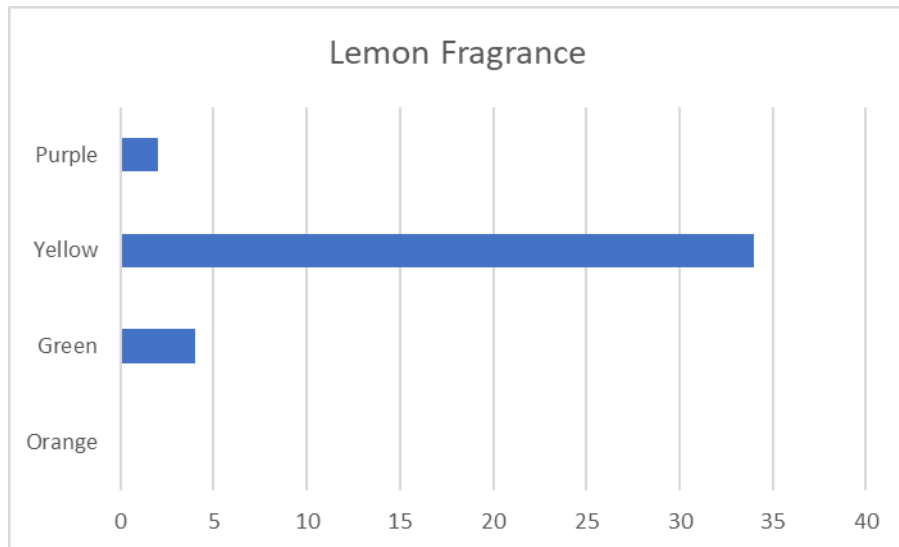


Figure 14: Frequency analysis of colours associated with lemon fragrance

Source: Author; N = 40

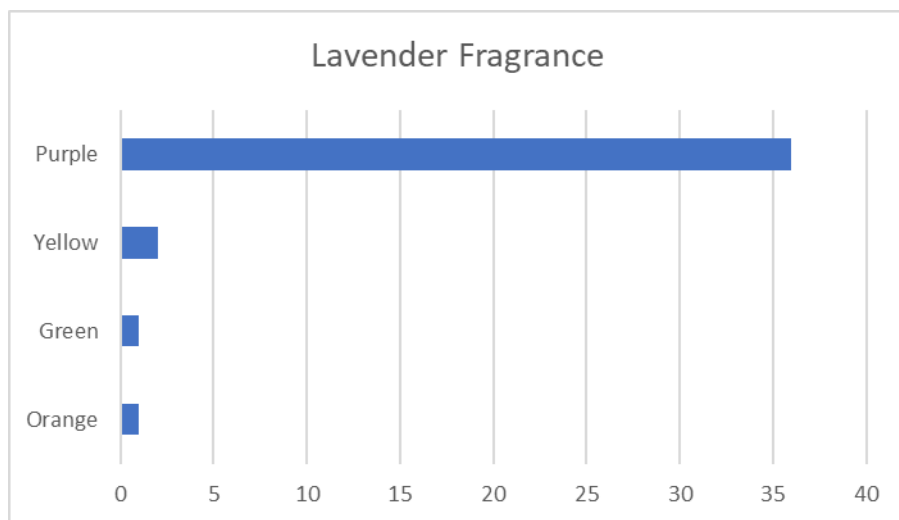


Figure 15: Frequency analysis of colours associated with lavender fragrance

Source: Author; N = 40

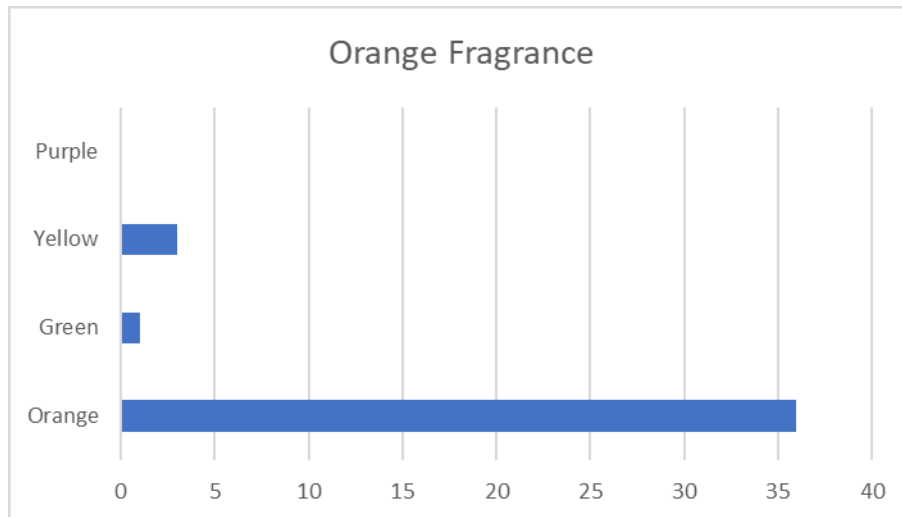


Figure 16: Frequency analysis of colours associated with orange fragrance

Source: Author; N = 40

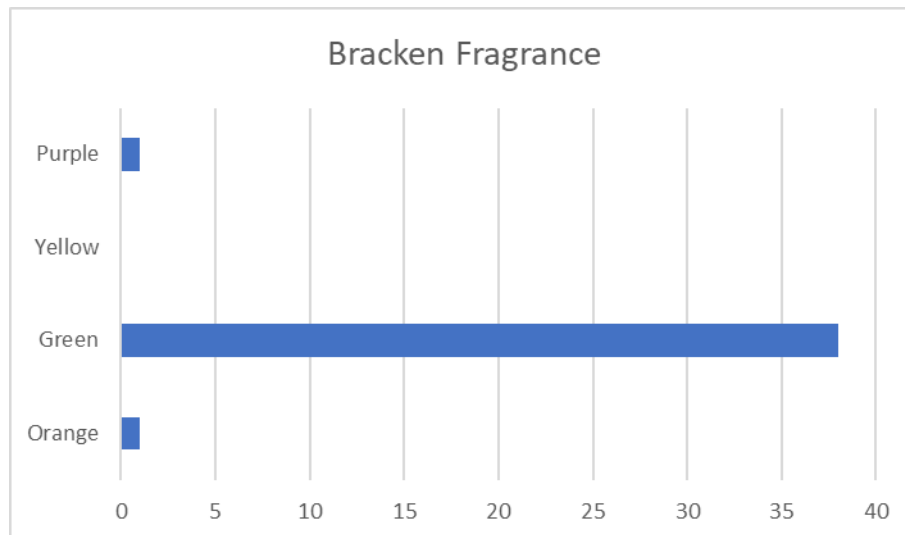


Figure 17: Frequency analysis of colours associated with bracken fragrance

Source: Author; N = 40

7.1.2 Proposition 2: The Results

In the second proposition, the participants received written colour descriptions and they had to match them to subsequently smelled fragrances. This was previously identified as semantic-perceptual type of congruency, thereafter referred to as mixed.

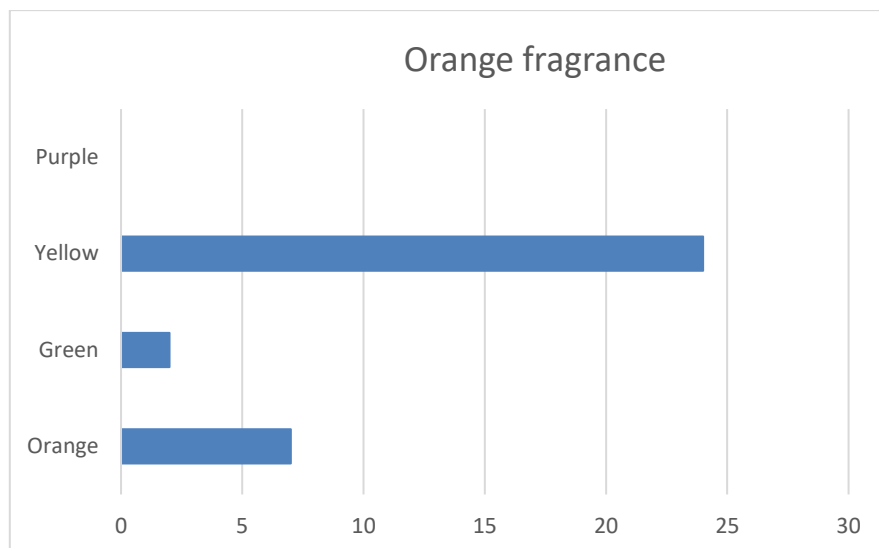


Figure 18: Frequency analysis of colours associated with orange fragrance

Source: Author; N = 40

The first graph (Figure 18) suggests that orange blossom scent after smelling was mostly categorised by the respondents as yellow and by only a minority as orange. Although the fragrance contained naturally sourced essence of orange, the respondents categorised the smell probably under citrusy scent and hence, chose yellow colour. Interestingly, purple was not selected at all.

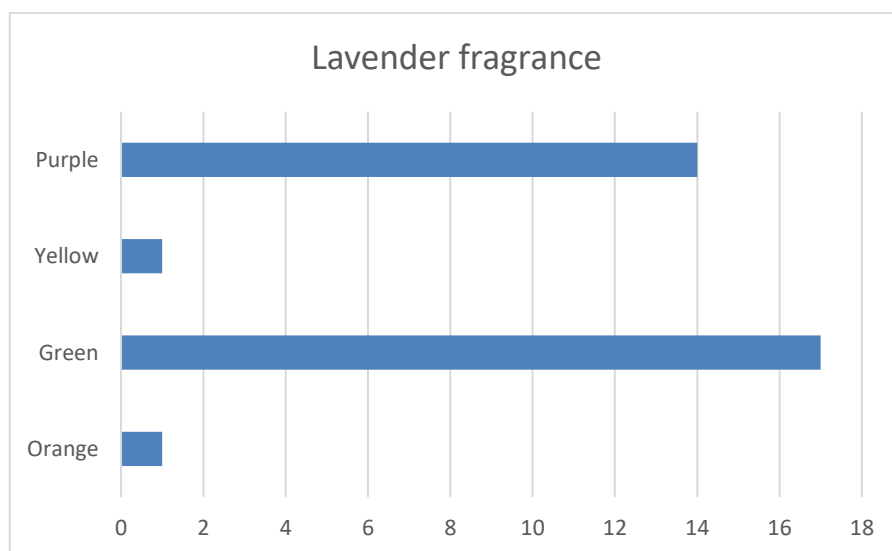


Figure 19: Frequency analysis of colours associated with lavender fragrance

Source: Author; N = 40

For lavender scent, the appropriate colours were green and little less purple. Interestingly, the green colour appears to be the most appropriate for lavender scent as opposed to pure semantic colour-odour associations.

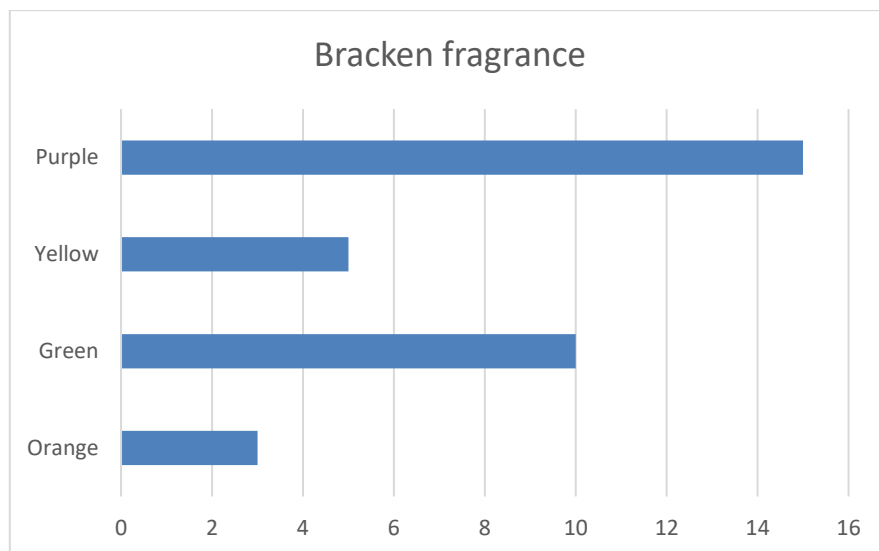


Figure 20: Frequency analysis of colours associated with bracken fragrance

Source: Author; N = 40

The scent of bracken was mostly evaluated as purple, followed by green, yellow and orange colour association. The diversity of the responses was greater than that exhibited for other fragrances.

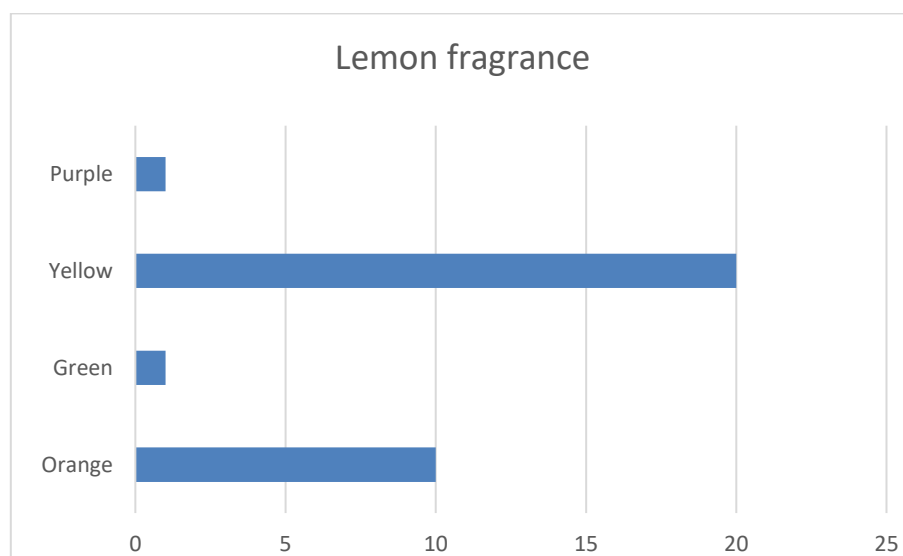


Figure 21: Frequency analysis of colours associated with lemon fragrances

Source: Author; N = 40

Finally, for the lemon scent, the most appropriate colours as chosen by the respondents were yellow, followed by orange, thus similar to semantic associations. Purple and green received an equal number of answers. In order to sum up the previous graphs, the results are presented also all together in the Appendix 3_a and 3_b. These two

propositions already revealed that there are observable differences between the suggested models. This illustrates that the form of assessment also plays a role.

Furthermore, for each scent, the respondents were required to note the word that mostly resembled the perceived odour. The most frequent semantic associations are the following (the numbers of the participants are in the brackets, in order by frequency):

- Orange fragrance: *lemon/citruses* (22); *orange* (5);
- Lavender fragrance: *pine/needles* (8); *lavender* (6);
- Bracken fragrance: *men/male fragrance* (7), *bathroom/toilet* (5); *soap* (5);
- Lemon fragrance: *lemon/citruses* (18); *vinegar* (6).

These are also summarised in Appendix 5_a and 5_b. As identified previously, it is common that people often experience problems when assigning verbal attributes to scents (de Wijk et al., 1995; Lawless & Engen, 1977). Despite relatively small number of participants, it is interesting to note that only lemon fragrance was identified correctly by the majority of the participants. It is also quite interesting to see the semantic associations which are the most common for specific scents. The lemon scent was mostly associated with yellow colour and the semantic association was mostly lemon or citrusy. On the other hand, lavender scent was not identified as purple, but instead was matched to green and the semantic associations showed that most people associated the lavender scent with pine or needles which are usually observable green in the nature. The scent of bracken had the most common semantic association of men fragrance and the main colour association was purple. Finally, orange was wrongly identified as the scent of lemon and hence the congruent colour was mostly yellow instead of orange. Out of these results, it appears that despite observable differences, the sensory input of odour semantically mediates the corresponding colour.

Table 9: Likelihood Ratio and Pearson's coefficient

	χ^2	df	$P(> \chi^2)$
Likelihood Ratio	104.615	9	0
Pearson	88.176	9	0

*Source: Author***Table 10: Cramer's V**

Contingency Coeff.	0.634
Cramer's V	0.474

Source: Author

Again, Table 9 and Table 10 describe the dependency between the colour and odour variables and Cramer's V then estimates the strength of such connection. In this case, the results demonstrate that it is no longer true that one odour associates one type of colour as there are at least two associated colour that correspond to the odour more. This is further supported by the Cramer's V, which is 0.474 and does not show that strong relationship among the variables as in the previous proposition. However, it is still substantial.

7.1.3 Proposition 3: The Results

In the third proposition, the participants were given differently coloured chips and they had to match them to fragrances presented in transparent bottles.

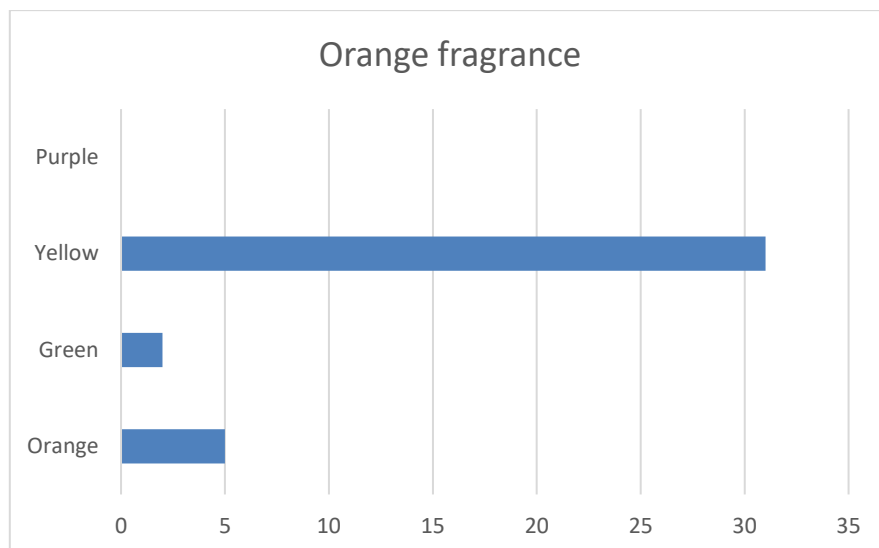


Figure 22: Frequency analysis of colours associated with orange fragrance

Source: Author; N = 40

As we can observe, yellow colour was mostly represented for the orange fragrance, followed by orange and green. The frequencies are almost identical to the ones that we could observe for orange scent in the previous Proposition 2.

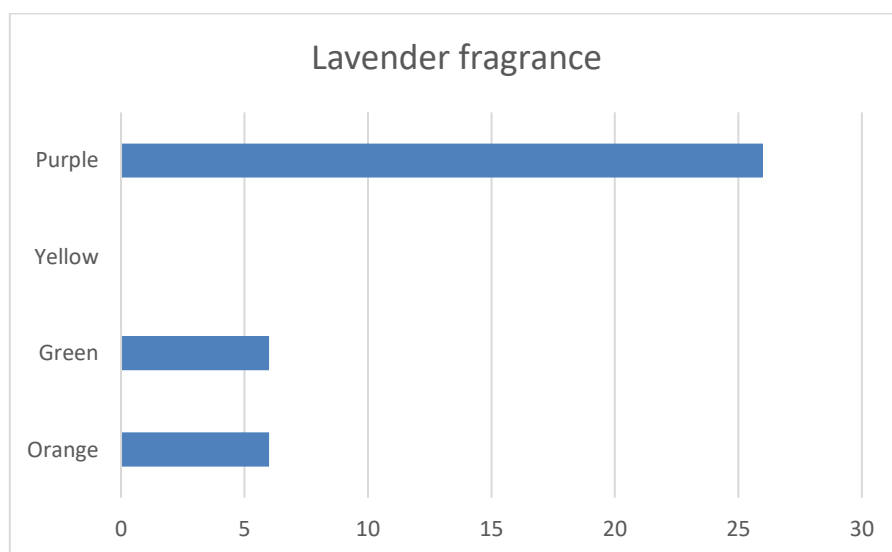


Figure 23: Frequency analysis of colours associated with lavender fragrance

Source: Author; N = 40

Furthermore, lavender fragrance was selected to be mostly corresponding to purple colour, followed by orange and green that received the same amount of responses. This is interesting because in previous Proposition 2, the most corresponding colour to lavender was green.

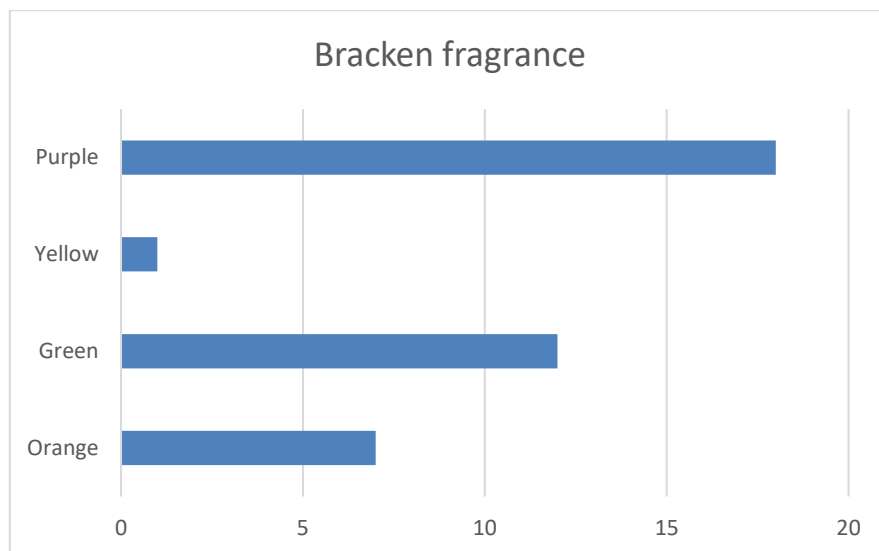


Figure 24: Frequency analysis of colours associated with bracken fragrance

Source: Author; N = 40

For the scent of bracken, the most corresponding colour was purple, followed by green and orange. The 2 most frequent answers are the same as we observed in Proposition 2, but then they were followed by orange and subsequently green as opposed to these results.

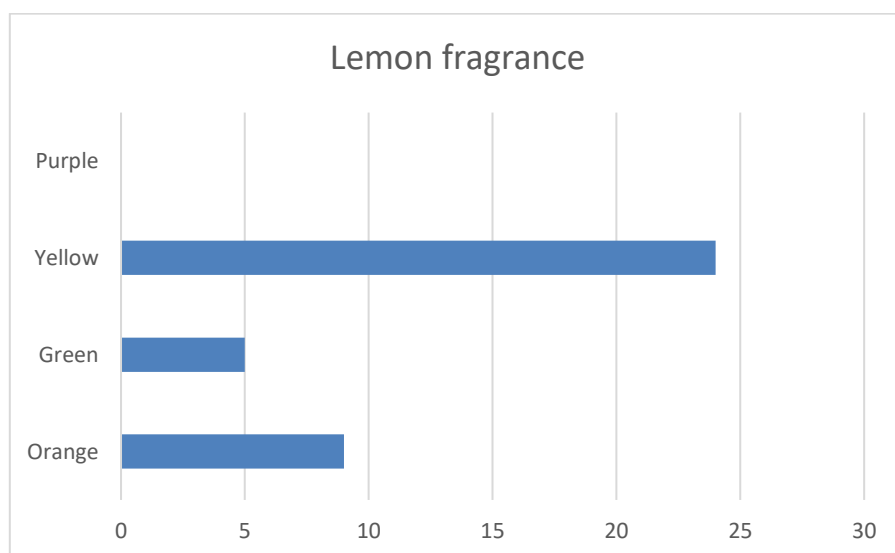


Figure 25: Frequency analysis of colours associated with lemon fragrance

Source: Author; N = 40

For the lemon scent, yellow colour was selected to be the most corresponding, followed by orange and green. Interestingly, and as opposed to the results in the second proposition, purple was not represented at all. In order to illustrate

the representativeness of the sample, Pearson's coefficient and Cramer's V were also calculated (Table 11 and Table 12).

Table 11: Likelihood Ratio and Pearson's coefficient

	χ^2	df	P(> χ^2)
Likelihood Ratio	141.99	9	0
Pearson	110.50	9	0

Source: Author

Table 12: Cramer's V

Contingency Coeff.	0.649
Cramer's V	0.492

Source: Author

The coefficients show that p-value is equal to 0, therefore the two variables are dependent. Moreover, the Cramer's V shows again substantial strength.

In addition, the most frequent semantic associations were also questioned in order to obtain more complete view. The most frequent associations are presented in the following paragraph:

- Orange fragrance: *Lemon/Citruses* (30)
- Lavender fragrance: *Lavender* (29); *Herb* (3)
- Bracken fragrance: *men/male fragrance* (17), *pine/needles/wood* (5); *sea* (5);
- Lemon fragrance: *lemon/citruses* (17); *orange* (6).

Here, interestingly, the participants immediately recognised the scent of lavender while in the previous proposition 2, they were having significant obstacles where the most common association was *pine/needles*.

7.1.4 Conclusions from the results of the first three propositions

The collected data revealed that there are observable differences between semantic, perceptual, mixed and also statistical congruency in terms of intuitive pairings. This

means that the congruency cannot be easily assessed without specifying the means of assessment as it was often presented in previous research. The samples of the participants are not meant to represent general population, but merely to illustrate that there are some differences that can bias the end results when it comes to sensory evaluation of products. The assumption from some previous research papers that there is only one congruent colour to an odour might not be then entirely valid and the form of testing also plays an important role in defining perceived congruency between the two modalities.

In the first proposition, the semantic congruency showed very similar results to the statistical congruency – participants selected yellow colour to be corresponding to lemon odour and purple being corresponding to lavender etc. However, the second proposition revealed different congruent combinations of colours and odours. Orange was evaluated as congruent to yellow, lavender was congruent to green, bracken to purple and lemon to yellow. In the third proposition, orange odour corresponded to yellow colour, lavender odour to purple colour, bracken to purple and lemon to yellow. Except for these mostly responded combinations, some percentage of the participants selected other colour options corresponding to the odour. The distribution of these answers will be matched to the results from the main experiment.

In addition, the participants were asked for their semantic associations with the odours. In the second proposition, the most frequent semantic association with lavender odour was lavender. However, in the third case, the most frequent association was pine/needle which probably resulted in greater selection of green corresponding colour. Despite this, it was demonstrated that the colour-odour congruency is, at least in some cases, semantically mediated.

7.2 The Experiment – The Results

Finally, the results of the experiment will be presented. The preference ratings of Czech; Slovak and Czech; and Slavic nationals will be analysed. Then, the factors that affect cross-modal correspondences will be further analysed with the use of linear regression. The models identified through propositions 1, 2 and 3 will be compared to the results from the main experiment. It should be possible to identify which type of association

model corresponds the most to the data from the Experiment, and thus which type of associations affect the decision-making process of preference ratings the most. This will enable to determine which type of congruency is the most valuable to marketers because it impacts the preference ratings of products that are coloured and possess odour characteristics.

In the Experiment, and because culture might play an important role in the subjective perception of scent, the results will be analysed for different nationalities separately. Therefore, the results for Czech nationals; Czech and Slovak nationals; and only Slavic nationals will be presented. Each time, the results from the two-way ANOVA, mean values and graph will be discussed. Slavic nationals were grouped together for analysis due to their relative language similarity. The results from the previous propositions will be then compared to the data collected from Czech nationals only in order to reduce the bias due to cultural differences. Moreover, and to a certain extent, the effect of nationality on cross-modal correspondences can be assessed through comparison of the results.

It is important to state here that the representation of Czech nationals in the data was greater compared to the representation of other nationals. Therefore, the results are generalisable only for Czech nationals, but the same might not apply to Slovak and Czech nationals or Slavic nationals, as the proportions of non-Czech nationals do not correspond to the relative sizes of the populations. However, it is still interesting to see the differences as it illustrates that the role of culture is evident.

7.2.1 The Preference ratings of Czech nationals

The data were cleared from foreign participants. Then, the participants who did not pass either the colour recognition test (9 people) or the test for anosmia (further 16 people) were excluded. This resulted in the total of 200 responses for further analyses. The univariate analysis of fragrance preference was applied first. Mean preference of different fragrances is displayed in Figure 26 with the dashed lines. The scale was from 1 to 10. Regarding the overall scent preferences, lavender was the least preferred scent, followed by orange, lemon and bracken, although the difference between lemon and bracken is relatively marginal. These results are unexpected; however, they are not of major interest, as the interaction between the odour and colour are considered here rather than just the preference of the individual scents.

The bars shown on Figure 26 also display mean rate of preference by fragrance type and bottle colour. The colours of the bars were selected to correspond with the bottle colours given to the participants. For the preference rate, it is clear that there was a difference observed for different fragrances as well as for different bottle colours for each fragrance. For example, the mean for lavender was 4.93, while the mean for bracken was 6.77. Different height of each quartet of bars corresponds with the conclusion of the univariate analysis that the preference of fragrance depends on its type. This analysis further reveals that bottle colour has different impact on preference for different fragrance types. We can see that in some cases, the colour affects the preference ratings more than in the other cases, and therefore the sensitivity is higher for lavender whereas quite insensitive for the lemon odour.

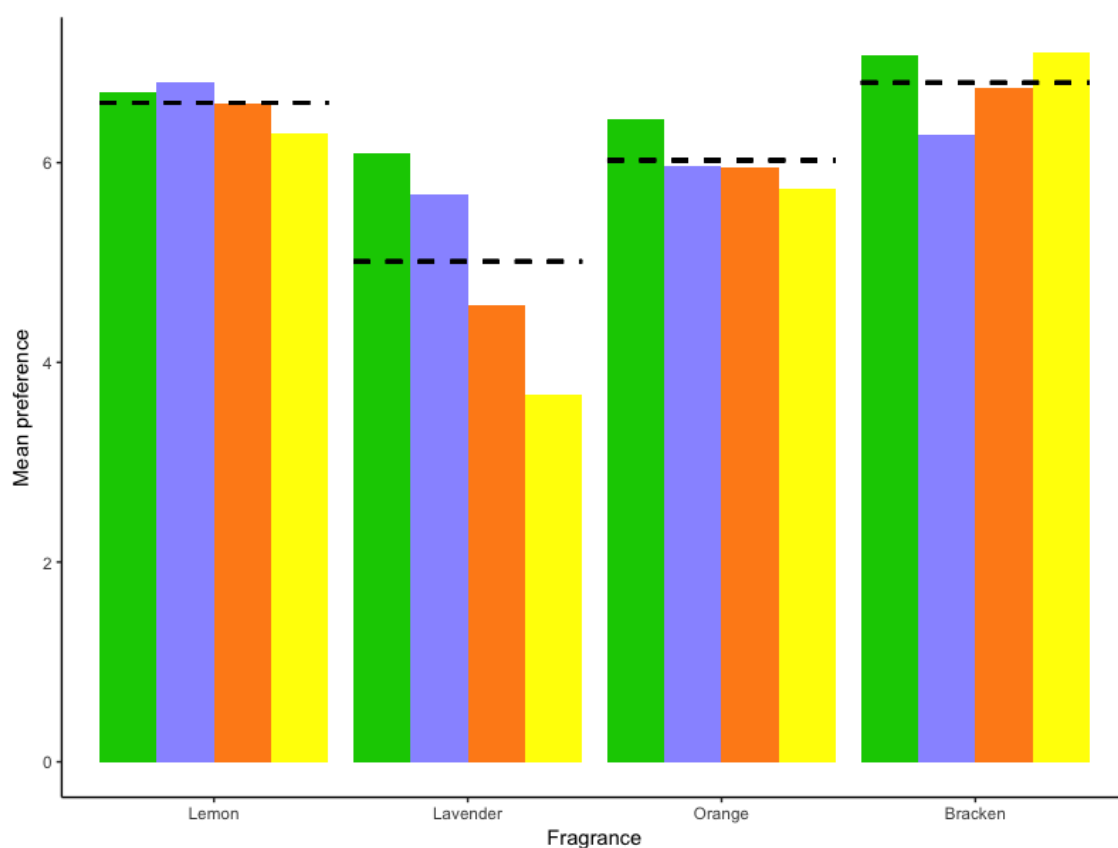


Figure 26: Czech nationals: Preference ratings of odours packaged in different colours

Source: Author; N = 200

The mean values for preference ratings for each colour and odour combination are shown in Table 13. We can see the most and least preferred colour and odour interaction. While these results are unexpected and interesting, not all of these

interactions are significantly different. The specific combinations that reached the significance level are presented in the section 7.2.7.

Table 13: Czech nationals: Mean values for preference ratings

Scent/Colour	Green	Orange	Yellow	Purple
Bracken	7.076923	6.745098	7.100000	6.280702
Orange	6.438596	5.95000	5.745098	5.961538
Lemon	6.705882	6.596154	6.298246	6.800000
Lavender	6.100000	4.578947	3.673077	5.686275

Source: Author

In order to explore the interaction between the colour and odour accurately, a two-way analysis of variance (ANOVA) was performed with results shown in Table 14. The ANOVA statistical test shows that the probability of having so different values for each fragrance is less than 0.0005, while the same probability for obtaining results this different for each colour is less than 0.003. Furthermore, the probability of the interaction between colour and odour appearing in the data by random is less than 0.006. These results confirm statistical significance of the dependence of fragrance preference on both fragrance type and bottle colour as well as the corresponding interaction. This suggests that certain differences in preference occurs for certain combinations of colour and odour; however, the ANOVA statistical test is insufficient to determine the combinations specifically. This finding also confirms that colour affects the perception of odour in terms of preference ratings.

Therefore, a visual percept such as colour has the ability to affect the odour's preference ratings which confirms the first hypothesis (H1) that cross-modal correspondences between colour and odour exist, at least for Czech nationals. In other words, the preference ratings of an odour could be manipulated by the selection of colour. This means that the second hypothesis (H2_a) is also supported, at least for Czech nationals, in the sense that perceived preference ratings of a fragrance are affected by colour.

Table 14: Czech nationals: Two-way ANOVA of fragrance preference

	Df	Sum Sq.	Mean Sq.	F value	Pr(>F)	Signif.
Fragrance	3	410	136.68	23.288	0.000	***
Colour	3	81	27.15	4.626	0.003	**
Interaction	9	136	15.11	2.575	0.006	**

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Source: Author; N = 200

7.2.2 The Intensity ratings of Czech nationals

Figure 27 displays mean rate of intensity by fragrance type and bottle colour. Black dashed lines again represent mean intensity for each fragrance. The univariate analysis of fragrance intensity was performed. Lavender scent was generally evaluated as the least intense, followed by orange, lemon and bracken, which interestingly, is the same ordering as we observed for fragrance preference. Difference in mean fragrance intensities is much lower than for mean fragrance preference. The mean for lavender was 6.11, while for bracken was 7.11. Two-way ANOVA (Table 15), however suggests significantly different impact of the fragrance type on intensity. The ANOVA statistical test shows that the probability of having so different values for each fragrance is again less than 0.0005, while the same probability for obtaining results this different for each colour is less than 0.106. The probability that the interaction appeared in the data by random is then less than 0.399. Although certain differences in intensity for different colours are observable, the magnitude of the differences is rather low. These results demonstrate statistical significance of the dependence of intensity rating on fragrance at 5 % significance level, but not colour or the interaction between colour and odour. This finding rejects the second hypothesis (H2_b), at least for Czech nationals, because although perceived preference ratings of a fragrance are affected by colour, perceived intensity ratings of a fragrance are not significantly affected by colour. The only significantly different result shows that the intensity ratings depend on the fragrance selection. This might be due to the selection of the chemical compounds as some might be perceived as more intense as identified in the section 2.5.

Table 15: Czech nationals: Two-way ANOVA of fragrance intensity

	Df	Sum Sq.	Mean Sq.	F value	Pr(>F)	Signif.
Fragrance	3	102	34.09	7.365	0.000	***
Colour	3	28	9.47	2.046	0.106	
Interaction	9	44	4.86	1.049	0.399	

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Source: Author; N = 200

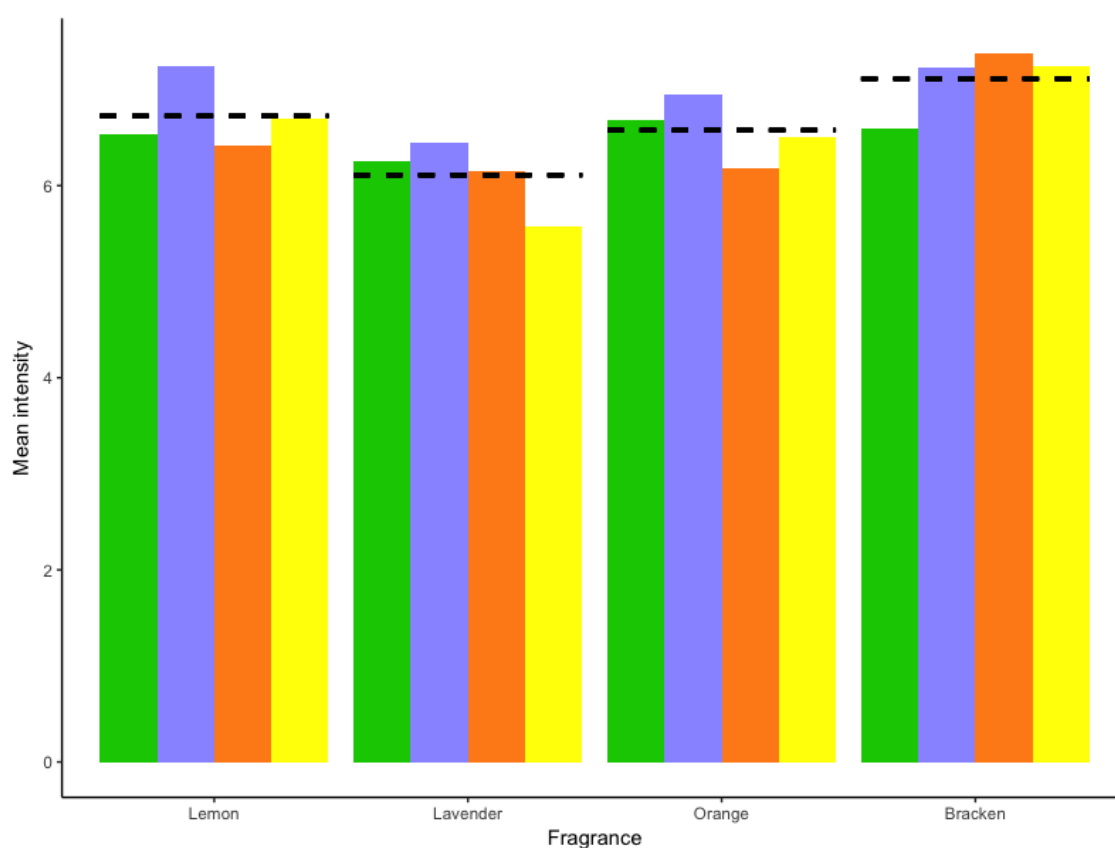


Figure 27: Czech nationals: Intensity ratings for odours packaged in different colours

Source: Author; N = 200

In addition, the mean values for intensity ratings for each colour and odour combination are also shown in Table 16. Again, while these data are interesting, only few of these interactions are in fact significantly different.

Table 16: Czech nationals: Mean values for intensity ratings

Scent/Colour	Green	Orange	Yellow	Purple
Bracken	6.596154	7.372549	7.250000	7.228070
Orange	6.684211	6.175000	6.509804	6.942308
Lemon	6.529412	6.423077	6.701	7.250000
Lavender	6.25000	6.157895	5.576923	6.450980

Source: Author

7.2.3 The Preference ratings of Czech and Slovak nationals together

The original data were cleared from other foreigners who were not Czech or Slovak nationals. Moreover, there were 10 respondents who did not pass the colour recognition test and further 21 who did not pass the anosmia test. This left 234 respondents for data analysis. Again, it is worth noting that the Czech and Slovak populations are not represented in proportion to their relative sizes and therefore these results should not be generalised to Czechoslovak population as such.

Figure 28 shows that the mean preference ratings for each scent were in the same order as for Czech nationals, who constituted the majority of this group. The least preferred scent was again lavender (6.1). The most preferred scent was again bracken with mean 6.8, followed by lemon with mean 6.67. The difference between them is this time much lower in comparison with the results obtained only for Czech nationals, but the sensitivity remains the highest for lavender.

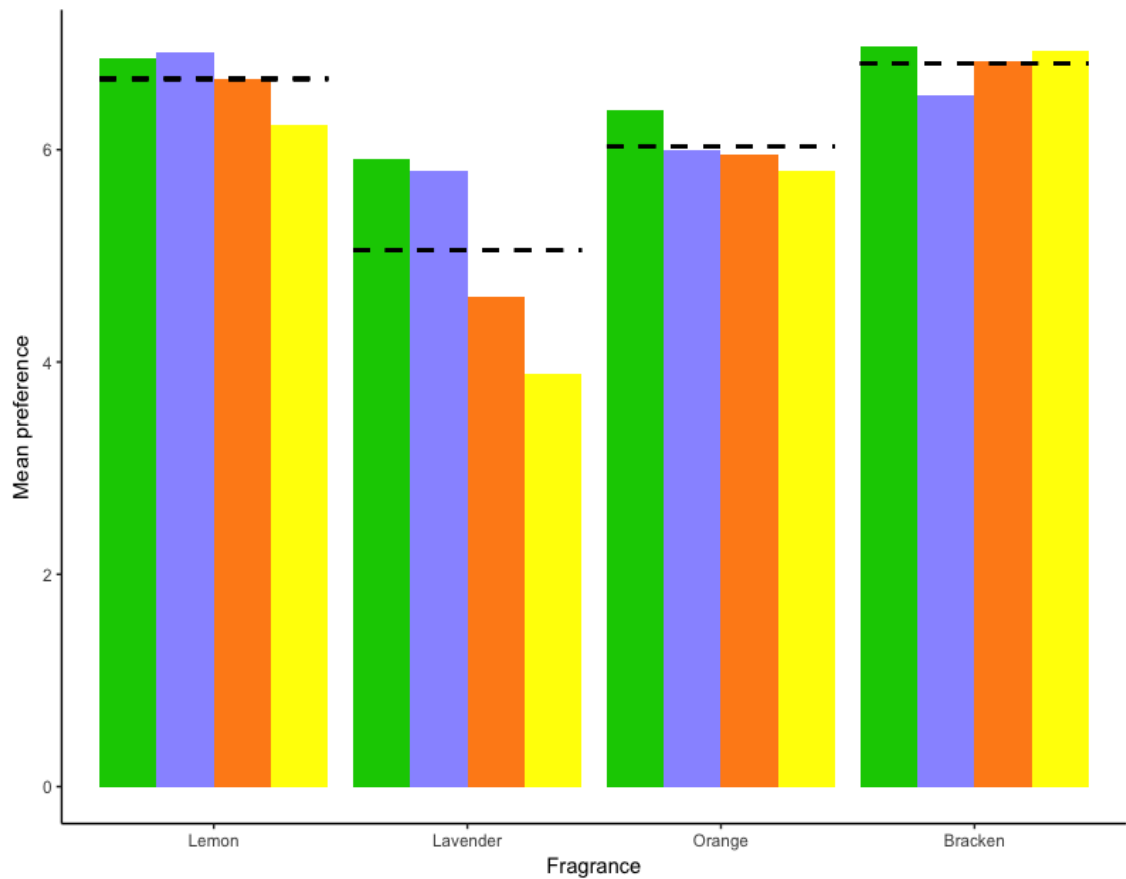


Figure 28: Czech and Slovak nationals: Preference ratings for odours packaged in different colours

Source: Author; N = 234

The mean values for preference ratings of Czech and Slovak nationals together for each colour and odour combination are shown in Table 17. We can again see the most and least preferred colour and odour interaction. As mentioned before, not all the mean values are significantly different.

Table 17: Czech and Slovak nationals: Mean values for preference ratings

Scent/Colour	Green	Orange	Yellow	Purple
Bracken	6.969231	6.830508	6.934783	6.515625
Orange	6.375000	5.956522	5.796610	6.000000
Lemon	6.864407	6.661538	6.234375	6.913043
Lavender	5.913043	4.609375	3.892308	5.796610

Source: Author

In order to analyse the significance, two-way ANOVA was performed. ANOVA statistical test (Table 18) shows that the probability of having so different values for each fragrance is less than 0.0005, while the same probability for obtaining results this different for each colour is less than 0.002. Furthermore, the probability of the interaction between colour and odour appearing in the data by random is less than 0.031. Therefore, we can see that the role of colour alone and fragrance alone in perceived preference ratings is significant. Moreover, the interaction of colour and fragrance is also significant, but is weaker when compared to the Czech nationals. This suggests that the Slovak nationals had slightly different preferences compared to the Czech nationals, especially when it is considered that the Slovak nationals formed only 14.5% of the respondents.

In light of the hypotheses, the first hypothesis (H1) is again supported. The second hypothesis (H2a) is also supported, at least for Czech and Slovak nationals.

Table 18: Czech and Slovak nationals: Two-way ANOVA of fragrance preference

	Df	Sum Sq.	Mean Sq.	F value	Pr(>F)	Signif.
Fragrance	3	487	162.32	27.020	0.000	***
Colour	3	90	30.14	5.017	0.002	**
Interaction	9	111	12.29	2.046	0.031	*

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Source: Author; N = 234

7.2.4 The Intensity ratings of Czech and Slovak nationals

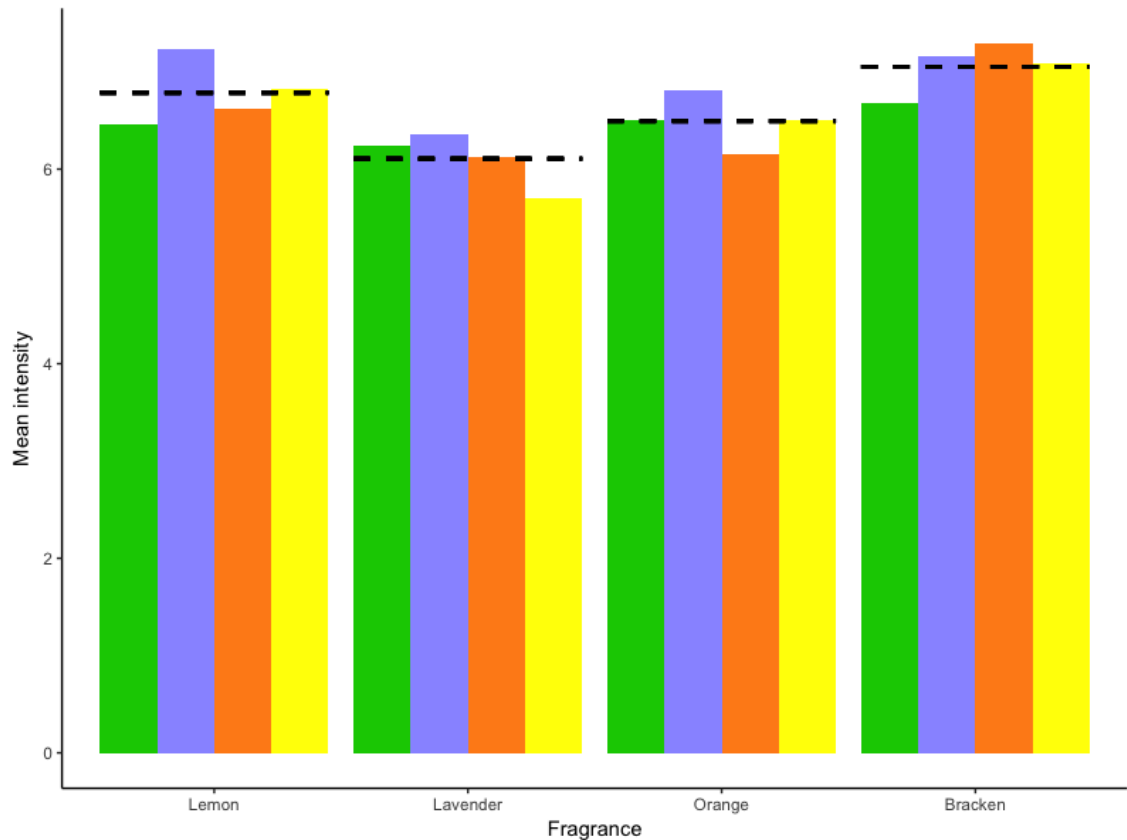


Figure 29: Czech and Slovak nationals: Intensity ratings for odours packaged in different colours

Source: Author; N = 234

The intensity ratings as shown in Figure 29 display again the same ordering as in previous cases. The mean values for intensity are displayed in Table 19. The mean for the mostly preferred bracken is 7.05, while the mean for lavender is 6.11. Therefore, the difference is slightly lower compared to the intensity ratings of Czech participants only.

Table 19: Czech and Slovak nationals: Mean values for intensity ratings

Scent/Colour	Green	Orange	Yellow	Purple
Bracken	6.679923	7.288136	7.086957	7.156250
Orange	6.500000	6.152174	6.508475	6.815385
Lemon	6.457627	6.615385	6.828125	7.239130
Lavender	6.239130	6.125000	5.707692	6.355932

Source: Author

In addition, and as shown in Table 20, the fragrance dependence is again below the 5 % significance level. However, the p-value of colour factor is 0.149 and the probability of the interaction results by random is 0.653. The colour dependence is lower, and insignificant, while the interaction of both appeared more probably by chance. Therefore, the first hypothesis (H1) and the second hypothesis (H2_b) have been both rejected for Czech and Slovak nationals considering the effect of a combination of colour and odour on intensity ratings.

Table 20: Czech and Slovak nationals: Two-way ANOVA of fragrance intensity

	Df	Sum Sq.	Mean Sq.	F value	Pr(>F)	Signif.
Fragrance	3	114	37.99	8.051	0.000	***
Colour	3	25	8.4	1.780	0.149	
Interaction	9	32	3.59	0.760	0.653	

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Source: Author; N = 234

7.2.5 The Preference ratings of Slavic nationals

The data analysis was performed by selecting the participants from Belarus, Ukraine, Czech Republic, Slovakia, Poland and Serbia due to some commonalities in the language development and potential link of language to cross-modal correspondences. Moreover, 11 participants did not pass the colour recognition test and further 30 of them did not pass the anosmia test. In total, 249 responses were further analysed.

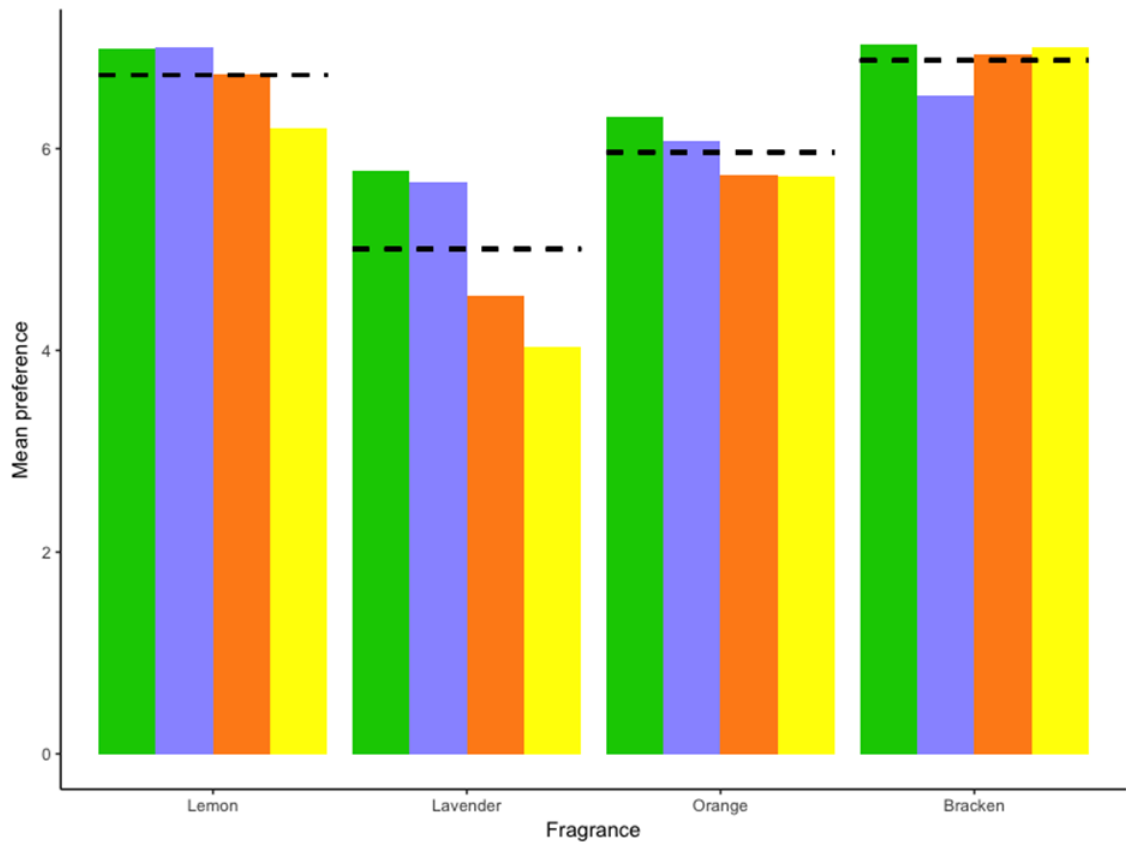


Figure 30: Slavic nationals: Preference ratings for odours packaged in different colours

Source: Author; N = 249

The graph (Figure 30) shows the same ordering as we observed previously in all the cases. The mean value of bracken is 6.87 and for lavender is 5.0. The difference is again similar to the ones we observed in Czech nationals and Czech and Slovak nationals together, a finding that should be expected given that the non-Czech nationals form only 19.7 % of the sample. In Table 21, it is possible to see the highest mean values for each colour and odour combination. Two-way ANOVA (Table 22) shows that the probability of having so different values for each fragrance randomly is less than 0.0005, while the same probability for obtaining results this different for each colour is again less than 0.002. For Slavic nationals, the colour and the fragrance interactions are not anymore, a significant factor at the 5 % significance level, as the probability of the interaction between colour and odour appearing in the data by random is less than 0.073. Therefore, it seems that with the increasing cultural range, the significance of the impact of interaction decreases, at least in these data with non-proportionally represented national groups. Therefore,

H_{2a} is rejected in the case of this non-representative sample, as the interaction does not have a significant effect on the preference rating scores.

Table 21: Slavic nationals: Mean values of fragrance preference

Scent/Colour	Green	Orange	Yellow	Purple
Bracken	7.029412	6.939394	7.000000	6.530303
Orange	6.318182	5.734694	5.727273	6.073529
Lemon	6.984848	6.735294	6.196970	7.000000
Lavender	5.775510	4.545455	4.029412	5.666667

Source: Author

Table 22: Slavic nationals: Two-way ANOVA of fragrance preference

	Df	Sum Sq.	Mean Sq.	F value	Pr(>F)	Signif.
Fragrance	3	575	191.8	31.729	0.000	***
Colour	3	93	30.87	5.106	0.002	**
Interaction	9	95	10.60	1.754	0.073	

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Source: Author; N = 249

7.2.6 The Intensity ratings of Slavic nationals

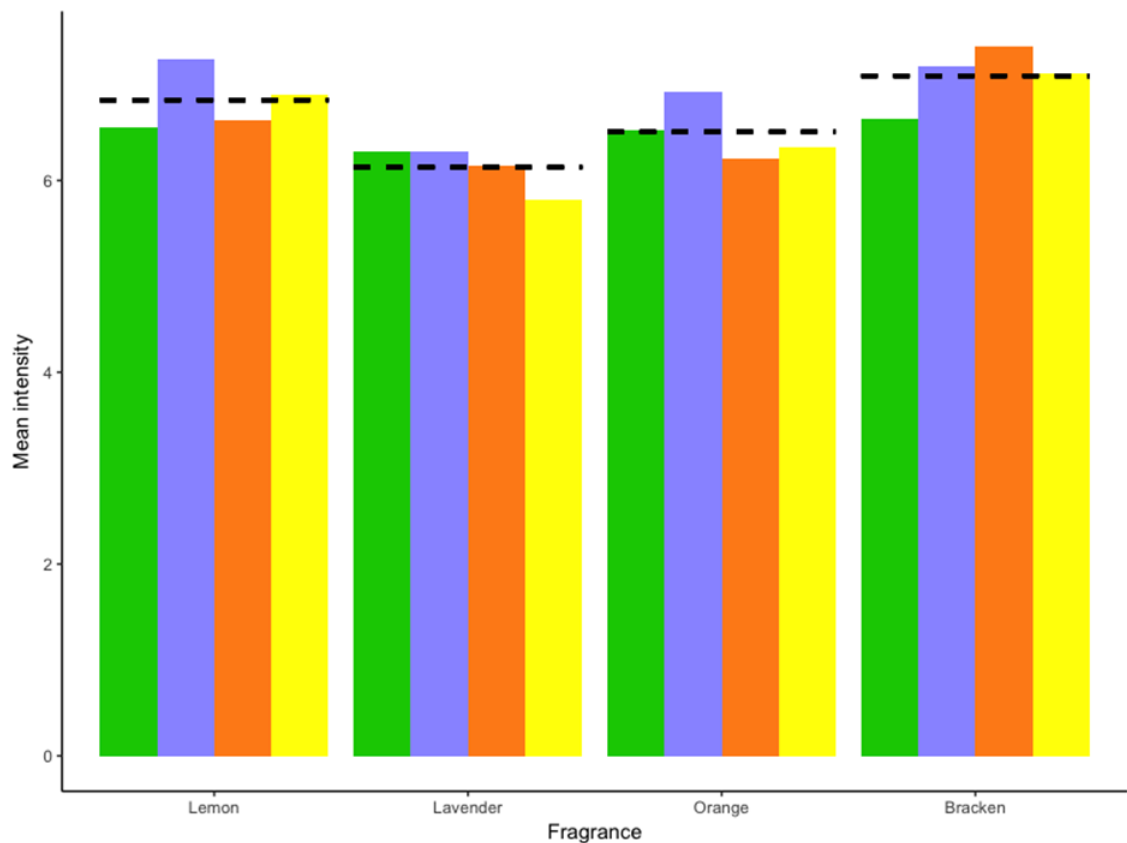


Figure 31: Slavic nationals: Intensity ratings for odours packaged in different colours

Source: Author; N = 249

The next graph (Figure 31) once more shows the same order for intensity ratings with the least preferred lavender and the most preferred scent of bracken. The mean for bracken is 7.09, while the mean for lavender is 6.14. All the mean values are also displayed in Table 23. It is again possible to see the highest ratings of intensity for different colour and odour combinations, but not all the results are significant. In addition, two-way ANOVA shows that the fragrance dependence is less than 0.0005, the colour dependence is lower than 0.123 and the probability of the interaction is less than 0.531 (Table 24). Interestingly, the probability of non-random interaction decreased as opposed to the results of the participants from the Czech Republic and Slovakia together. This shows that the effect of interaction of colour and odour on intensity ratings also decreases with greater cultural range of the participants. However, all the results presented verified that the effect of the interaction on intensity ratings is in fact insignificant. Therefore, H_{2b} is also rejected for Slavic nationals.

Table 23: Slavic nationals: Mean values of fragrance intensity

Scent/Colour	Green	Orange	Yellow	Purple
Bracken	6.647059	7.393939	7.122449	7.196970
Orange	6.530303	6.224490	6.348485	6.926471
Lemon	6.560606	6.632353	6.893939	7.265306
Lavender	6.306122	6.151515	5.794118	6.303030

Source: Author

Table 24: Slavic nationals: Two-way ANOVA of fragrance intensity

	Df	Sum Sq.	Mean Sq.	F value	Pr(>F)	Signif.
Fragrance	3	125	41.76	8.791	0.000	***
Colour	3	28	9.18	1.933	0.123	
Interaction	9	38	4.24	0.893	0.531	

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Source: Author; N = 249

7.2.7 Specific colour and odour combinations that increase or decrease the preference ratings

While the previous sections presented the data results and then analysed them by using the ANOVA test, it did not clarify which specific combinations of colour and odour increased or decreased the preference levels. In summary, the two-way ANOVA showed that p-value for the interaction of colour and odour for the preference is 0.006 for Czechs; 0.031 for Czech and Slovak; and for Slavic respondents this interaction is insignificant. On the other hand, the intensity ratings appeared to be insignificant in all the three cases. This led to several decisions with regards to further analyses. First of all, due to the importance of cultural homogeneity, only the Czech participants will be included in the further analysis. Also, the importance of colour and odour combination for intensity ratings is insignificant and therefore, no further analysis is needed. In order to reveal more details about the dependence structure of fragrance preference, a multivariate analysis was performed using the classical linear model.

Linear regression is a standard mathematical method used in order to estimate the relationship between a number of variables (Kutner, 2005). The emphasis is placed on the relationship between a dependent variable (also called response variable) and one or more independent variables (sometimes called explanatory variables). In other words, if we know the values for the response variable and the explanatory variables as well, linear regression reports how is a change in each of the explanatory variables reflected in a change in the response variable. Since in our case we have a discrete explanatory variable (i.e. colour), it is necessary to select one of the explanatory variable values to serve as a baseline against which all the other values will be compared. Note that this is not required for continuous variables, as the value 0 can be used as the baseline. This allows us to see how a change in value (i.e. different colours) affect the dependent variable (i.e. the participants preference). Therefore, this method allows us to see which combinations of colour and odour increase or decrease the preference and also the significance of these results. This will help us to answer the third hypothesis, which is trying to answer if congruent colour and odour combinations generate more favourable evaluations in terms of preference ratings.

In total, 4 tables are presented as well as the coefficient plots (Figures 32-36) in order to visualise the estimates. The coefficient plots also demonstrate the results and both – increasing and decreasing tendency of the colour-odour combination on the preference ratings.

Table 25: Linear regression 1: Lavender odour in purple flask compared to other 3 colour options

	Estimate	Std. Error	T value	Pr(> t)	Significance
Yellow flask	-2.0132	0.4664	-4.316	0.0003	***
Green flask	+0.4137	0.4999	+0.828	0.4089	
Orange flask	-1.1073	0.4562	-2.427	0.0161	*

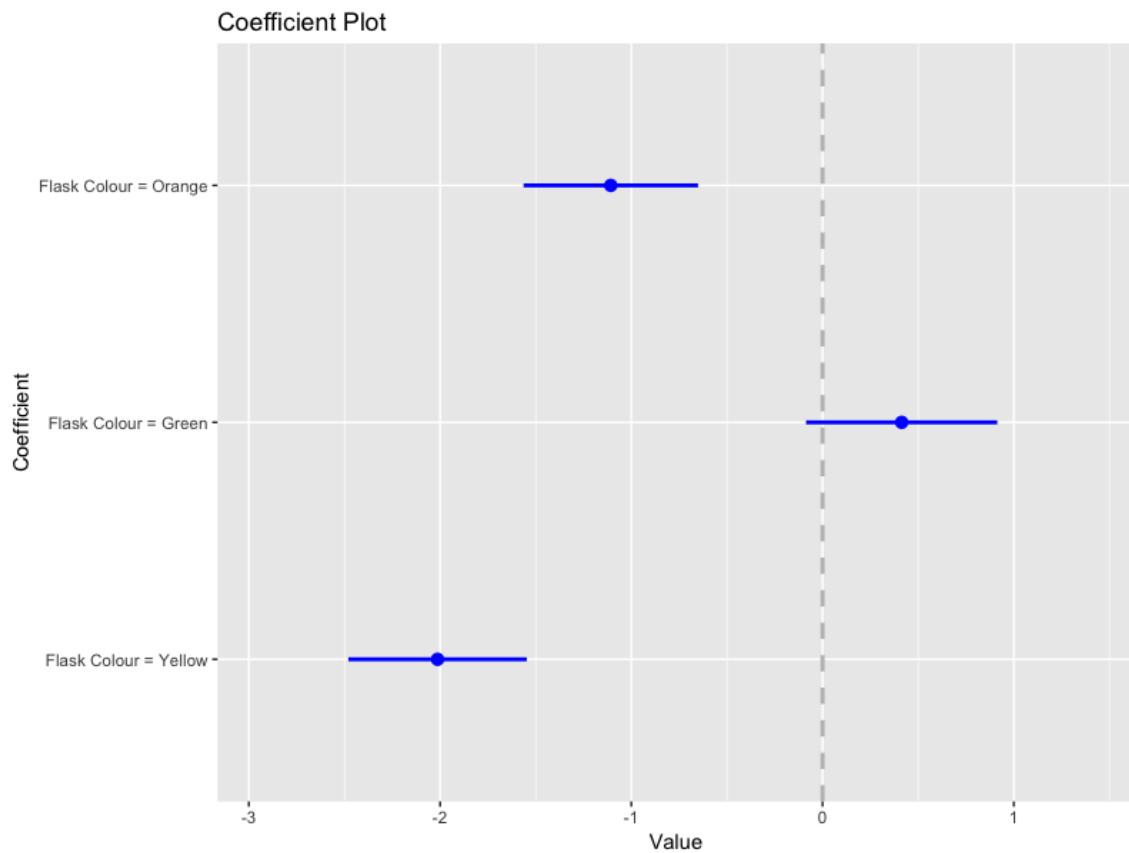
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Source: Author; N = 200

Table 25 shows that the lavender odour in yellow flask loses on average approximately two preference points (on the scale from 1 to 10) as compared to the same odour in purple flask (i.e. the baseline value) and that this result has a very high statistical

significance. Moreover, the lavender odour in orange flask loses approximately 1.1 preference points as compared to the baseline value (purple colour), also with a high statistical significance. The green flask, on the other hand, seems to improve the preference over the baseline colour, but this result is not significantly different. These results are the only ones that reached significance level among all the colour and odour variations. Still, the linear regressions of other colour-odour combinations are presented due to their relative importance for marketers.

Figure 32: Linear regression 1: Coefficient plot



Source: Author; N = 200

Table 26: Linear regression 2: Bracken odour in green flask compared to other 3 colour options

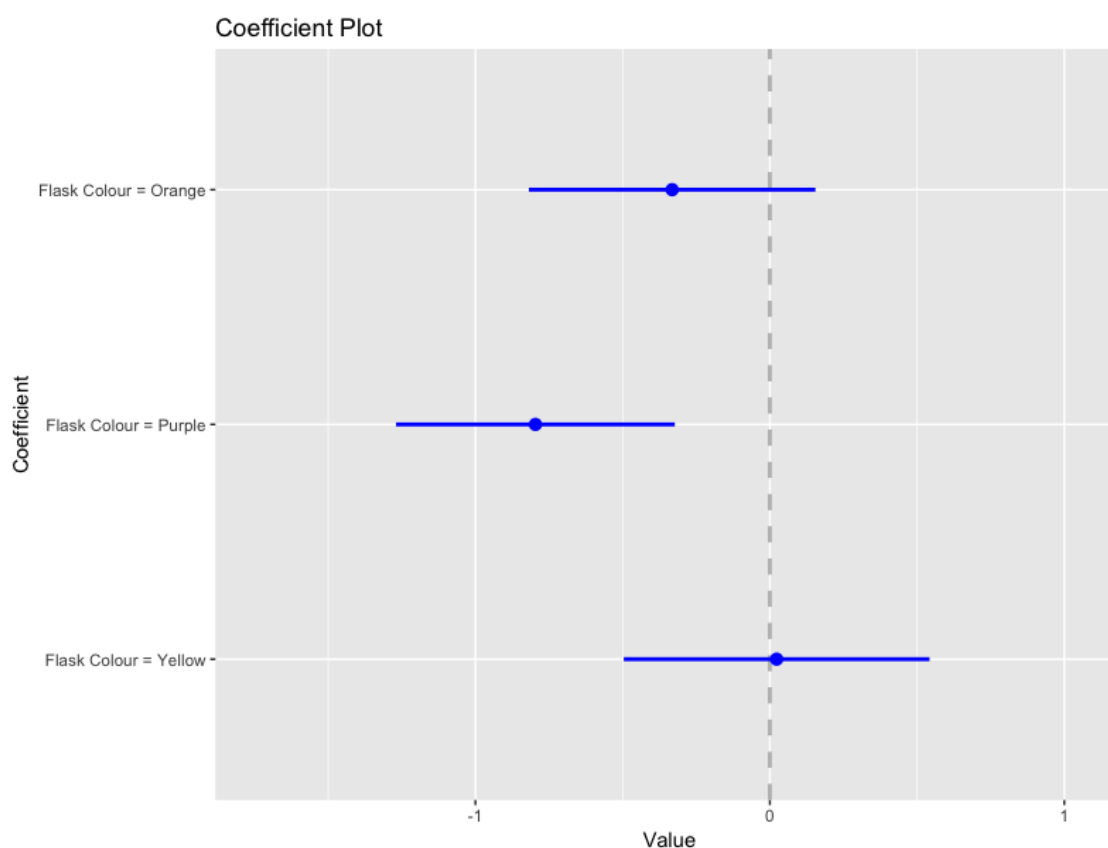
	Estimate	Std. Error	T value	Pr(> t)	Significance
Yellow flask	+0.02308	0.51919	+0.044	0.9646	
Purple flask	-0.79622	0.47341	-1.682	0.0942	.
Orange flask	-0.33183	0.48651	-0.682	0.4960	

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Source: Author; N = 200

In Table 26, we can see that bracken scent preference was enhanced when combining it with yellow flask as compared to the baseline green colour, however the result is statistically insignificant and the effect is rather small. Purple and orange flask both decreased the preference levels, but the results are again insignificant. It may be worth noting, nonetheless, that while the purple flask effect of reducing the preference by 0.8 preference points is statistically insignificant, the probability of this effect being true is over 90 %. This is why, despite not reaching the 5 % significance level, some of the results are noteworthy and might be valuable for product managers in practice.

Figure 33: Linear regression 2: Coefficient plot



Source: Author; $N = 200$

Table 27: Linear regression 3: Orange odour in orange flask compared to other 3 colour options

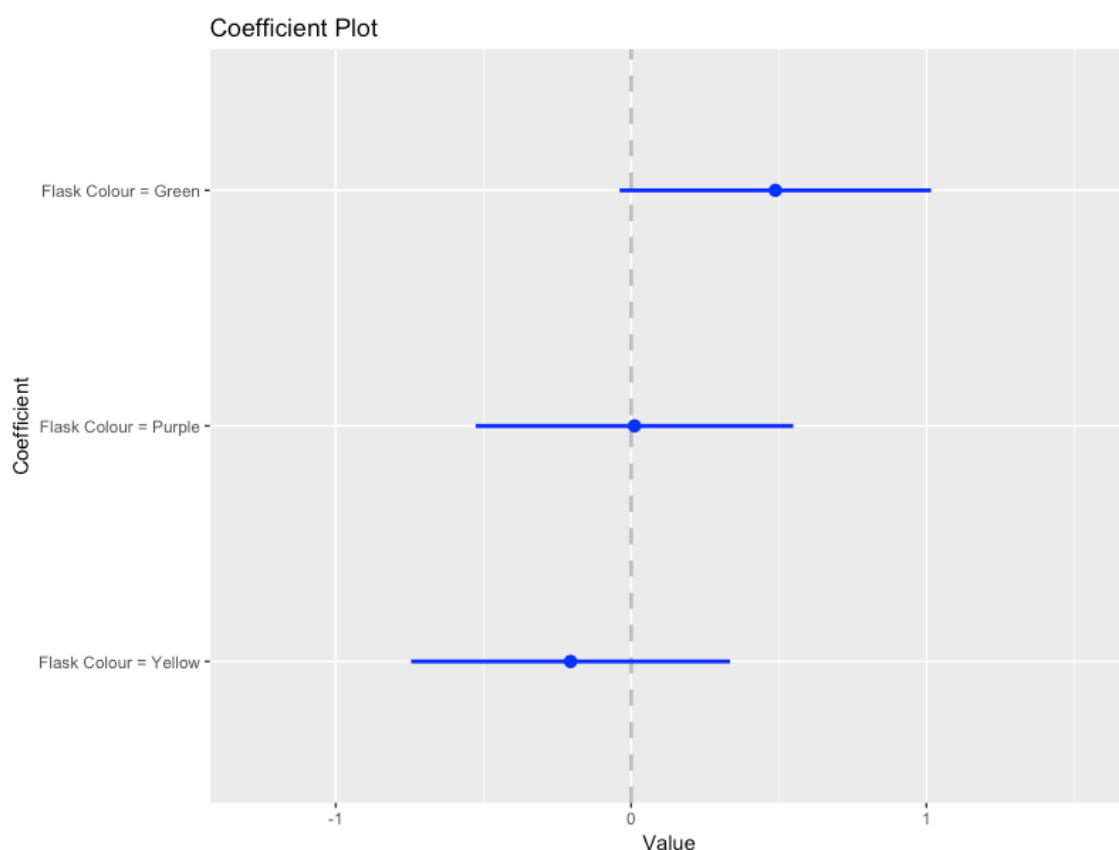
	Estimate	Std. Error	T value	Pr(> t)	Significance
Yellow flask	-0.20490	0.54006	-0.379	0.705	
Purple flask	+0.01154	0.53778	+0.021	0.983	
Green flask	+0.48860	0.52742	+0.926	0.355	

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Source: Author; $N = 200$

In Table 27, we can see that yellow, purple and green flasks changed the preference levels mildly, but the results are insignificant. Therefore, there is no real certainty that this effect was caused by the change of variable and, furthermore, there seems to be no effect of the flask colour for the orange odour.

Figure 34: Linear regression 3: Coefficient plot



Source: Author; $N = 200$

Table 28: Linear regression 4: Lemon odour in yellow flask compared to other 3 colour options

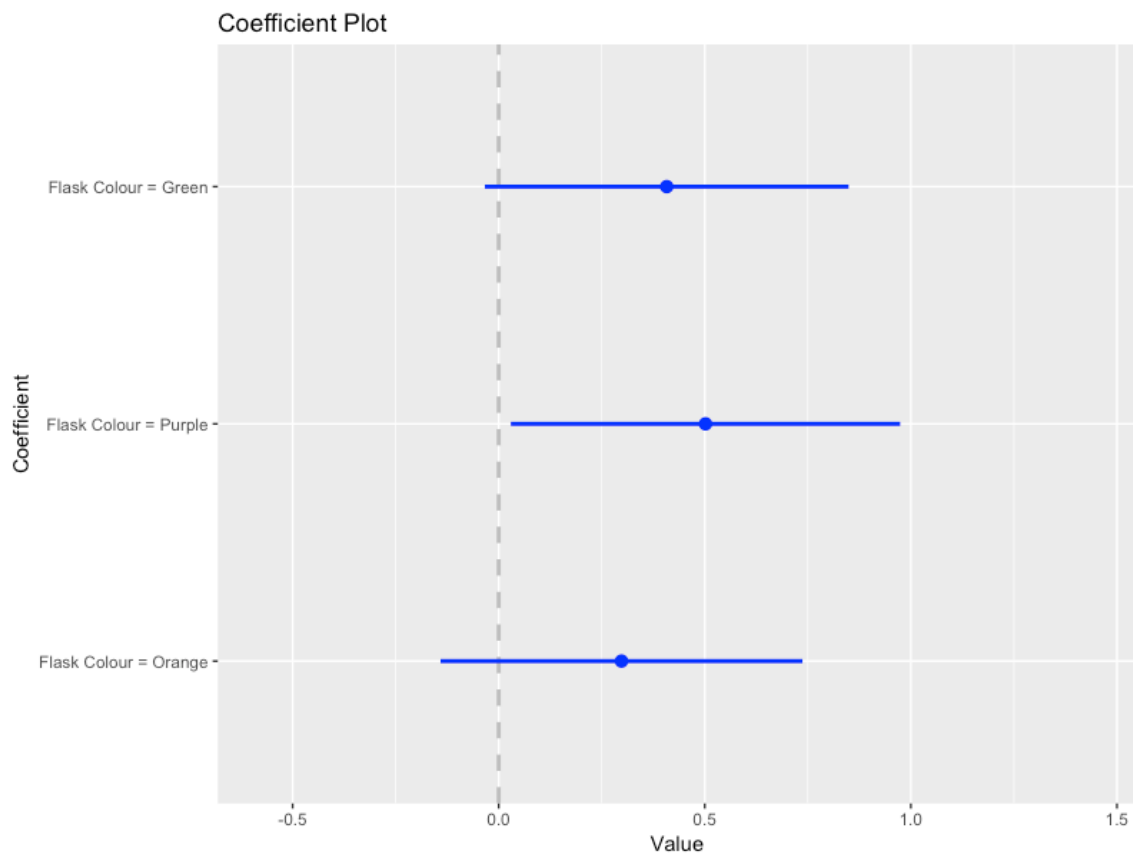
	Estimate	Std. Error	T value	Pr(> t)	Significance
Orange flask	0.2979	0.4391	0.679	0.498	
Purple flask	0.5018	0.4722	1.062	0.289	
Green flask	0.4076	0.4413	0.924	0.357	

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Source: Author; $N = 200$

As shown in Table 28, the lemon odour in yellow flask, when compared to orange, purple and green flasks, demonstrated increasing preference levels in all the three cases. However, the data showed again low significance and therefore it is not possible to conclude that there is any real difference in the preference caused by the flask colour.

Figure 35: Linear regression 4: Coefficient plot



Source: Author; N = 200

In summary, the data revealed that some colours might increase the odours preference ratings and some might decrease the preference ratings. The specific cases that decreased the preference ratings and were demonstrated at 5 % significance level were lavender in orange and yellow coloured flasks as compared to the same odour in the purple coloured flask. All the other results were not significant, but could be still important for marketers since some of them show the increasing or decreasing tendencies of preference (especially the case of bracken odour in purple flask, which decreases the preference with over 90 % probability). In addition, it appears that colour is unable to significantly improve the perception of odour, but it might have significant negative effect on the preference ratings.

7.2.8 The factors that affect preference ratings

In the previous sections 7.2.1 – 7.2.6, the collected data were analysed with an emphasis on the nationality and grouped into Czechs; Czechs and Slovaks; and Slavic

participants. Their preference and intensity ratings were analysed further by using ANOVA. This helped us to answer the hypotheses H1, H2_a and H2_b which all relate to the first formulated research question whether the colour of packaging affects the perceived preference and intensity ratings of scent.

Then, since the colour showed no significant effect on intensity ratings, we focused on assessing the specific colour and odour combinations that do increase or decrease the preference levels by linear regression. However, the results showed that some colours when combined with one type of odour do make a significant difference in perceived preference levels, while others do not. More specifically, significant effect of lavender odour packaged in yellow or orange colour was demonstrated. Based on the results, it appears that colour might have a significant negative effect on the preference ratings when compared to the baseline values.

In addition, in the sections 7.1.1 to 7.1.4 we defined the congruency which could be classified into 4 different types as it was supported by the collected and evaluated data. The defined congruencies will be further compared to the data obtained through the experiment and linear regression should be able to determine the most fitting model based on the consumers preference rating of scented and coloured product (H4). This will be presented in the forthcoming section. What still remains to be answered is the second research question – are there any significant factors that affect the perception of scent in differently coloured packaging? From the previous sections, we clarified that nationality plays a role in preference ratings of specific colour and odour combinations as there were observable differences in between the culturally homogenous groups and this relationship further increased when assessing the answers from all the Slavic respondents. However, it still needs to be determined whether there is any effect of gender or if a preferred colour plays any role in the estimation of the preference levels of colour-odour combinations. This will be the subject of this section.

For the analysis, the linear regression appeared to be convenient, commonly used in similar situations. Again, it is necessary to select one of the explanatory variables to serve as a baseline against which all the other values will be compared for each discrete variable (i.e. the colour preference, the age group and the gender). Previously, one colour and odour combination were selected as explanatory variable in each case

(i.e. lavender in purple flask, lemon in yellow flask). Now, among the selected factors that could potentially play a role in determining consumers preference ratings of colour and odour combination is age group (with the baseline value being Age group 1), preferred colour (with the baseline value being green) and gender (with the baseline value being female).

Table 29: Linear regression 1: Selected factors that affect preference ratings

	Estimate	Std. Err.	T value	Pr(> t)	Signif.
Age group 2	+0.17553	0.39949	+0.439	0.66050	
Preferred colour purple	-0.07638	0.23098	-0.331	0.74097	
Preferred colour orange	+0.41683	0.31457	+1.325	0.18552	
Preferred colour yellow	-0.12081	0.27990	-0.432	0.66614	
Gender (baseline = female)	+0.55800	0.20389	+2.737	0.00634	**

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

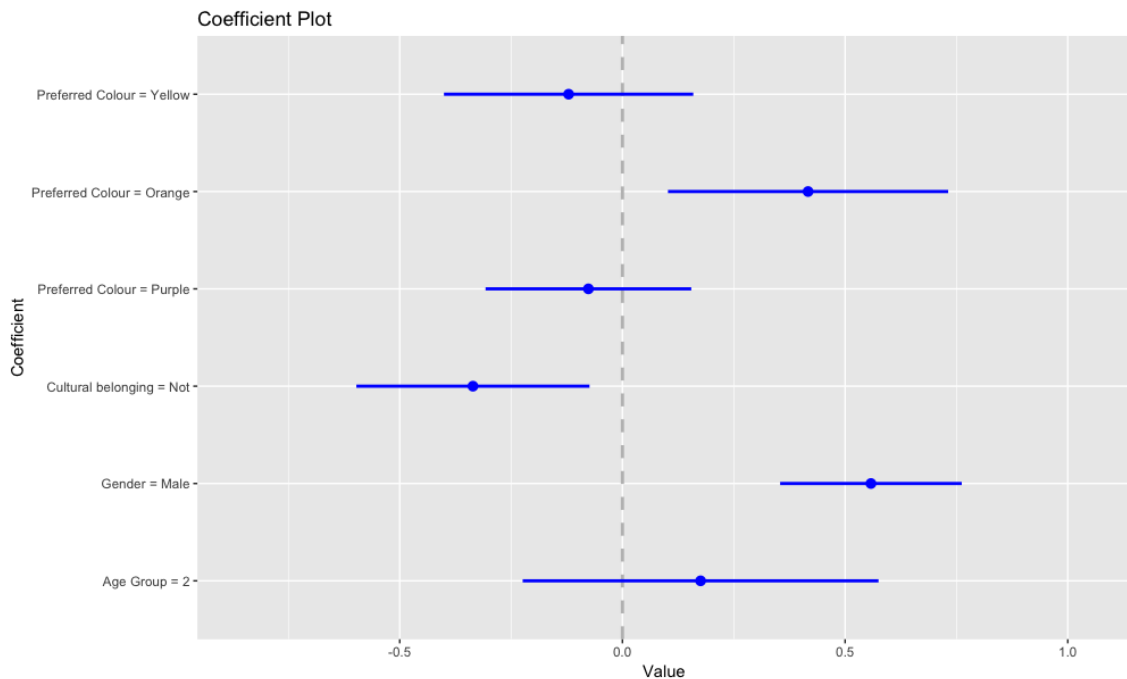
Source: Author; N = 200

As shown in Table 29, the second age group with the participants from 25 to 34 causes increase in preference levels by approximately 0.2 preference points (on the scale from 1 to 10) as compared to the first age group including participants from 18-24 years. However, the change appeared to insignificant.

The same is true when focusing on the role of preferred colour as selected by the participants in the questionnaire. Therefore, it seems that preferred colour does not play any role in estimating the preference for colour-odour interactions.

To the contrary, gender plays a significant role in estimating the preference ratings. Males compared to females added on average 0.6 preference points to each evaluated scented and coloured flask. The significance of this result is very high. In conclusion, the marketers should control for the number of males and females in their studies that involve product's scent and colour. The factors are further shown in the coefficient plot bellow.

Figure 36: Factors- coefficient plot 1



Source: Author; $N = 200$

7.2.9 Which type of congruency had the highest score of preference ratings?

In this final section, the last results will be presented. The data will provide the verification for the fourth hypothesis. The previously identified types of congruencies (propositions 1 to 3) will have their predictions compared to the real data results and therefore it will be possible to decide which type of congruency explains the data the most or if none of the models explain the data well. Again, linear regression analysis appeared to be most convenient, as the model predictions (i.e. the percentage of participants that preferred one colour over another) and the experimental data (the preference of participants for particular colour-odour combination) are not directly comparable. Nonetheless, the linear regression method can answer which of the propositions is the most useful in predicting the experimental data and therefore (if doing the full experiment is not practical) which of the propositions should be used to estimate the optimal colour-odour combinations. As in the previous data, only the Czech participants were included in this analysis.

In the proposition 1, the participants had to match one colour (out of four) to a selected fragrance. This type was further classified as *semantic colour-odour congruency*.

In the proposition 2, the participants had to match fragrance in transparent flask to a written colour, therefore this type was classified as the *mixed semantic-perceptual colour-odour* congruency.

In the proposition 3, the participants obtained colour cards which they had to match to fragrance stimuli. Therefore, this type was called *perceptual colour-odour congruency*.

The fourth type of congruency was the *statistical congruency* as defined in the literature. This one is defined as it occurs in the nature. However, whilst bracken, orange or lemon have obvious colours in nature, lavender could be regarded as purple, but also by some, as green. Therefore, both options had equally distributed values in this statistical model (0.5).

The method of evaluation accounted for the distribution of answers – for example, in the first proposition, a total of 34 participants selected yellow colour for the lemon fragrance, but although minority, some percentage of the participants also selected green and purple colours. Such results were reflected in the proposition models.

Table 30 shows that propositions 1, 3 and 4, while having a profound effect on the colour-odour preference, are not significant predictors for the preference.

However, proposition 2 (where the participants had to match fragrance to a colour in a written form) does increase the preference levels by approximately 2.6 points and this result is significant. To clarify these results, the regression analysis is used to determine how a change in the proposition values (i.e. between having value 0 – no participants selecting this combination; and 1 – all the participants selecting this combination) affects the average preference ratings. This means that the difference between colour for which no participant matched the fragrance will have, on average, 2.58 preference points less than a colour for which all participants matched the fragrance.

Table 30: Congruency – The comparison of the proposition models with the data results

	Estimate	Std. Error	T value	Pr(> t)	Signif.
Proposition 1	1.34311	0.98570	1.363	0.17340	
Proposition 2	2.57801	1.15697	2.228	0.02615	*
Proposition 3	-2.04261	1.28101	-1.595	0.11122	
Statistical model	-1.08974	0.94542	-1.153	0.24940	

Source: Author; N = 200

Therefore, it appears that the Proposition 2 can predict the preference rating better than the other three methods. On the other hand, none of these models reflect the data in perfection.

Chapter 8

Conclusions from the Proposition 1, 2 and 3 and the Experiment

This section serves as a condensed summary of the results. It is followed by a discussion on the topics that were presented in the literature review. All the hypotheses bellow (Table 31) were the subject of testing through the designed propositions (minor results) and the experiment. Now, each of them will be discussed separately. Clearly, two last hypothesis both refer to the preference ratings of colour and odour, thus cross-modal correspondences.

Table 31: Summary of the hypotheses

H1: Cross-modal correspondences between colour and odour exist.
H2_a: The perceived fragrance preference ratings are affected by colour.
H2_b: The perceived fragrance intensity ratings are affected by colour.
H3: Semantically congruent cross-modal correspondences increase perceived preference ratings.
H4: One of the association models will predict the data results more precisely and therefore would be amenable to be used as a generalisation tool.
H5_a: Individual colour preference might affect the preference ratings significantly if applied to culturally consistent participants.
H5_b: Gender might affect the preference ratings significantly if applied to culturally consistent participants.

8.1 H1: Cross modal correspondences between colour and odour exist

As defined in the beginning of the literature review, cross-modal correspondences refer to the existence of certain sensory connectivity in human perception which can be commonly found and somehow correspond with each other. In other words, it is also the compatibility effect between at least two attributes or sensory dimensions of a product, such as colour and odour. Gilbert et al. (1996) identified certain more appropriate combinations of colours and odours that are stable over time and they somehow correspond with each other. He further found that lavender oil was evaluated mostly as yellow. Pine Yarnor Oil, possibly the most similar to the bracken scent, was mostly evaluated as green. Bergamot oil, which is similar to lemon or orange, was mostly evaluated as yellow; followed by orange and green.

In this thesis, it was argued that there might exist more types of colour and odour association pairings which was further the subject of the three propositions. Although the composition of the scents used in this research might slightly differ, the Czech participants seem to have a variety of colour-odour associations. In the first proposition, the semantic congruency showed very similar results to the statistical congruency – participants selected yellow colour congruent to lemon odour, purple congruent to lavender etc. However, the second proposition revealed different congruent combinations of colours and odours. Orange was evaluated as mostly congruent to yellow, lavender was congruent to green, bracken to purple and lemon to yellow. In the third proposition, orange odour corresponded to yellow colour, lavender odour to purple colour, bracken to purple and lemon to yellow. Except for these mostly responded combinations, some percentage of the participants selected also other colour options. This shows that the cross-modal congruency of colour and odour might exist, but the exact colour-odour combinations depend on the method of testing, the formulated question and the presented stimuli. This might subsequently affect the results. In addition, it appears that the congruent combinations are semantically mediated as shown in the Proposition 2 and 3 where the participants had to note their associations with the given fragrances. It appears that except for lemon odour which was in all the cases matched to yellow colour, there is no consistent pairing of congruent colour to an odour and it always depends on the method of testing.

Therefore, in order to measure whether the cross-modal correspondences (the combined effect of colour and odour) exist, it was necessary to not only investigate the appropriate combinations, but also evaluate how it affects human perception. Therefore, another variable was added to this equation – the participants gave their preference and intensity ratings to each colour-odour combination and the changes in the ratings across the same type of fragrance, but packaged in differently coloured bottles were analysed. The variables of intensity and preference ratings will also help to proof the hypothesis H1.

In conclusion, cross-modal correspondences between colour and odour exist in the sense that the majority of the participants selected one colour as most appropriate for an odour, but the specific choice always depends on the method of testing. In total, 4 possible methods of identifying matches between colour and odour were identified in the literature review: statistical, perceptual, mixed and semantic. This is why it is necessary to add intensity and preference ratings as control variables in order to examine the effect of cross-modal correspondences, and thus – verify their existence.

8.2 H2a: The perceived fragrance preference ratings are affected by colour

The second hypothesis aimed to examine the role of colour in the odour preference ratings. Also, the H1 was further examined by analysing the role of the cross-modal correspondences in preference ratings. The two-way ANOVA showed that the p-value for the interaction is 0.006 for Czechs; and 0.031 for Czech and Slovak participants. Both results demonstrated significant effect of colour and odour combination on preference ratings. However, for Slavic participants, the p-value was 0.073, which is already not significant at the standard 5 % level of significance. These results verified that the choice of combination of colour and odour plays a role in preference ratings (as shown on Czech and Czech and Slovak participants), but this might be highly dependent on the culture of the respondents and it is possible that the more homogenous group is selected, the greater will be the significance. In conclusion, the existence of cross-modal correspondences by means of a change in preference ratings was verified and the results were significant, at least if applied to culturally homogenous group of participants.

However, ANOVA did not reveal the specific choices of colour and odour that affect the preference ratings and more specifically – whether for example packaging lavender to yellow or purple impact the odour preference ratings significantly.

In order to measure this effect, linear regression analysis was applied and revealed that for example a combination of lavender scent and yellow colour decreases significantly the preference by approximately 2 points on the preference scale when compared to the combination of lavender scent in purple flask. Also, yellow colour decreases the preference ratings by approximately 1.1 points. Some other combinations such as bracken in purple decreased the preference by 0.8, but the result here was insignificant, although within 90 % certainty. These results demonstrated that the perceived fragrance preference ratings are in some cases negatively affected by a choice of colour as compared to the baseline colours. In other cases, this effect is so small that it is insignificant and the colour does not play a role.

These findings have some direct implications for the marketers. Based on the research results, it is not advised to combine lavender perfume with orange or yellow colour as it might decrease the overall preference ratings of the product. However, the type of fragrance also plays a role, so this finding must not be applied to any lavender scent. On the other hand, this might be interesting and valuable notion in mass-production where the colour and odour options could subsequently result in decrease or increase of profit. This might support the quantitative approach in selection of colour and odour in practice as it might increase or decrease the preference levels significantly and subsequently the profit. As demonstrated, it is possible that the wrong choice of colour applied to scented product would result in decline of preference by 2 scale points.

In conclusion, this finding is original as the preference ratings of odour with the variable of colour were not previously studied. It was identified that the sense of smell alone is critical to the perception of flavours, can also affect our mood, promote products or position a brand (Herz, 2007; Morrin, 2010; Martin et al., 2001). Now, it might be also concluded that scent can affect, at least in some cases, the preference ratings.

For culturally homogenous participants, it was demonstrated that the choice of colour significantly affects the preference ratings of odour, at least in some cases.

This finding is particularly important in practice for product designers and marketers, but could be also useful for marketing theory. First of all, it is necessary to account and control for the nationality of the target market when assessing the best colour and odour product characteristics. Secondly, it was verified that cross-modal correspondences between colour and odour exist and the correspondence of colour and odour affect the preference ratings. This means that the marketers could potentially select more efficient colour-odour combinations that subsequently lead to increased loyalty, increase in sales and generally more positive evaluations of the product.

8.3 H2_b: The perceived fragrance intensity ratings are affected by colour

The results showed that intensity and preference ratings might be correlates as lavender scent was generally evaluated as the least intense, followed by orange, lemon and bracken, which interestingly, is the same ordering as we observed for fragrance preference across all the cultural segments.

Difference in mean fragrance intensities is much lower than for mean fragrance preference which corresponds to the finding from the literature review that humans are generally not that sensitive with regards to intensity of odours and are able to notice a change in approximately 25 % difference of concentration of an odour (Fontana and Mad'a, 2018).

Across all the three nationalities, two-way ANOVA suggested significantly different impact of the fragrance type on intensity. This means that there were significant observable differences between lavender, orange, lemon and bracken. Again, this supports the claims that not only concentration of the compounds plays a role, but also the specification of the odour compounds, as all the odours had the same proportion of the ingredients, but still were rated differently with regards to intensity ratings.

However, the results suggested that perceived intensity ratings of a fragrance are not significantly affected by colour. The interaction of colour and odour also did not play a significant role in intensity ratings. Therefore, the colour-odour combination does not play a significant role in intensity ratings.

This means that it is not possible to enhance or lower fragrance intensity by colour and in this case, the cross-modal correspondences do not have any effect. Compared to the literature review, this finding is interesting in light of the preliminary experiment of Gatti, Bordegoni, & Spence (2014) who showed that the perceived fragrance intensity was significantly enhanced when the soap was coloured. This effect was also demonstrated by Van Doorn et al. (2014) as illustrated in the literature review.

In both cases, the authors used white or transparent vs coloured objects. It is still possible that transparent or white colour has some effect on fragrance intensity compared to coloured options as the experiment design in this thesis did not account for white colour option. But it is not possible to generalise that colour has some effect on fragrance intensity as only the comparison between white/transparent and coloured product might play some role in perceived intensity ratings.

In conclusion, colour does not play a role in perceived intensity ratings with a possible exception of transparent or white colour where the intensity might be perceived lower.

Based on the results, H2_b is rejected. Due to no impact of colour on the fragrance intensity ratings, the intensity was excluded from further hypothesis testing.

8.4 H3: Semantically congruent cross-modal correspondences increase perceived preference ratings

As clarified in the literature review, the author wanted to examine whether for example lemon odour obtains higher preference ratings if packaged in yellow packaging as compared to other colour options. These intuitive combinations are mostly used in the FMCG sector in order to package products and they are coherent with the semantical congruency as defined in the literature review. The data revealed that Czech participants gave the highest mean values to the following combinations: bracken in yellow packaging, orange in green packaging, lemon in purple packaging and lavender in green packaging. Therefore, the intuitive (semantical) combinations did not obtain the highest preference ratings as speculated. However, not all the values were significant, so the linear regression was also applied. As already presented, only lavender in yellow and orange packaging decreased significantly the preference ratings. For other combinations, the certainty is too low. Therefore, the hypothesis H3 was rejected.

This finding is of a great importance for marketers as the intuitive selection of colour in fact does not generally increase preference ratings, at least with certainty. On the other hand, and as identified in the literature review, colour can still serve for the purpose of differentiation of a product, sign of quality if applied to food or in order to aid faster visual identification in a store.

8.5 H4: One of the association models will predict the data results more precisely and therefore would be amenable to be used as a generalisation tool

This hypothesis was the most difficult one to be tested accurately and in order to do so, it was necessary to first define the various types of congruencies. These were previously identified in the literature review as statistical, perceptual, mixed and semantic. The identification resulted in 4 types of congruencies on which the participants could base their decision-making with regards to appropriate or inappropriate (congruent and incongruent) pairings of colours to odours. These 4 types of congruencies were then compared to the preference ratings collected in the experiment. The results showed that the Proposition 2 reflected the preference ratings better than the other 3 types of congruencies. To be more specific, the p-value was less than 0.027 and therefore significant.

The implications of these results are particularly interesting for product managers and marketers in general. It appears that intuitive colour-odour choices such as branded lemon scented product in yellow packaging might not be the best approach as it does not increase the preference levels with significant probability. On the other hand, should the marketers wish to take more scientific approach on choosing congruent colour and odour to a product, they should present the participants the colour options in a written form and let them match the words (disregarding the hue) to the selection of scented products. This method would – as suggested by the results – be most predictive of the real preferences, and subsequently lead to increased preference ratings.

Please note that these results were controlled for all the other factors such as gender, age, nationality or preferred colour. Therefore, the marketers are advised to control for this in their product testimonials as well.

Since the propositions reflect only 4 possible congruencies, no model reflects in perfection the real preference ratings. However, the second model is more precise than the other three types of congruencies in estimating the preference ratings. Therefore, the H4 was verified and the specific model that predicts the preference ratings more precisely is defined by Proposition 2.

8.6 H5a: Individual colour preference might affect the preference ratings significantly if applied to culturally consistent participants

The last three hypotheses all relate to the second research question and try to investigate the factors that might influence the preference ratings. Apparently, the preferred colour did not play a role in preference ratings of coloured and scented product based on the results of the linear regression analysis. Therefore, it appears that adults do not regard their personal colour preference as an important factor in evaluating the product preference.

Based on the literature review, in food, it appears that colour is an important factor and this is further illustrated by artificial colouring in food industry (Gormley, 1992). On the other hand, it appears that favourite colour as a variable is mainly important for children (Léon et al., 1999). Finally, Yu et al. (2018) concluded that personal colour preferences affect purchase intentions, but this varies across the product categories and they are secondary to product functionality and colour performance. Given this, the results indicate that at least for perfume industry, the favourite colour does not play a role for adults.

Therefore, the H5_a was rejected.

8.7 H5b: Gender might affect the preference ratings significantly if applied to culturally consistent participants

As opposed to the previous rejection, and based on the results of the linear regression analysis, it appears that gender plays a significant role in estimating the preference ratings. Males compared to females added on average 0.6 preference points to each

evaluated scented and coloured flask. The significance of this result is very high. It is recommended that the marketers should control for the number of males and females in their studies as it might affect the preference ratings involving product's scent and colour. In conclusion, the H5_b was verified as the gender plays a significant role in preference ratings of colour and odour. This also makes gender an important factor to control for in studies that focus on scent evaluations. It could be assumed that this is because women are generally more knowledgeable of various scents, similarly to their ability to verbalise more types of colours.

In addition to these factors, it was also identified that culture might play a role in cross-modal correspondences. The age does not play a significant role, at least if evaluated as a comparison between two age groups. Perhaps, the difference between the age groups would have to be greater.

8.8 Conclusion summary

As illustrated in the literature review, many scientists dedicated years to studies of cross-modal correspondences. It is interesting to see that our senses might be somehow manipulated as proven in this research where visual percept such as colour might affect the perception of odour. However, from the marketing perspective, the most valuable information is not only whether it is possible to affect perception, but more specifically, whether marketers can manipulate consumer behaviour through the senses and whether there is any measurable effect on preference or overall evaluations of the product. Through the verification of a set of proposed hypotheses, it was possible to identify that cross-modal correspondences generally exist in the sense that each odour seem to have the most matching colour, but the specific combinations of colours and odours vary based on the method of testing. In order to measure the effect of cross-modal correspondences, two more variables were added – preference and intensity. The results suggested that there is a significant effect of colour on the preference ratings of odour. Therefore, there is certain compatibility effect between colour, odour and preference ratings and the specific combination of colour and odour play a role in preference ratings. However, this effect was not demonstrated on Slavic participants, despite the fact that non-Czech participants formed only 19,7 % of the sample. This might show that culture is also an important factor and the finding might apply only to culturally homogeneous groups. In addition, the effect of colour

on intensity ratings appeared insignificant. The specific combinations of colours and odours that significantly decreased the preference ratings was only lavender odour packaged in yellow and orange colour. This finding is still interesting, especially if applied to mass-production as the preference ratings differed by approximately 1 to 2 points on a scale from 0 to 10, making it a valuable result with practical implications. Out of the analysed factors, age group appeared insignificant, but this was almost certainly due to small age gap between the two compared categories. Preferred colour as stated by the participants appeared to have very small effect on the ratings, which was again insignificant. This finding might be applied to perfume industry as it was directly proven that favourite colour does not play a role in preference ratings of scent. On the other hand, gender plays a significant role in preference ratings and males were inclined to give more favourable evaluations with regards to preference by approximately 0.6 points.

Furthermore, this research tried to discover if there is any causal effect between various types of associations and the preference ratings. This is because the concept of preference ratings is rooted in our decision-making processes and therefore, it would be beneficial to reveal the mechanisms behind it. If it was possible to predict the congruent colour to an odour, which will result in more favourable evaluations, it could help marketers with product design. It was confirmed that the proposition 2 and hence the semantic-perceptual congruency model predicts the real preference ratings the best. This result, as opposed to the previous ones, is generalisable and not confined specifically to Czech participants. It could be used as a theoretical framework in designing product testimonials. The method of proposition 2 gave the participants colours in a written form (disregarding the hue) and they had to match them to scents. This is again directly applicable to marketing, where one does not have to conduct large-scale experiment as such, but use this method in order to identify the consumer preferences. This method is certainly more reliable than the other three proposed methods and is capable of the most precise prediction of the preference ratings. However, it might also suggest that the congruency of odours to colours is determined by hue, rather than specific colour options and when a participant can use all the hues of particular colours when exposed to written concept of colour, it might then be perceived as more congruent with regards to preference ratings. This requires

further inspection and it might also serve as suggestion for future directions of the study.

Although the empirical results did not intend to examine the specific role of expectations and novelty, it is safe to assume that these processes affected the preference scores. Therefore, they form an inseparable part in the literature review.

Here, it is also important to explicitly evaluate whether the main aims and objectives were successfully accomplished. The RQ1 was formulated in order to investigate if the colour of the packaging plays a significant role in the consumers perception of scent. This was further divided on the effect of colour on odour on a) intensity and b) preference ratings. Based on the findings, some colour and odour combinations significantly affect the perceived preference (such as yellow and green packaging applied to lavender odour). This means that in some cases, the colour of the packaging might affect the perception of scent. On the other hand, the intensity ratings were not significantly changed, so the colour of the packaging does not affect the odour intensity scores.

The RQ2 wanted to examine if there are any significant factors that affect the perception of scent in differently coloured packaging. Among these factors was gender, nationality, preferred colour and association types. Based on the findings, preferred colour appears to not to play a significant role for adults in preference ratings of a particular scent. On the other hand, nationality appeared to decrease the effect of cross-modal correspondences and it might be speculated that this is due to differences in culture. Gender also significantly affected the preference ratings. Association types (or also types of congruencies) played an important role in estimations of preference. In summary, both questions were answered through the set of propositions and the experiment presented in this thesis.

Moreover, the third and fourth remaining objectives were clarified as described in this summary.

Limitations and future directions of the research

Chapter 9

Limitations

9.1 Limitations of the experiments – participants, the environment and the procedures

During the research, couple of specific problems occurred. The major one related to the nature of scents. It was important to ensure uniform dispersion of scent and eliminate the odours within the lecture hall where the experiment took place. This is why the fragrance containers were selected rather than fragranced products and those included exactly 2 ml of fragrance. It would not be possible to regulate the uniform dispersion of scents if the objects of the testing were already fragranced products, mainly because the scents also change their intensity over time.

As a result, the dispersion of the fragrance was the responsibility of the participants who had to spray the fragrance twice on a perfume testing stripe. The spray applicator was the same, however, the strength of the participants or the position of their finger when spraying might have affected the exact amount of fragrance, and therefore could impact the intensity. Due to the number of the participants in this study and also the relative insensitivity towards fragrance intensity, the differences should be negligible. Despite this, and especially in small-scale studies, it is important to ensure that the amount of dispersed fragrance is uniform. As shown on page 19, there are some already existing commercial tools (AromaJet) which ensure uniform dispersion. Unfortunately, the solutions are costly and hence, it was not possible to use them.

Moreover, the odour characteristics are so complex in relation to perception as it is very difficult to account for all of them. It is incorrect to simply assume that olfactory perceptions are generally stable over time. Also, and as identified in the literature review, individuals perceive identical odorants in different way. One of the problems that occurred during the experiment was also related to the difficulty with the verbalisation of scents. When performing the standard test for anosmia, some

participants used emotional responses in order to describe the odours such as “Christmas” for cinnamon odour or “Cleaning” for vinegar. In order to not to subjectively assume a line between the right or already wrong emotional responses, all these answers were excluded from the research. This affected the final data set.

The lecture hall was well-ventilated and the participants were seated in order to maximise the minimum distance from each other (in accordance with the protocol ISO/IEC 8589). However, in practice, the odours present in the environment might still have impaired some answers. It is almost impossible to ensure that the environment is completely odour free as even the paper testing stripes or respondents carry an odour to some extent. In some previous experiments, the participants were instructed to not to use perfume on the day of the experiment. This was not regarded as necessary in the conducted propositions and the experiment as it is again practically inconceivable to ensure that all the participants are odour free (for example washing powder on clothes usually contains certain smell or aromatic food eaten previously). There is still quite high chance that the participants would use fragrance out of habit despite the previous notice, and therefore this instruction was not included in the studies. In addition, in the usual settings such as in store, the environment is also not completely odour-free.

Preceding a careful consideration, due to time scale of the study, financial constraints and room availability, it was not possible to test the participants separately to allow the room to be completely odour-free. This is why the participants were at least offered coffee beans in order to disrupt the smell from the previous samples and they were instructed to smell them in between the fragrance sampling.

Regarding the way of testing, the perfumer recommended to use glass plates since this would eliminate the contamination of paper odour. However, due to safety of the participants, this was not adopted.

The participants were selected with regards to their relative accessibility and they were all students of the University of Economics. It was expected that the majority of the participants will be from the Czech Republic. However, this shown as false belief because a relatively large amount of the participants was from other countries such as Slovakia, Ukraine, Russia, Italy, Spain or even Mexico. Since the previous studies demonstrated that there might be certain differences in cross-modal correspondences

across geographically close countries such as France and Great Britain (Jacquot et al., 2016), it was necessary to analyse the results with an emphasis on the differences between the participants from different countries. The data were interpreted with the limitation that the majority of the participants in all the three groups (Czech, Czech and Slovak and Slavic) are still Czech. This means that the data should not be viewed as representative for the separate nationalities, but they only illustrate the differences in the results with additional culture influences.

Moreover, the inclusion of different age groups was considered. The existing research papers often select students in order to test the hypotheses. In order to demonstrate the existence of cross-modal correspondences (that colour affects the perception of odour), the demographic sample of 18-24 years old students appeared to be sufficient. In order to test the impact of colour on odour preference and intensity ratings, this age group could probably show larger effect than would appear in standard population due to possible decrease of vision (colour recognition ability impairments) and olfaction (the impairment of scent recognition due to decline of olfactory cues) with an increasing age. However, those participants would be in any case removed from the experimental study due to impairments. There is no evidence that people have different vision or olfactory cues when older, despite the increasing relative insensitivity with an increasing age. This is why there is no reason to object that the effect therefore does not exist at all; but younger participants might demonstrate stronger effect. As claimed by Kaeppler and Mueller (2012), elderly participants might also be in some cases excluded from olfactory studies. As the relatively limited funding for the research and limited time frame did not allow to replicate the procedures for different age groups, this explanation must suffice.

In order to test the congruency effect on preference and intensity, the answers of 40 students between 18-24 were analysed. The participants of other than Czech nationality were not included in the analysis. The sample was controlled for gender with only minor deviations. Whilst this sample might not be sufficient to represent the whole population, it is enough to demonstrate that there are significant differences in the proportion of the selection of congruent colours to odours dependant on the type of the testing. This was further supported by χ^2 test and Cramer's.

Moreover, some would claim that individual life-style or occurring trends might be also an important aspect with regards to fragrance perception and evaluation. However, the subject of the study was not to assess the possible individual differences in fragrance perception, but to examine the significantly different effects of interaction between colour and odour on preference and intensity. The life-style or current trends might temporarily affect individual consumer choices, but as mentioned in the results, preferred colour alone (or fashionable colour) did not affect the preference ratings. The preference of fragrance alone might be again affected by current trends or life-style. However, the studied effect did not focus on particular odour preferences, but instead measured the preference ratings in relation to matched interactions of colours and odours. In this sense, the personal preferences might be disregarded, but the measured effect is increasing or decreasing tendency of the interactions with regards to preference. In principle, the same applies for the effect of university education as all the subjects were gathered from the university settings.

In conclusion, the experiment procedures were extremely demanding in order to ensure controlled environment, especially due to the nature of the scents. However, most limitations that resulted from the experiment design were considered and hopefully reflected.

9.2 Limitations of the data analysis

As mentioned already before, five ways of data analysis were selected – ANOVA, linear regression, frequency analysis, Cramer's V and Chi-squared test. All the methods also represent some limitations, already discussed in the methodology. This section provides a comprehensive summary of the limitations.

For χ^2 test, the condition is to have at least 5 observations for each variable which was not confined in some cases. However, for the purpose of the illustration of the representativeness of the results, this method appeared to be sufficient.

Similarly, for ANOVA and linear regression, it was assumed that both scales are normally distributed and that observations are independent and have identical variance in each group considered. The questionnaires required the participants to rate the preference and intensity on a scale from 1 to 10. As the scales are in fact discrete on the range 1-10 and four observations are collected for each respondent, these

assumptions are not fully valid in the experiments. Tails are heavier than normal. Therefore, statistical significance was interpreted with this limitation and focus was put on descriptive outputs of the statistical tools applied. In any case, the participants used all 10 values in order to describe their a) preference and b) intensity ratings. The Appendix 8 suggests that the scale was not too subtle.

In addition, the participants had to respond whether they feel culturally connected to Czech culture. This question was presented in order to test the major cultural influence on the foreigners. It was assumed that the participants that lived in another country for more than 5 years (for example in their childhood), but they spend the majority of time in Czech Republic, would be predominantly affected by Czech culture and therefore could be included in the data analysis. However, many participants responded that they do not feel culturally connected to Czech culture despite not living in a foreign country for longer than 5 years and despite their nationality being Czech. This is why this question was eventually withdrawn from the data analysis. The participants who lived more than 5 years abroad were cleared from the data set and the nationality remained the only index.

As resulted from the literature review, culture plays an important role in matching two or more stimuli cross-modally. Therefore, the ANOVA was analysed for each nationality or national group (Slavics) separately. However, the only generable results were obtained for the Czech participants as they formed a significant part of the respondents. Therefore, the results were presented with this limitation in mind.

9.3 Future directions of the research

The future directions might include replications of some of the studies that claim that colour affects the perceived intensity as this was not verified in this study, in fact the hypothesis was rejected for all three tested groups (Czechs, Czech and Slovaks and also Slavic participants). Although, there might be an exception for white and transparent colour as this study did not use neutral colours in order to verify the hypothesis. In any case, the conclusion of such studies should be that neutral colours affect perceived intensity, while others do not.

More studies of cross-modal correspondences in different cultures might also be of interest since it appears that culture plays a role in preference evaluations

regarding colour and odour. Of course, the studies are not limited to vision and olfaction, but could be applied to any two interaction of the senses.

Furthermore, the concept of perceived quality might be of great importance for marketers. A combination of certain sensory characteristics might be given to sensory participants randomly and the changes with regards to evaluations of quality might be observed.

One of the verified hypotheses resulted in gut feeling that the congruency of odours to colours is determined by hue, rather than specific colour options and when a participant can use all the hues of particular colours when exposed to written concept of colour, it might then be perceived as more congruent with regards to preference ratings. This requires further inspection and it might also serve as suggestion for future directions of the study.

Also, it would be interesting to apply more qualitative approach with regards to life-style segmentation and the role of sensory characteristics for the specific subgroups. While this study focused on proving the existence of cross-modal correspondences and therefore selected relatively younger participants, the role of sensory attributes might not play such an important role for mid-aged or elderly.

Finally, more studies of biometric tools and understanding of how our brain operates and integrates sensory perception could help towards more understanding of consumer behaviour. This would lead to further stream of research about the sensory characteristics of the products and how those affect our cognition and perception.

In practice, it might be beneficial to study more sensory congruence where the consumer might easily confuse two products with similar sensory cues. Some scheme could be helpful to also serve as a guideline for companies in order to avoid fines. For example, a company called Kantar Millward Brown had one case where they had to compare two products with regards to their sensory similarity in order to present evidence in the case of their client. Moreover, the representative of the company claimed that large corporations usually judge product sensory aspects based on larger entities such as Europe, China, USA, Australia etc. However, given the results of this study, it might not be the best sales strategy as the culture might play an important role in perception of colour and odour. This is why it would be beneficial to apply the

method identified from this study and adjust the product characteristics to the market, if the financial benefits allow to do so.

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³ All the references should comply with APA Style according to <http://www.apastyle.org/>

List of tables

Table 1: Key changes in the marketing paradigm according to Achrol & Kotler (2012).....	27
Table 2: Schmitt's (1999) 5 experiences that a company can provide.....	28
Table 3: Types of assessment of various congruencies between colour and odour	87
Table 4: Formulated Hypotheses	90
Table 5: The key to recognise fragrances in transparent perfume bottles	98
Table 6: The possible combinations of colours and odours given to the respondents (A-H group).....	101
Table 7: Likelihood Ratio and Pearson's coefficient.....	106
Table 8: Cramer's V	106
Table 9: Likelihood Ratio and Pearson's coefficient.....	112
Table 10: Cramer's V	112
Table 11: Likelihood Ratio and Pearson's coefficient.....	115
Table 12: Cramer's V	115
Table 13: Czech nationals: Mean values for preference ratings	119
Table 14: Czech nationals: Two-way ANOVA of fragrance preference.....	120
Table 15: Czech nationals: Two-way ANOVA of fragrance intensity.....	121
Table 16: Czech nationals: Mean values for intensity ratings	122
Table 17: Czech and Slovak nationals: Mean values for preference ratings	123
Table 18: Czech and Slovak nationals: Two-way ANOVA of fragrance preference...	124
Table 19: Czech and Slovak nationals: Mean values for intensity ratings	125
Table 20: Czech and Slovak nationals: Two-way ANOVA of fragrance intensity.....	126
Table 21: Slavic nationals: Mean values of fragrance preference	128
Table 22: Slavic nationals: Two-way ANOVA of fragrance preference.....	128
Table 23: Slavic nationals: Mean values of fragrance intensity	130
Table 24: Slavic nationals: Two-way ANOVA of fragrance intensity.....	130
Table 25: Linear regression 1: Lavender odour in purple flask compared to other 3 colour options.....	131
Table 26: Linear regression 2: Bracken odour in green flask compared to other 3 colour options.....	133

Table 27: Linear regression 3: Orange odour in orange flask compared to other 3 colour options.....	134
Table 28: Linear regression 4: Lemon odour in yellow flask compared to other 3 colour options.....	135
Table 29: Linear regression 1: Selected factors that affect preference ratings	138
Table 30: Congruency – The comparison of the proposition models with the data results	141
Table 31: Summary of the hypotheses.....	142

List of figures

Figure 1: Nakamoto laboratory tool for digital transmission of scent.....	20
Figure 2: AromaJet tools for scent emission	21
Figure 3: Orangina bottle	29
Figure 4: Colourless Pepsi – Crystal Pepsi	29
Figure 5: An example of Revlon's scented enamel product line.....	31
Figure 6: Hollister Co.: The Front of the store in Texas, USA.....	32
Figure 7: Fragrance wheel	35
Figure 8: An Illustration of the Stroop effect	55
Figure 9: Experiment results: Colour-odour cross-modal correspondences.....	70
Figure 10: Picture of the lecture hall where the experiment took place	88
Figure 11: The Ishihara test: a test that is used to diagnose colour vision deficiencies .	96
Figure 12: Illustration of the fragrances from the perfume brand "Provence et Nature"	98
Figure 13: Pictures of the preparatory stages – group H coloured bottles filled with perfumes.....	102
Figure 14: Frequency analysis of colours associated with lemon fragrance	107
Figure 15: Frequency analysis of colours associated with lavender fragrance.....	107
Figure 16: Frequency analysis of colours associated with orange fragrance	108
Figure 17: Frequency analysis of colours associated with bracken fragrance.....	108
Figure 18: Proposition 2 – Orange fragrance: experimental results	109
Figure 19: Proposition 2 – Lavender fragrance: experimental results.....	109
Figure 20: Proposition 2 – Bracken fragrance: experimental results.....	110
Figure 21: Proposition 2- Lemon fragrance experimental results	110
Figure 22: Proposition 3 – Fragrance A – Experimental results.....	113
Figure 23: Proposition 3 – Fragrance B – Experimental results.....	113
Figure 24: Proposition 3 – Fragrance C – Experimental results.....	114
Figure 25: Proposition 3 – Fragrance D – Experimental results.....	114
Figure 26: Czech nationals: Preference ratings of odours packaged in different colours	118
Figure 27: Czech nationals: Intensity ratings for odours packaged in different colours	121
Figure 28: Czech and Slovak nationals: Preference ratings for odours packaged in different colours	123

Figure 29: Czech and Slovak nationals: Intensity ratings for odours packaged in different colours	125
Figure 30: Slavic nationals: Preference ratings for odours packaged in different colours	127
Figure 31: Slavic nationals: Intensity ratings for odours packaged in different colours	129
Figure 32: Linear regression 1: Coefficient plot.....	132
Figure 33: Linear regression 2: Coefficient plot.....	134
Figure 34: Linear regression 3: Coefficient plot.....	135
Figure 35: Linear regression 4: Coefficient plot.....	136
Figure 36: Factors- coefficient plot 1	139

List of appendices

Appendix 1: Anglia Ruskin University – Ethics procedure	183
Appendix 2: Proposition 2 – Example of the questionnaire & Instructions	187
Appendix 3 _a : Associations of colours with odours according to respondents – Proposition 2	189
Appendix 4 _b : Associations of colours with odours according to respondents – Proposition 3	190
Appendix 5: Experiment – Example of the questionnaire	191
Appendix 6 _a : Semantic associations with the odours according to respondents – Proposition 2	192
Appendix 7 _b : Semantic associations with the odours according to respondents – Proposition 3	193
Appendix 8: Written consent with the research and data processing	194
Appendix 9: Proposition 3 – Questionnaire.....	195
Appendix 10: Values used on the scale from 1 to 10 for preference and intensity	196

Appendix

Appendix 1: Anglia Ruskin University – Ethics procedure

Section 2: Research Ethics Checklist (Refer to Section 3 for an explanation of the colour coding.)

N.B. If you are conducting research that involves ‘animals and significant habitats’, please use the Stage 1 Research Ethics Application Form involving Animals and Habitats (www.anglia.ac.uk/researchethics).

You must provide a response to ALL questions. Please refer to the Question Specific Advice for completing the Stage 1 Research Ethics Application Form for guidance.

Will your research (delete as appropriate):				
1	Involve human participants?	●	YES	NO
2	Create a risk that individuals and/or organisations could be identified in the outputs?	●		
3	Involve participants whose responses could be influenced by your relationship with them or by any perceived, or real, conflicts of interest?	●		
4	Involve the co-operation of a ‘gatekeeper’ to gain access to participants?	●		
5	Offer financial or other forms of incentives to participants?	●	YES	NO
6	Involve the possibility that any incidental health issues relating to participants be identified?	●	YES	
7	Involve the discussion of topics that participants may find distressing?	●	YES	
8	Take place outside of the country where you work and/or are enrolled to study?	●	YES	NO
9	Cause a negative impact on the environment (over and above that of normal daily activity)?	●		
10	Involve gathering or preparing non-living biological samples <i>not held already</i> in a university, museum or other collection?	●		
11	Involve genetic modification of human tissue, or use of genetically modified organisms classified as Class One activities? ⁴ .	●		
12	Involve genetic modification of human tissue, or use of genetically modified organisms above Class One activities?.	●		NO

⁴ Email FST-Biologicalsafety.GMO@anglia.ac.uk for further information.

² As above.

13	Collect, use or store any human tissue or DNA (including but not limited to, serum, plasma, organs, saliva, urine, hairs and nails)? ⁵	●	YES	NO
14	Involve medical research with humans, including clinical trials or medical devices?	●		NO
15	Involve the administration of drugs, placebos or other substances (e.g. food, vitamins) to humans?	●		NO
16	Cause (or have the potential to cause) pain, physical or psychological harm or negative consequences to humans?	●		NO
17	Involve the collection of data without the consent of participants, or other forms of deception?	●		NO
18	Involve interventions with people aged 16 years of age and under?	●		NO
19	Relate to military sites, personnel, equipment, or the defence industry?	●		NO
20	Risk damage/disturbance to culturally, spiritually or historically significant artefacts/places, or human remains?	●		NO
21	Contain research methodologies you, or members of your team, require training to carry out?	●		NO
22	Involve access to, or use (including internet use) of, material covered by the Counter Terrorism and Security Act (2015), or the Terrorism Act (2006), or which could be classified as security sensitive? ⁶	●		NO
23	Involve you or participants in a) activities which may be illegal and/or b) the observation, handling or storage (including export) of information or material which may be regarded as illegal?	●		NO
24	Require ethical approval from any recognised external agencies? e.g. NHS, Social Care, Ministry of Justice, Ministry of Defence. Please refer to the Question Specific Advice for the Stage 1 Research Ethics Application Form and Code of Practice for Applying for Ethical Approval for further information.	●		NO
25	Involve individuals aged 16 years of age and over who lack 'capacity to consent' and therefore fall under the Mental Capacity Act (2005)?	●		NO
26	Pose any ethical issue not covered elsewhere in this checklist (excluding issues relating to animals and significant habitats which are dealt with in a separate form)?	●	YES	

⁵ For any research involving human material you must contact Matt Bristow (matt.bristow@anglia.ac.uk) for further guidance on how to proceed

⁶ The Counter Terrorism and Security Act (2015) and Terrorism Act (2006) outlaws web posting of material that encourages or endorses terrorist acts, even terrorist acts that have occurred in the past. Sections of the Terrorism Act also create a risk of prosecution for those who transmit material of this nature, including transmitting the material electronically. The storage of such material on a computer can, if discovered, prompt a police investigation. Visits to websites related to terrorism and the downloading of material issued by terrorist groups (even from open-access sites) may be subject to monitoring by the police. Storage of this material for research purposes may also be subject to monitoring by the police. Therefore, research relating to terrorism, or any other research that could be classified as security-sensitive (for example, Ministry of Defence-commissioned work on military equipment, IT encryption design for public bodies or businesses) needs special treatment. If you have any doubts about whether your research could be classified as security-sensitive, please speak to your FREP Chair.

Please note that the Faculty Research Ethics Panel (FREP) will refer to the Office of the Secretary and Clerk any application where, in the view of the Chair, the proposed research poses a risk of a legal or security related nature to Anglia Ruskin University. The Chair will seek guidance from the Secretary and Clerk before the FREP decides if the proposed research can be granted ethical approval and/or the nature of any special arrangements which need to be put in place.

Section 3: Approval process

All student applications must be sent to your Supervisor for checking.
Your Supervisor must then forward the application to the DREP/FREP (as appropriate)

FREP = Faculty Research Ethics Panel

DREP = Departmental Research Ethics Panel



NO answered to all questions
Risk category Green



Complete Section 5 of this form and then send it to your DREP (or FREP for the Faculty of Medical Science only).
You do not require ethical approval from a committee.
You can start your research immediately.



YES to any of Questions 1-11 and/or 26 but NO to all other questions
Risk category Yellow



Complete Section 4 and 5 of this form and submit it, and the Participant Information Sheet (PIS) and Participant Consent Form (PCF), to your DREP (or FREP for Faculty of Medical Science only). Your faculty may require further documents.
You need to wait for ethical approval before you start your research.



YES to any of Questions 12-23
Risk Category Red



Complete Section 5 of this form and complete the Stage 2 Approval form. Submit both, and any other documents required, to your FREP.
If you answered YES to Question 22 you must also complete and submit for consideration by the committee the Stage 3 Approval form.
You need to wait for ethical approval before you start your research.



YES to either or both of Questions 24-25
Risk Category Purple



You need external approval(s) which, if granted, may be regarded as equivalent to approval from an Anglia Ruskin ethics committee.
Refer to the Question Specific Advice for the Stage 1 Research Ethics Application Form and Code of Practice for Applying for Ethical Approval for further information
You need to wait for ethical and/or governance approval before you start your research.

Appendix 2: Proposition 2 – Example of the questionnaire & Instructions

Návod

Prosím, dodržujte uvedené instrukce během experimentu:

- 1) Nemanipulujte prosím s předměty, dokud nejste vyzváni výzkumným týmem;
- 2) Pokud máte alergii nebo trpíte zvýšenou citlivostí na některou z uvedených látek: květinové vůně, citrusy, seno, bylinky, líh, alkohol nebo éterické oleje; konzultujte prosím svou účast na experimentu s výzkumným týmem;
- 3) Pokud se vám z jakéhokoliv důvodu udělá nevolno během experimentu nebo budete mít potíže s dýcháním, můžete kdykoliv experiment přerušit;
- 4) Některé používané látky mohou být hořlavé. Proto prosím dbejte zvýšené opatrnosti při manipulaci s nimi;
- 5) Testovací vzorky vůní prosím nevdechujte ústy a omezte jejich kontakt s pokožkou na nezbytné minimum;
- 6) Kdykoliv dostanete během experimentu pocit, že špatně cítíte testovanou vůni, přičichněte si ke kávovým zrnům, které mají schopnost neutralizace pachů (dostupné vždy v každé lavici).

Při vyplňování dotazníku prosím dbejte na dodržení následujících pokynů:

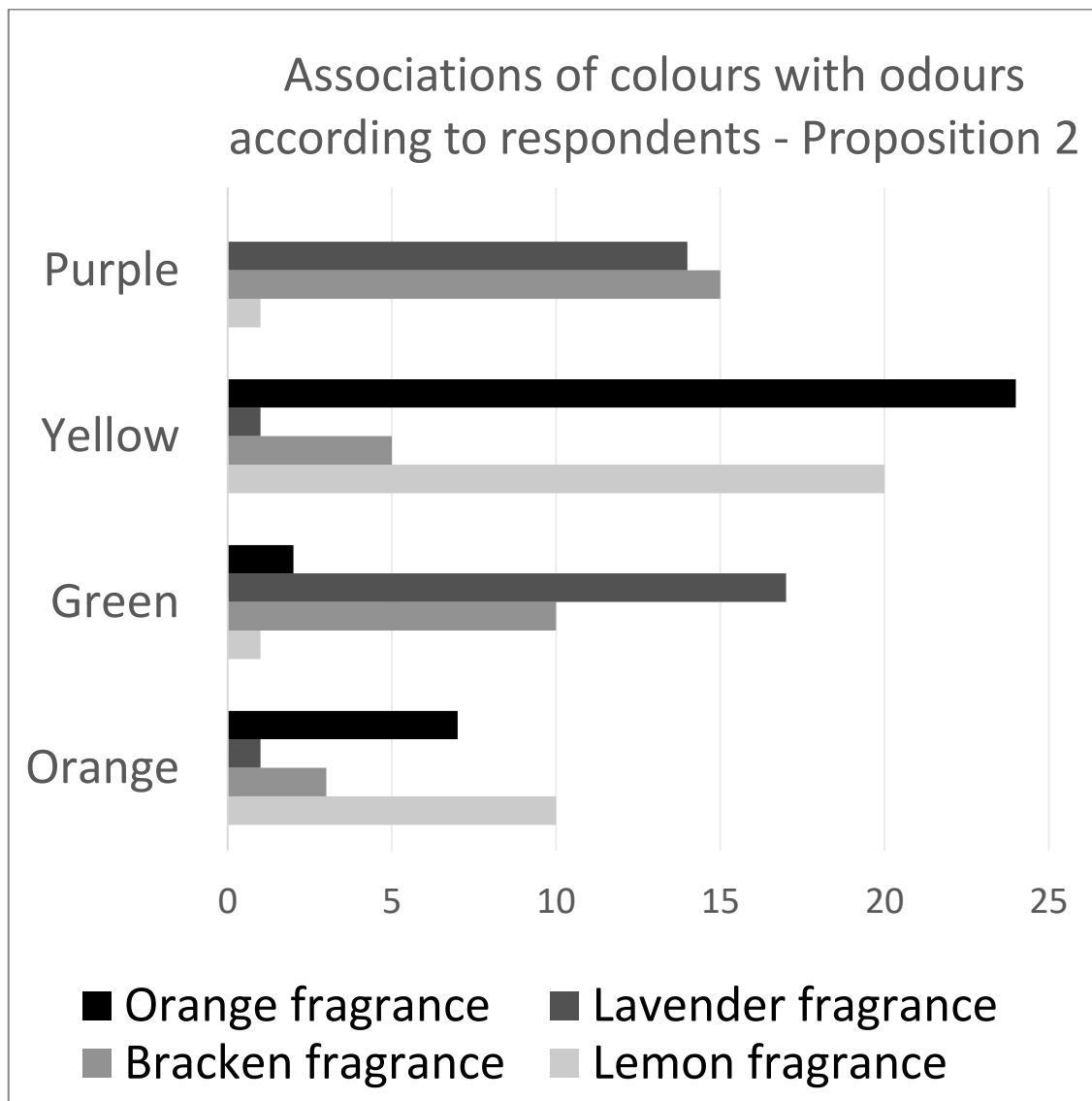
- 1) Až budete vyzváni k manipulaci s vůněmi, vezměte si vždy jednu lahvičku s aplikátorem do dvojice studentů. Vůni aplikujte ve dvojici na testovací papírek a následně každý zaznamenejte svou vlastní odpověď;
- 2) Při manipulaci s vůněmi postupujte následovně: Vezměte si lahvičku s aplikátorem a připravte si testovací papírek. Silně 2x stiskněte aplikátor, co nejbližší u testovacího papírku tak, aby do sebe nasákl parfémovou vodu. Počkejte alespoň 1 minutu a přičichněte si k vůni. Netřepte papírkem (vůně by byla rozptýlena v prostředí a rušila by jiné respondenty, kteří právě testují jiné vůně). Až poté vyplňte otázky k dané vůni.

Demografické údaje							
1	Do jaké věkové skupiny patříte?	18-24	25-34	35-44	44-59	60-74	75+
2	Jaká je vaše národnost?						
3	Žil/a jste déle než 5 let v jiné zemi, než je Česká republika?	Ano			Ne		
	Pokud ano, uveďte prosím, v jaké zemi jste strávil/a déle než 5 let.						
4	Jste:	Žena			Muž		
Na znamení, že se nacházíte v tomto bodě, zvedněte nyní ruku.							
Obrázky							
6	Na projektoru nyní uvidíte celkem 2 obrázky na prezentaci. Zapište prosím číslo, které vidíte.	Obrázek 1:		Obrázek 2:			
Průhledná lahvička T1 nebo T2							
Nyní si vezměte bílou/transparentní lahvičku označenou písmenem T1 nebo T2 . Na testovací papírek vždy ve dvojici stříkněte dvakrát vůni pomocí aplikátoru a přivoňte si.							
7	Zakroužkujte čitelně písmenko, které se nachází na víčku lahvičky. (Bez zaznamenání je celý experiment neplatný!)	T1			T2		
8	Vůně mi připomíná nejvíce (popište max. 1 slovem):						
Vůně A							
Nyní si vezměte lahvičku označenou písmenem A. Na testovací papírek vždy ve dvojici stříkněte dvakrát vůni pomocí aplikátoru a přivoňte si. V odpovědi zanedbejte odstín.							
9	Jakou barvu obalu byste zvolil/a pro vůni A?	žlutá	zelená	fialová	oranžová		
10	Vůně mi připomíná nejvíce (popište max. 1 slovem):						
Vůně B							
Nyní si vezměte lahvičku označenou písmenem B. Na testovací papírek vždy ve dvojici stříkněte dvakrát vůni pomocí aplikátoru a přivoňte si. V odpovědi zanedbejte odstín.							
11	Jakou barvu obalu byste zvolil/a pro vůni B?	žlutá	zelená	fialová	oranžová		
12	Vůně mi připomíná nejvíce (popište max. 1 slovem):						
Vůně C							
Nyní si vezměte lahvičku označenou písmenem C. Na testovací papírek vždy ve dvojici stříkněte dvakrát vůni pomocí aplikátoru a přivoňte si. V odpovědi zanedbejte odstín.							
13	Jakou barvu obalu byste zvolil/a pro vůni C?	žlutá	zelená	fialová	oranžová		
14	Vůně mi připomíná nejvíce (popište max. 1 slovem):						
Vůně D							
Nyní si vezměte lahvičku označenou písmenem D. Na testovací papírek vždy ve dvojici stříkněte dvakrát vůni pomocí aplikátoru a přivoňte si. V odpovědi zanedbejte odstín.							
15	Jakou barvu obalu byste zvolil/a pro vůni D?	žlutá	zelená	fialová	oranžová		
16	Vůně mi připomíná nejvíce (popište max. 1 slovem):						

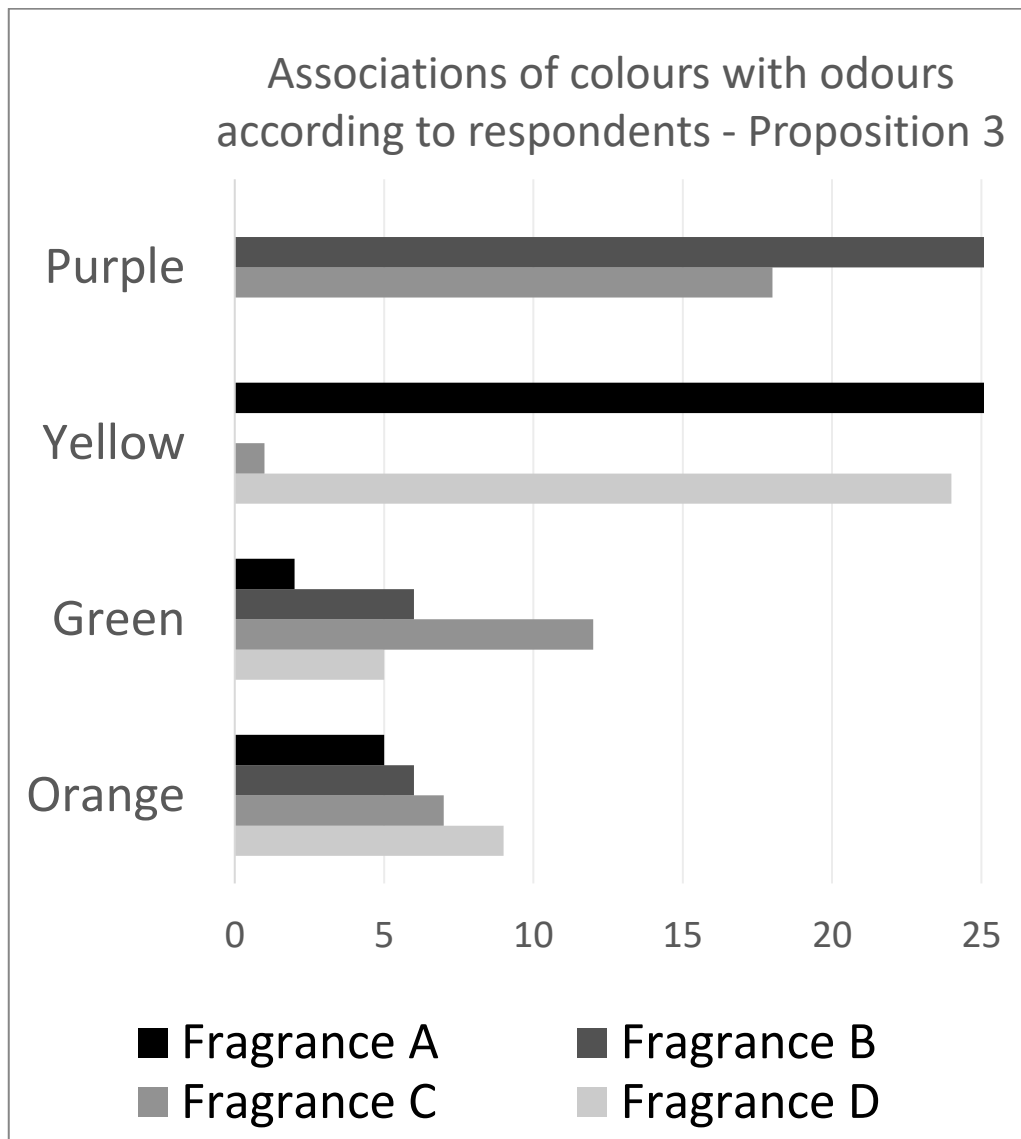
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Appendix 3a: Associations of colours with odours according to respondents – Proposition 2



Appendix 4_b: Associations of colours with odours according to respondents – Proposition 3



Appendix 5: Experiment – Example of the questionnaire

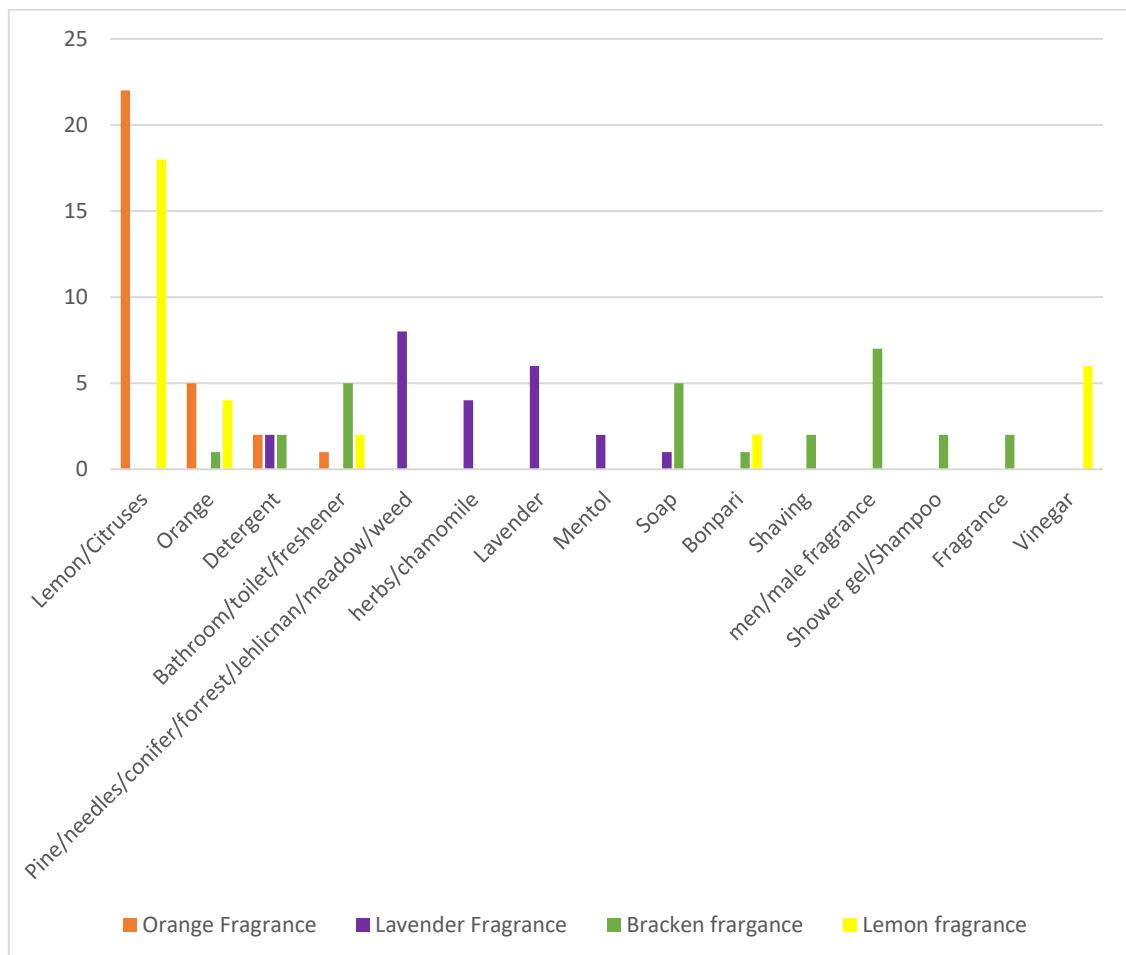
Obecné – zakroužkujte odpovědi											
1	Do jaké věkové skupiny patříte?	18-24	25-34	35-44	44-59	60-74	75+				
2	Cítíte se kulturně spjatá/ý s Českou republikou?							Ano	Ne		
3	Žil/a jste déle než 5 let v jiné zemi než je Česká republika?							Ano	Ne		
Pokud ano, uveďte prosím, v jaké zemi jste strávil/a déle než 5 let.											
4	Pohlaví:							Žena	Muž		
5	Jakou barvu máte nejraději z následujících barev:	Zelená	Žlutá	Fialová	Oranžová						
Na znamení, že se nacházíte v tomto bodě, zvedněte nyní ruku.											
Obrázky											
6	Na tabuli nyní uvidíte celkem 3 obrázky. Zapište prosím číslo, které vidíte.	Obrázek A:		Obrázek B:		Obrázek C:					
Průhledná Lahvička											
Nyní si vezměte bílou/transparentní lahvičku. Na testovací papírek vždy ve dvojici stříkněte dvakrát vůni pomocí aplikátoru a přivoňte si.											
7	Zaznamenejte čitelně písmenko, které se nachází na víčku lahvičky. (Bez zaznamenání je celý experiment neplatný!)										
8	Vůně mi připomíná nejvíce										
Zelená lahvička											
Nyní si vezměte zelenou lahvičku. Na testovací papírek vždy ve dvojici stříkněte dvakrát vůni pomocí aplikátoru a přivoňte si. Zakroužkujte odpověď.											
		Nejslabší Nejsilnější									
9	Intenzita vůně je:	1	2	3	4	5	6	7	8	9	10
		Nelíbá Líbá									
10	Vůně je:	1	2	3	4	5	6	7	8	9	10
Fialová lahvička											
Nyní si vezměte fialovou lahvičku. Na testovací papírek vždy ve dvojici stříkněte dvakrát vůni pomocí aplikátoru a přivoňte si. Zakroužkujte odpověď.											
		Nejslabší Nejsilnější									
11	Intenzita vůně je:	1	2	3	4	5	6	7	8	9	10
		Nelíbá Líbá									
12	Vůně je:	1	2	3	4	5	6	7	8	9	10
Oranžová lahvička											
Nyní si vezměte oranžovou lahvičku. Na testovací papírek vždy ve dvojici stříkněte dvakrát vůni pomocí aplikátoru a přivoňte si. Zakroužkujte odpověď.											
		Nejslabší Nejsilnější									
13	Intenzita vůně je:	1	2	3	4	5	6	7	8	9	10
		Nelíbá Líbá									
14	Vůně je:	1	2	3	4	5	6	7	8	9	10
Žlutá lahvička											
Nyní si vezměte žlutou lahvičku. Na testovací papírek vždy ve dvojici stříkněte dvakrát vůni pomocí aplikátoru a přivoňte si. Zakroužkujte odpověď.											
		Nejslabší Nejsilnější									
15	Intenzita vůně je:	1	2	3	4	5	6	7	8	9	10
		Nelíbá Líbá									
16	Vůně je:	1	2	3	4	5	6	7	8	9	10

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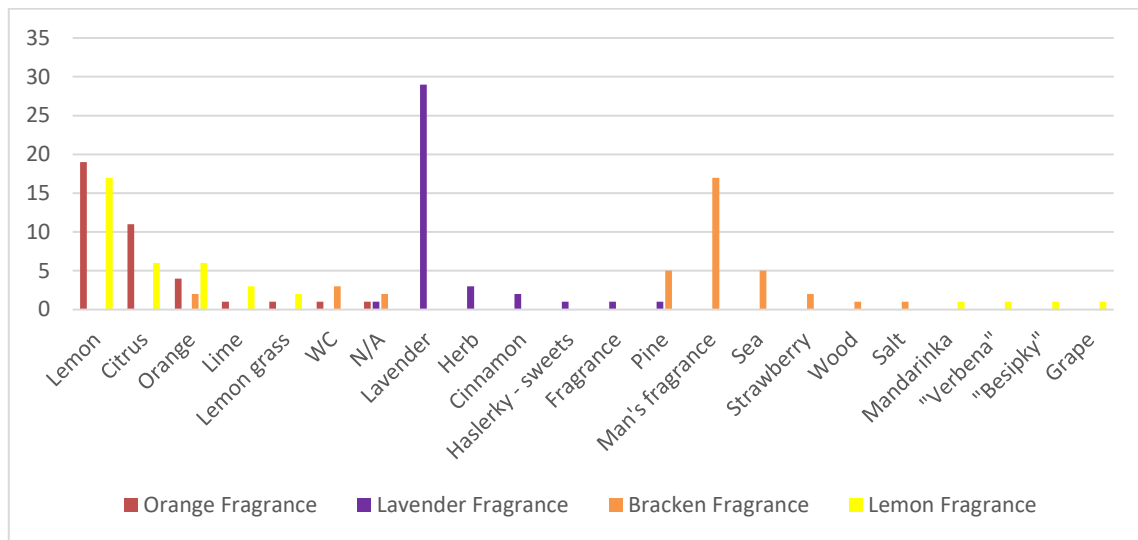
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Appendix 6a: Semantic associations with the odours according to respondents – Proposition 2

Please note, that the colours were added only for comprehension.



Appendix 7_b: Semantic associations with the odours according to respondents – Proposition 3



Appendix 8: Written consent with the research and data processing



Souhlas se zpracováním údajů pro účely experimentu

Hlavní řešitelka projektu:

Adriana Starostová (Adriana.starostova@hotmail.com)

1. Souhlasím se zpracováním dat za účelem výzkumu. Rozumím, jaká je moje role v tomto experimentu a veškeré otázky mi byly zodpovězeny před provedením experimentu.
2. Rozumím, že mám právo na ukončení experimentu kdykoliv v průběhu z jakéhokoliv důvodu.
3. Byla jsem informována, že studie bude probíhat anonymně. Se získanými daty bude i tak nakládáno s opatrností.
4. Mohu se zeptat na jakékoliv otázky před i během experimentu.

Ochrana dat GDPR: Souhlasím, že veškerá poskytnutá data mohou být zpracována Vysokou školou ekonomickou v Praze za účelem výzkumu, a to v rozsahu daném designem experimentu.

Jméno účastníka.....Podpis.....Datum.....

Appendix 9: Proposition 3 – Questionnaire

Demografické údaje							
1	Do jaké věkové skupiny patříte?	18-24	25-34	35-44	44-59	60-74	75+
2	Jaká je vaše národnost?						
3	Žil/a jste déle než 5 let v jiné zemi, než je Česká republika?	Ano			Ne		
	Pokud ano, uveďte prosím, v jaké zemi jste strávil/a déle než 5 let.						
4	Jste:	Žena			Muž		
Na znamení, že se nacházíte v tomto bodě, zvedněte nyní ruku.							
Obrázky							
6	Na projektoru nyní uvidíte celkem 2 obrázky na prezentaci. Zapište prosím číslo, které vidíte.	Obrázek 1:		Obrázek 2:			
Průhledná lahvička T1 nebo T2							
Nyní si vezměte bílou/transparentní lahvičku označenou písmenem T1 nebo T2 . Na testovací papírek vždy ve dvojici stříkněte dvakrát vůni pomocí aplikátoru a přivoňte si.							
7	Zakroužkujte čitelně písmenko, které se nachází na víčku lahvičky. (Bez zaznamenání je celý experiment neplatný!)				T1	T2	
8	Vůně mi připomíná nejvíce (popište max. 1 slovem):						
Vůně A							
Nyní si vezměte lahvičku označenou písmenem A . Na testovací papírek vždy ve dvojici stříkněte dvakrát vůni pomocí aplikátoru a přivoňte si. V odpovědi zanedbejte odstín. Udělejte křížek u barvy, kterou byste zvolil/a.							
9	Jakou barvu byste přiřadil/a k vůni A?						
10	Vůně mi připomíná nejvíce (popište max. 1 slovem):						
Vůně B							
Nyní si vezměte lahvičku označenou písmenem B . Na testovací papírek vždy ve dvojici stříkněte dvakrát vůni pomocí aplikátoru a přivoňte si. V odpovědi zanedbejte odstín.							
11	Jakou barvu byste přiřadil/a k vůni B?						
12	Vůně mi připomíná nejvíce (popište max. 1 slovem):						
Vůně C							
Nyní si vezměte lahvičku označenou písmenem C . Na testovací papírek vždy ve dvojici stříkněte dvakrát vůni pomocí aplikátoru a přivoňte si. V odpovědi zanedbejte odstín.							
13	Jakou barvu byste přiřadil/a k vůni C?						
14	Vůně mi připomíná nejvíce (popište max. 1 slovem):						
Vůně D							
Nyní si vezměte lahvičku označenou písmenem D . Na testovací papírek vždy ve dvojici stříkněte dvakrát vůni pomocí aplikátoru a přivoňte si. V odpovědi zanedbejte odstín.							
15	Jakou barvu byste přiřadil/a k vůni D?						
16	Vůně mi připomíná nejvíce (popište max. 1 slovem):						

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Appendix 10: Values used on the scale from 1 to 10 for preference and intensity

