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FACULTY OF BUSINESS ECONOMICS
Master of Management

Master's thesis

Looking through the colour and the shape of food packaging:
The use of crossmodal correspondences in the design of food
packaging windows

Promotor :
Prof. dr. Willem JANSSENS

Supervisor :
Mevrouw Carmen ADAMS
Mevrouw Lieve DOUCE

Maximilian Engels

*Thesis presented in fulfillment of the requirements for the degree of Master of
Management*

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Preface

This master's thesis completes my studies in the Master of Management program with specialization in International Marketing Strategy at Hasselt University.

I would like to give special thanks and acknowledgement to my supervisors Prof. Dr. Wim Janssens and Carmen Adams as well as Lieve Doucé for their professional advice, endless support and patience given during the entire time spent in writing this thesis. They have stimulated my interest in the fields of crossmodal correspondence, packaging and marketing and truly inspired me personally and academically.

I would also like to thank Prof. Dr. Charles Spence, Martin Schmitt, Vankaew Jutharath, Sebastian Beck, Trina Bentley, Jeff Zack, Anirudha Mukhedkar and Andreas Kioroglou for sharing their experiences on food packaging and the processes of packaging development. I appreciate the inspiring conversations we had, their full support for the study, and their insights which have added substantial value to the study.

Furthermore all students who participated in my practical tests deserve my thanks.

Finally, I would like to thank my family and friends for supporting and believing in me throughout my whole education.

Summary

This thesis aimed to examine if and how different window shapes and window colours on food packaging can influence the product perception of customers. Herein the focus was set on marketing relevant aspects.

The research started with an extensive literature review. Subsequently eight international expert interviews with packaging designer, packaging product coordinators and researchers were conducted. The outcomes of these were combined to formulate hypotheses for the possible sensoral effects (crossmodal correspondences) of window colour, window shape and their interaction on the tested food stimulus. Penne pasta was chosen as such as it is widely sold in packaging with windows and is perceived neutral in shape.

It was expected that if the perceived shapes of the window frame and of the window colour are identical they would strengthen positive product perceptions. Thus pretests have been conducted to find two window shapes and window colours each of which are perceived to differ similarly strongly from neutral in angularity/roundness but in opposite directions and as strongly as possible. This allowed the combination of round and angular window frames and window colours within the main test.

To avoid that aspects other than the perceived shape would give a bias to the latter results, a wide range of these aspects was tested as well.

Regarding general food packaging or penne pasta packaging, the perceived usability, the estimated usage possibility and preferences for certain shapes and window colours have been examined. Additionally, the perceived lightness of the coloured window foils was tested. For this data a wide variety of statistical analyses with SPSS has been performed.

It was discovered that window colours were perceived to differ in shape especially due to their transparency intensity value. Still, it was possible to find a pairing of window colours that fulfilled the above tasks to a wide extent. Hence this pairing could be used for the main test without expecting biased outcomes. The situation was similar for the possible window shapes so that two contrary window shapes were chosen for the main test.

Interestingly no significant preferences for window colours that match the colour of the product have been confirmed. Also no general rejections for window colours that contradict the product colour were shown. Furthermore, a general preference for higher transparency intensity values and thus perceived lighter window colours was examined.

Within the main test the for its purposes ideal window shapes and window colours were then combined. Because within a control group also an uncoloured window foil was used 6 different window shape (angular/round) - window colour (angular/round/neutral) pairings resulted. These windows were placed on identical boxes which were filled with uncooked penne.

To allow a later practical usability of the results, a pre-post-consumption-comparison was implemented. Thus the participants were shown one of these packaging combinations and had to fill out a questionnaire before they were served prepared penne pasta and another questionnaire afterwards.

The findings revealed that the window colour is barely relevant for the product perception prior to eating and seeing the unpackaged product. On the other hand some significant effects have been shown afterwards as a window colour that did not match the product colour led to a more positive taste rating, a higher purchase likelihood and the perception that the actual taste was much better than expected. Still, this result has not been explainable by an interaction effect with the window shape or a preference for a specific perceived shape of the window colour.

In general no interaction effects of window shape and window colour could be confirmed.

Conversely it was confirmed that the window shape has significant effects on a wide range of marketing relevant product perceptions. Angular window shapes led to better ratings in packaging attractiveness, expected taste of the penne, actual taste of the penne and purchase likelihood before and after eating and seeing the unpackaged product.

Comparing the effect strength of window shape and window colour the findings revealed that in fact window shape had stronger influence on the perceived actual taste of the penne and naturally on those perceptions where the window colour had no significant effects. In these the window shape explained up to 4.2% of the examined variance in product perceptions and 11% of the variance in the perceived overall packaging shape. Only for comparison of expected and actual taste the window colour had a significantly stronger effect than the window shape with 3.8 %.

Reviewing the results of the practical studies, the thesis comes to the conclusion that in particular the window shape on food packaging should be considered wisely. On the other hand the use of perceivably coloured windows apparently is of minor relevance but also brings a possible risk. Even though a certain window colour led to positive product perceptions after eating and seeing the unpackaged product the results also indicate that the consumer believes to have had a bad first impression of the product.

Thus it could be that in other test scenarios in fact the window colour leads to a significantly negative impression prior to eating and seeing the unpackaged product.

Because the study is complex, several graphics and tables were incorporated to increase the understandability. By deducting those as well as references and appendix from the number of pages, a total of approximately 89 pages for the written text is reached.

Keywords: food packaging, visual marketing, sensory marketing, crossmodal correspondence

Table of Contents

Preface	I
Summary	III
List of Figures	IX
List of Tables	X
List of Abbreviations	XII
1 Introduction	1
1.1 Problem Definition and Purpose	1
1.2 Central Research Question and Sub-questions	2
1.3 Research Approach	5
2 Literature Review	7
2.1 Crossmodal Correspondence	7
2.1.1 Definition of Crossmodal Correspondence	7
2.1.2 Importance of Crossmodal Correspondence for Marketing	9
2.1.3 Crossmodal Correspondence related Theories	10
2.2 Packaging	11
2.2.1 Definition of Packaging	11
2.2.2 Types of Packaging	12
2.2.3 Importance of Packaging for Marketing	14
2.2.4 Use of optical Factors in general Packaging	17
2.2.5 Consumer Deception by Packaging Design	19
2.3 Colour and Transparency	19
2.3.1 Definition of Colour	19
2.3.2 Colour Measurement and Perception	22
2.3.3 Colour Ramifications and Connotations	24
2.3.4 Use of Colour in general Packaging	29
2.3.5 Definition of Transparency	30
2.3.6 Interaction between Transparency and Colour	32
2.3.7 Use of Transparency in general Packaging	34
2.4 Shapes	35
2.4.1 Definition of Shapes	35
2.4.2 Shape Ramifications and Connotations	37
2.4.3 Use of Shapes in general Packaging	38

2.5	Food	39
2.5.1	Definition of Food	39
2.5.2	Peculiarities of Food Packaging	40
2.5.3	Use of Colour in Food Packaging	40
2.5.4	Use of Transparency in Food Packaging	42
2.5.4	Use of Shapes in Food Packaging	44
2.5.5	Influence of Colour on Food Perception	46
2.5.6	Influence of Shapes on Food Perception	50
3	Hypotheses and Conceptual Model	53
3.1	General Hypotheses	53
3.2	Influence of the Window Shape on the Product Perception	54
3.3	Influence of the Window Colour on the Product Perception	55
3.4	Influence of Window Shape and Colour on the Product Perception	58
3.5	Conceptual Model	60
4	Practical Studies	61
4.1	Study 1 (Pretest)	61
4.1.1	Aim of the Study	61
4.1.2	Set up of the Study	61
4.1.3	Abstract of the Analyses & Conclusion	63
4.1.4	Detailed Analyses - Table of Content	64
4.1.5	Analysis of the perceived Shapes	64
4.1.6	Analysis of the Preference Rankings	65
4.1.7	Analysis of the Usability Ratings	67
4.1.8	Analysis of the estimated Usage Possibilities	68
4.2	Study 2 (Pretest)	70
4.2.1	Aim of the Study	70
4.2.2	Set up of the Study	70
4.2.3	Abstract of the Analyses & Conclusion	72
4.2.4	Detailed Analyses - Table of Content	73
4.2.5	Analysis of the perceived Shapes	73
4.2.6	Analysis of the Preference Rankings	75
4.2.7	Analysis of the Usability Ratings	75
4.2.8	Analysis of the estimated Usage Possibilities	76

4.3	Study 3 (Pretest)	79
4.3.1	Aim of the Study	79
4.3.2	Set up of the Study	79
4.3.3	Abstract of the Analyses & Conclusion	82
4.3.4	Detailed Analyses - Table of Content	85
4.3.5	Analysis of the perceived Shapes	85
4.3.6	Analysis of the Lightness Rankings	87
4.3.7	Analysis of the Preference Rankings	88
4.3.8	Analysis of the Usability Ratings	90
4.3.9	Analysis of the estimated Usage Possibilities	93
4.4	Study 4 (Main test)	96
4.4.1	Aim of the Study	96
4.4.2	Set up of the Study	96
4.4.3	Abstract of the Analyses & Conclusion	98
4.4.4	Detailed Analyses - Table of Content	99
4.4.5	Analysis of Variance - Overview	99
4.4.6	Existence of significant Effects	100
4.4.7	Evaluation of the Effect Strength	102
4.4.8	Significant Effects for one specific Factor	102
4.4.9	Significant Effects for two specific Factors - fixed Window Colour	104
4.4.10	Significant Effects for two specific Factors - fixed Window Shape	107
4.4.11	Repeated Measures - Analysis of Effect Changes	110
5	Discussion and Conclusion	113
5.1	Analysis of the Hypotheses	113
5.2	Theoretical Contribution	118
5.3	Implications for Managers	121
5.4	Limitations and Recommendations for future Research	123
	References	126
	Appendix	151
	A. Full Transcript of the Interviews	151
	B. Shape Calculations for Study 1	165
	C. Penne Pasta Preparation	168

List of Figures

Fig. 1: <i>Different Penne Pasta Packaging used by Barilla USA</i>	5
Fig. 2: <i>Layers of Packaging</i>	14
Fig. 3: <i>Schematic Representation of the Production Process of a Packaging</i>	15
Fig. 4: <i>Differences in Value: Hue and Saturation held constant</i>	20
Fig. 5: <i>Differences in Saturation: Value and Hue held constant</i>	21
Fig. 6: <i>Differences in Hue: Value and Saturation held constant</i>	21
Fig. 7: <i>Munsell Colour System</i>	22
Fig. 8: <i>Lines that best correspond to the shown Colour Shape Associations</i>	27
Fig. 9: <i>The Four-Luminance Pattern</i>	33
Fig. 10: <i>Different Shapes and Boundaries</i>	37
Fig. 11: <i>D: Example of the inappropriate Use of Windows on Food Packaging (1)</i>	43
Fig. 12: <i>D: Example of the inappropriate Use of Windows on Food Packaging (2)</i>	43
Fig. 13: <i>USA: Window Shapes on Packaging</i>	45
Fig. 14: <i>GB: Window Shapes on Packaging</i>	45
Fig. 15: <i>CH: Window Shapes on Packaging</i>	45
Fig. 16: <i>F: Window Shapes on Packaging</i>	45
Fig. 17: <i>Conceptual Model – Influencing the Consumer by Window Shape and Colour</i>	60
Fig. 18: <i>Window Shapes tested within Study 1</i>	62
Fig. 19: <i>Preferences – Cochran’s Q Test for all relevant Window Shape Pairings</i>	67
Fig. 20: <i>Usability Rating – Cochran’s Q Test for all relevant Window Shape Pairings</i>	68
Fig. 21: <i>Estimated Usage Possibility – Friedman Test for relevant Window Shape Pairings</i>	69
Fig. 22: <i>Window Colours tested within Studies 1 and 2</i>	71
Fig. 23: <i>Preferences – Chi² Test for red and blue</i>	75
Fig. 24: <i>Usability Rating – Cochran’s Q Test for red and blue</i>	76
Fig. 25: <i>Estimated Usage Possibilities – Friedman Test for red</i>	77
Fig. 26: <i>Estimated Usage Possibilities – Friedman Test for blue</i>	77
Fig. 27: <i>New Window Colours tested within Study 3</i>	80
Fig. 28: <i>Usability Rating (general) – Cochran’s Q Test for green and yellow</i>	90
Fig. 29: <i>Comparison Usability Rating (penne) – Cochran’s Q Tests for all highly transparent coloured Foils</i>	92
Fig. 30: <i>Comparison Usability Rating (general/penne) – significant Cochran’s Q Tests</i>	93
Fig. 31: <i>Window Colour – Window Shape Combinations tested within Study 4</i>	97

Fig. 32: <i>Effects of Window Shape and Window Colour on Packaging Attractiveness</i>	105
Fig. 33: <i>Effects of Window Shape and Window Colour on perceived Packaging Shape</i>	108
Fig. 34: <i>Effect Changes for Purchase Likelihood from M1 to M2 based on Window Colour</i>	112
Fig. 35: <i>Descriptive Results of Studies 2 (red and blue) and 3 (green and yellow)</i>	119
Fig. 36: <i>Reworked conceptual Model – Influencing the Consumer</i>	121

List of Tables

Tab. 1: <i>Example of a Checklist for Development and Evaluation of Consumer Packaging</i> ...	13
Tab. 2: <i>Relationships between Parameters and their Perceptibility without Synaesthesia</i>	16
Tab. 3: <i>Polypropylene (PP) Plastic compared with other transparent Packaging Materials</i> ..	35
Tab. 4: <i>Comparison of the Results for all Window Shapes</i>	64
Tab. 5: <i>Perceived Shape – Paired Samples Test for all relevant Window Shape Pairings</i> ...	65
Tab. 6: <i>Perceived Shape - Descriptive Results for all Window Shapes</i>	65
Tab. 7: <i>Preferences - Descriptive Results for all Window Shapes</i>	66
Tab. 8: <i>Comparison of the Results for red and blue</i>	73
Tab. 9: <i>Perceived Shape – Descriptive Results for red and blue Window Colours</i>	73
Tab. 10: <i>Perceived Shape – Parameter Estimates for red and blue Window Colours</i>	74
Tab. 11: <i>Perceived Shape – Paired Samples Test for red and blue Window Colours</i>	74
Tab. 12: <i>Comparison of the Results for green and yellow</i>	82
Tab. 13: <i>Comparison of the Results for all highly transparent Foils</i>	83
Tab. 14: <i>Perceived Shapes – Descriptive Results for diverse Colours</i>	86
Tab. 15: <i>Perceived Shapes – Excerpt of the pairwise Comparisons for diverse Colours</i>	86
Tab. 16: <i>General significant Effects of Window Colour and Window Shape</i>	101
Tab. 17: <i>Strength of general significant Effects of Window Colour and Window Shape</i>	102
Tab. 18: <i>Concrete significant Effects of Window Colour and Window Shape in general</i>	104
Tab. 19: <i>Concrete significant Effects of Window Shape – Window Colour fixed</i>	106
Tab. 20: <i>Concrete significant Effects of Window Colour – Window Shape fixed</i>	109
Tab. 21: <i>Effect changes from M1 to M2</i>	111
Tab. 22: <i>Effect Changes for Purchase Likelihood from M1 to M2 based on Window Colour</i>	112

List of Abbreviations

ANOVA	Analysis of variance
e.g.	exempli gratia (for example)
et al.	et alii (and others)
EU	European Union / European Parliament
FDA	Food and Drug Administration
FTC	Federal Trade Commission
i.e.	id est (that is to say)
km	kilometre
m	metre
mm	millimetre
NHL	National Hockey League
nm	nanometre
p	page
R&D	research & development
SD	standard deviation
TIV	transparency intensity value (Y) in %
VAS	Visual Analogue Scale

1 Introduction

1.1 Problem Definition and Purpose

Hundreds of studies focus on the different meanings and influences that specific colours or specific shapes of packaging, logos, graphics or even font types can have on the consumer (e.g. Velasco et al., 2014; Malfatti et al., 2014). Amongst others it has been documented that colours and shapes can have significant influence on product ratings and hence purchase intentions (Rebollar et al., 2012). Indeed the rapid commoditization of several product categories has been shown to be at variance with design factors of packaging which in this can act as a point of differentiation and hence competitive advantage (Page & Herr, 2002).

But especially the food and beverages industry is in charge of matching packaging design factors and product attributes ideally as particularly for those several sensory modalities (taste, hearing, smell, feel, touch) interact with each other and form an overall product impression described as crossmodal correspondence (e.g. Holt-Hansen, 1968, 1976; Spence, 2011b, c). Since the "first taste" almost always is perceived with the eye, visual aspects need to be considered to positively affect the subsequent willingness of a customer to accept a product (Imram, 1999). Hence food as a classical commodity item seems to be the ultimate product category to prove any influences of packaging design on product ratings. In fact much research at least to some extent chose food or beverages as test products or main focus of attention (e.g. Argo & White, 2012; Becker et al., 2011; Bremner et al., 2013).

Still some everyday phenomena that concern food and its packaging have barely been part of any research at all or at least are only available company-internal. Astonishingly one of these aspects of food packaging is very visible and could possibly merge perceptually with the packaging content. The few available studies focusing on this aspect of packaging indicate clearly that it can have a major influence on food consumption, food attractiveness and hence purchase and rebuy likelihood (Deng & Srinivasan, 2013).

This aspect is the use of transparent windows on food packaging.

When considering the documented general influence of shapes and colours of packaging on customers it seems natural to examine these in context to food packaging windows as well.

Since there is apparently no corresponding research available, this Master's thesis aims to bridge the gap and to answer the emerging marketing questions, which will be formulated in the following chapter. Based on penne pasta which have been shown to be perceived neutral in shape by Adams et al. (2014) and which are frequently sold in packaging with windows, the research will therefore seemingly for the first time examine the possible influences of

window colour and window shape on the customer perception of food products. In doing so it will seemingly also be the first one to explore the above at all as no comparable studies concerning other product categories than food are available. As a result, this thesis could possibly form the basis for further research with marketing related focus on perceptions caused by window shape and window colour.

1.2 Central Research Question and Sub-questions

Since this thesis is focusing on marketing aspects, it is aiming to find effects caused by window colour and window shape that can influence the overall customer/consumer perception for a food product positively or negatively not only for the first buy but also for assumed rebuys. Hence it is necessary to examine these perceptions in a pre-post-consumption-comparison to achieve results with a value for factual marketing purposes. These purposes are anticipated in controlling packaging attractiveness, product attractiveness, purchase likelihood, accepted maximum price and perceived taste quality.

Keeping in mind the existing research concerning different usages of shapes (packaging, logos, graphics, font types) one has to wonder whether these principles are also relevant for food packaging windows.

In practice very different and sometimes extraordinary window shapes are widely used for food products¹. In fact the author has documented that some companies over time primarily changed the window shape of their food packaging instead of any other aspects². Hence concerning the window shape it first of all it needs to be asked:

Q1. Does the shape of food packaging windows have an influence on product perceptions?

Given that an effect caused by the window shape can be confirmed, one naturally has to think about factors that differentiate certain shapes from each other and thus could explain their different effects on the product perception. Focusing on the classical distinction between angularity and roundness, the question to be asked is:

Q1a. Will a perceived round in contrast to an angular window shape lead to different product perceptions?

¹ See different window shapes used on food packaging worldwide, p.45.

² Barilla USA sold penne pasta in packaging with different windows shapes. Except to these barely any adjustments have been made in the past. See p.5.

Finally it is obvious that the product could be perceived differently inside or outside the packaging as in the latter case it is not any more surrounded by the window shape. Thus one might also wonder:

Q1b. Will the window shape have an influence on the product perception after seeing and eating the unpackaged food product?

Q1c. Is the possible effect of the window shape on the product perception after seeing and eating the unpackaged food product identical with the effect before?

But another aspect that has not been researched so far could be promising for future food packaging designs. Comparing common food packaging windows with beverage bottles, it is evident that these types of transparent packaging often differ especially due to the colour presence in bottles and colour absence in food packaging windows. Yellow lemonades, red wines and oils are often sold in green glass bottles; orange juice and beer can be bought in brown glass or plastic bottles, and water in blue plastic bottles.

Keeping in mind that specific colours are shown to have significant influences on the observer and sometimes even modify body functions (Batra et al., 1998) one has to ask why there is this difference between such comparable product categories.

The reasoning found in literature is based on the differentiation between production zones, the protection of light sensitive products or innovation (Sonsino, 1990; Seeger, 2009).

But could food packaging windows make use of colour for similar reasons?

Correspondingly it has to be asked at first:

Q2. Does the colour of food packaging windows have an influence on product perceptions?

Given that the aforementioned question can be confirmed, again one has to think about which aspects differentiate colours and hence might trigger different outcomes. Keeping in mind the high relevance of food colour on the food perception one has to think about if the window colour needs to fit to the product or not:

Q2a. Does the matching of expected food colour and window colour have relevance for the product perception?

Yet another fascinating effect of colours could have an influence on the product perception. As will be shown specific colours are associated with specific shapes. Thinking about the relevance that specific shapes of the window frame could have for the product perception,

one could ask a similar question for the window colour:

Q2b. Will a perceived round in contrast to an angular window colour lead to different product perceptions?

Further it seems very probable that perceivable window colours might result in perceived strong differences in product perception before and after seeing and eating the unpackaged product. This is because the packaged product behind a coloured window might look different when being unpackaged and without a coloured window in front of it. Here the following needs to be asked:

Q2c. Will the window colour have an influence on the product perception after seeing and eating the unpackaged food product?

Q2d. Is the possible effect of the window colour on the product perception after seeing and eating the unpackaged food product identical with the effect before?

Finally, as windows always need to have a certain shape and hence a perceivable window colour can only appear in combination with such one has to think about how these factors interact with each other. Because the window shape might be associated with a certain colour but also since the window colour might be associated with a certain shape it can be asked if these perceived matching pairings result in better overall product perceptions. Hence it needs to be asked:

Q3a. Is the unity theory also feasible for a combination of perceived same shaped window colour and window shape?

Furthermore one might wonder which of the packaging attributes window colour and window shape is more important for the design of food packaging windows. Thus the following needs to be asked:

Q3b. Which factor has a stronger impact on the product perception - window shape or window colour?

In addition to the above, the thesis will also give answers to several related and often very specific questions, which will evolve within chapter 5. These could possibly also be highly relevant for other marketing related aspects in context to food packaging.



Fig. 1: *Different Penne Pasta Packaging used by Barilla USA*

Sources: USA-drinks.de & Econnect-USA.com

1.3 Research Approach

To answer the above research questions practical as well as theoretical sources are required. Therefore the literature review in Chapter 2 will summarize existing research as well as practical information and in this will already include data collected in interviews with international packaging designers, researchers and others. The information will be contextualized as far as possible and thus result in units which in that form have not been found in other sources while preparing this thesis. The overall aim of Chapter 2 is to guarantee a general overview of thesis related topics when possible and a detailed one when necessary and expedient.

In Chapter 3 hypotheses that focus on the named research questions will be formulated and include the information out of Chapter 2. These hypotheses build the construct, which the practical studies in Chapter 4 are based on. As opposed to the conducted interviews with professionals³ the studies focus on the consumer directly and hence are based on different questionnaires that have been completed by more than 240 students. Besides the hypotheses from Chapter 3 the studies will also build on their mutual outcomes and hence are logically related to each other. Therefore each study's set up will be explained and drafted separately in Chapter 4 and thus in many cases depend on the previous results.

As a necessity each study's results will hence also be revealed after its completion to guarantee a traceability of the conception of the following studies.

³ See Appendix A. Full Transcript of the Interviews, p.151ff.

Due to the huge amount of analyses that have been conducted each study is given its own table of contents as well as an overall abstract of the analyses.

In Chapter 5 all findings will be interrelated and evaluated. Based on this the theoretical contribution will be presented and correspondingly managerial implications will be formulated.

Finally, research limitations and in that possibilities for future research will be explained.

2 Literature Review

Before formulating the research hypotheses and presenting the studies conducted, an overview of the theoretical notions implied will be given as these are presupposed and used in the following chapters.

2.1 Crossmodal Correspondence

Since this thesis focuses on crossmodal correspondences between window colours, window shapes and the food product, the following information is highly relevant for understanding the later tested connections between those.

2.1.1 Definition of Crossmodal Correspondence

Crossmodal correspondence can be described as the matching of different sensual modalities and thus the reciprocal influence these modalities have on each other and on the overall perception of a certain object (Spence, 2011). Consequently the perception of one sensory impulse can be changed more towards the direction that another impulse indicates. For example, it is possible to influence perceived sounds by showing specific shapes (O'Boyle & Tarte, 1980; Ramachandran & Hubbard, 2001), to influence the perceived softness of a material by changing its colour (Rohm et al., 1997) and to change the perceived smell via different visual surroundings (Gilbert et al., 1996). The paired sensual modalities can most probably be located in any of the sensory possible perceptions, which are sight, hearing, taste, smell and touch (Spence, 2011). In this context Wan et al. (2015) state that crossmodal correspondences are generally based on crossmodal expectations and thus on the belief that certain sensorial attributes automatically indicate others.

Another famous example by one of the founders of the crossmodal correspondence theory Köhler (1947) was later overworked by Ramachandran and Hubbard (2001, 2003). This is the association of nonsense words such as 'bouba', 'maluma', 'lula' and 'bobolo' with rounded shapes as well as 'kiki', 'ruki', 'takete' and 'decter' with angular shapes, which was examined for 95-98% of the test persons. This result became the base for much research concerning crossmodal correspondence and will also be used within this thesis as it enables comparison of the perceived roundness or angularity of different sensual impressions.

Obviously food and beverages are perceivable with all senses. Probably due to that, much research focus on the influence of crossmodal correspondence on food or beverage perception and many interesting examples exist that show a clear interaction between taste perception and other sensual impressions.

An overview of such concrete crossmodal correspondences that influence food perception and are relevant for this thesis will be given in chapters 2.5.5 and 2.5.6.

While crossmodal correspondence is believed to be a common phenomenon which affects human beings in different everyday life situations, it is continuously discussed how far this and so-called synaesthesia, which 1 in 2000 human beings experience, relate to each other and if crossmodal correspondence is not just a light form of it (Welsch & Liebmann, 2003).

In this context Harrison and Baron-Cohen (1996) along with others (Marks, 1975; Cytowic, 1989a,b; Motluk, 1994) define synaesthesia as the effect that stimulation of one sensory modality automatically triggers an often comparably strong perception in a second, which is not perceived directly due to respective impulses. For example some synesthetes strongly perceive a taste just by seeing a specific colour (Welsch & Liebmann, 2003).

With the exception of the strength of the triggered second sensory perception, this definition of synaesthesia indeed is close to that of crossmodal correspondence. Yet Spence (2013), one of the most renowned scientists in context to crossmodal correspondence, argues that crossmodal correspondence is no weak form of synaesthesia e.g. since the latter is idiosyncratic (Martino & Marks, 2001; Meier & Rothen, 2009; Simner et al., 2006) and thus not as regular and predictable as crossmodal correspondences. More precisely to a certain extent it has been observed that people all over the world seem to show identical crossmodal correspondences while so-called synesthetes often differ in their perceptions (Hinton et al., 1994). In addition crossmodal correspondences are often explainable while synesthetic mappings are usually not (Calkins, 1893; Spence, 2013). Additionally, most synesthetes consciously experience their synesthesia while people without synaesthesia are not necessarily aware of their modified perception due to crossmodal correspondence (Spence, 2012; van Campen, 2011; Ward et al., 2008). Harrison and Baron-Cohen (1996) believe that unusual neonatal neural pathways between different brain areas give reason to the rare phenomenon synaesthesia. Thus it can be asked how far crossmodal correspondence is explainable by usual neonatal neural pathways between different brain areas.

Some researchers believe that crossmodal correspondence possibly can evolve as a follow of learning to connect certain impressions or as a result of innate nature and thus genetics (Spence, 2011; Lewkowicz & Turkewitz, 1980; Mondloch & Maurer, 2004; P. Walker et al., 2010, Bremner et al., 2013). Possibly both are true.

There are often congruencies for a wide range of people e.g. cultures on how specific colours/wavelengths influence other perceptions (Knoedel, 1978). But on the other hand it has been documented that certain isolated cultures like the African Himba show different

crossmodal correspondences than Western cultures (Bremner et al. 2013).

Still crossmodal correspondences often can be traced back to classical conditioning (Behrens, 1982; Luscher & Scott, 1969; Grossman & Wisenblit, 1999). For instance if 6-year-old children are shown a reddish yellow which accords with the colour of fire they do not associate it above average extent with heat (Behrens, 1982). But if older people are confronted with the same colour they commonly associate it with heat and fire and might even feel a temperature difference of up to 6° Celsius caused by the "warmth" or "coldness" of a room's colour (Küthe & Küthe, 2002; Behrens, 1982). Of course this conditioning is not the only proper explanation for a sensory connection between red and heat but one that seems feasible and can be shown for several other crossmodal correspondences between colour perception and diverse sensual impressions. As a result colours (but not only these) are widely associated with certain tastes, feelings, sounds and smells⁴.

2.1.2 Importance of Crossmodal Correspondence for Marketing

It quickly becomes apparent that crossmodal correspondence can be a mighty but also dangerous tool for marketing purposes and moreover can barely be ignored as the sensual perception happens permanently and thus also for products and packaging (Vaih-Baur, 2010). Hence specific connections between certain sensual impressions will likely occur even if a company is not aiming to make use of any crossmodal correspondences.

For example Garber et al. (2001) showed that colour will signal flavour even if it is not intending to do so. Inconsistent combinations of different sensual modalities in this can lead to negative associations by the customer and hence probably to corresponding low sales rates. Accordingly Behrens (1982) and Vaih-Baur (2010) note that behaviour is not determined by objective reality, but by the perceived. A simple but very renowned example in that context is referring to the artificial colouring of food⁵. In a study by Wheatley (1973) people ate a meal composed of blue coloured steak, green french fries, and red peas under red light conditions which prevented the participants realising that under standard light conditions the food would look different to the expected⁶. The participants did not react in any special way while eating the food but some reported feeling ill after standard light conditions were activated. This example, which probably is easy to re-enact for the reader, makes

⁴ See chapter 2.3.3 Colour Ramifications and Connotations, p.24 and 2.4.2 Shape Ramifications and Connotations, p.37.

⁵ Also see chapter 2.5.5 Influence of Colour on Food Perception, p.46.

⁶ This scenario is typical for professional food testing as the test persons will not be influenced by the product colour but perceive all tested food as very much alike coloured.

sense if the association of the colour is influencing the perceived taste or edibility. Keeping in mind that probably any connection between different stimuli is possible, one can ask how for example the packaging influences the perception of packaged products. Indeed several researches exist that focus on how packaging colour, shape, texture, material, size and several others influence the product perception. It has been shown that out of a marketing based few it is relevant to examine how the ubiquity of crossmodal correspondence can be used properly without underestimating the danger of generating undesirably connected perceptions for a product (Woods et al., 2011). Furthermore, it is also relevant that these knowingly generated crossmodal correspondences are not leading to the customer being disappointed after his purchase as they were too strong or too positive (Spence, 2012; Schifferstein, 2001). Finally marketers should check on a regular basis if perhaps currently generated crossmodal correspondences are possibly incongruent and hence even cause decreasing sales (Spence, 2012).

2.1.3 Crossmodal Correspondence related Theories

It is not always possible to perfectly delimit the boundaries between crossmodal correspondences and certain related theories. Hence these shall be described shortly.

Irradiation Phenomenon

The irradiation phenomenon, which was popularized by Spiegel (1970), Scharf & Volkmer (1997) and Medeyros (1982), basically describes the effect that a constant characteristic of one object can be perceived as changed because the surrounding characteristics have changed and hence irradiate on the consistent characteristics. This definition is very close to that of crossmodal correspondence, as also one sensual perception will be influenced by another. Though the named usage of this theory seems to have vanished in favour of the crossmodal correspondence theory after 1997.

Unity Effect

The unity effect describes the situation that two sensorial impressions referring to an object strengthen each other due to their conformance (Veryzer & Hutchinson, 1998; Spence, 2007; Vatakis et al., 2008). In this the overall perception will be stronger than the “virtual sum” of both impressions would have been.

Halo Effect

Non-conform sensorial impressions can lead to the so-called halo effect. That is one of the opposing impressions will be reinterpreted in favour of the general attitude towards the object (Alvensleben, 1989). A positive or negative attitude towards the object will then lead to a preferred perception of positive or negative characteristics, which in turn can strengthen the existing attitude towards the object (Alvensleben, 1989; Engelage, 2002). This phenomenon will sometimes increase with repeated consumption of a product (Engelage, 2002) and gives reason for the statement that the first impression of a product counts (Medeyros, 1982).

2.2 Packaging

The field of packaging marketing has been widely investigated but still proves to be an area that allows extensive research. In the following an overview concerning new and established theories, results and relevant regulations shall be given that will be required further on.

2.2.1 Definition of Packaging

Packaging needs to fulfil several functions, which can be categorized by their importance as primary and secondary functions. Primary functions must necessarily be satisfied for any packaging. Secondary functions are only relevant for the fulfilment of additional tasks that extend those of a basic packaging (Wenger, 1967).

Primary functions are containment, transportability, protection, information on price, quantity, quality and content as well as utility (Wenger, 1967; Boesch, 1989; Paine & Paine 1992; Singh & Singh, 2005)⁷. Utility comprises the ease of opening and closing, reuse, application, dispensing, and the usability of instructions and directions (Singh & Singh, 2005).

Probably protection is the most important task of packaging since annual losses through damaged packaging alone in the US exceeds \$10 billion (Singh & Singh, 2013).

The EU defines packaging as '*all products made of any materials of any nature to be used for the containment, protection, handling, delivery and presentation of goods, from raw materials to processed goods, from the producer to the user or the consumer.*' (European Parliament, 1994). Thus except for presentation the EU bases its definitions of packaging on the primary functions.

Secondary functions are especially relevant for producers and often not realized by

⁷ Also see chapter 2.2.5 Consumer Deception by Packaging Design, p.19.

consumers. These are adaptations to the manufacturing process (hand or machine work, clearance speed etc.), rationalization of the sale (maximum capacity utilization plus aimed lowest possible cost factor for the entire product) and impact on sales and advertising (support of promotions and sales) (Wenger, 1967; Boesch, 1989, Paine & Paine, 1992). Further ecological requirements by law must be taken into account.

Concerning the EU regulations (European Parliament, 1994b) packaging shall therefore be of as little material as possible *'to maintain the necessary level of safety, hygiene and acceptance for the packed product and for the consumer'*. Furthermore, if possible it shall be recyclable or reusable and if being incinerated or landfilled packaging shall be of minimal toxic impact to the environment. Finally if the product is being sold in supermarkets or vending machines it is necessary that the packaging of a product is well fitting for the shelf or the compartment size (Moser, 2002)⁸. However, all prior aspects aim for functional targets, 'good' packaging should also be of an aesthetic value to the consumer (Hassenzahl, 2008; Jordan, 2000; Liu, 2003; Norman, 2004). Accordingly a consumer will rate each packaging on whether (1) the packaging protects the goods enough; (2) if the packaging is practical for the use of the goods (easy to open, resealable etc.); (3) if the packaging is honest; (4) if the packaging is too large or appropriately sized and (5) if it is appealing (Wenger, 1967).

2.2.2 Types of Packaging

Depending on the sector packaging needs to fulfil very specific requirements that exceed the aforementioned. To that end many packaging agencies have specialised in single sectors or those which correspond to their expertise like food and beverages (Ambrose & Harris, 2011). A rough differentiation may be industrial packaging vs. consumer packaging wherein both can include food, beverages and others. Characteristics of consumer packaging differ from those of industrial packaging as far as the second especially do not have to include as many elements with value for advertising (Hüttel, 1998)⁹. For example besides standard consumer packaging several modifications of it exist, some of which are occasion-related packages, sample packaging, combi packages, multipacks, packages with secondary use, promotion packages, luxury packages and gift packages (Wenger, 1967; Hüttel, 1998).

Of course as industrial packaging is not aimed at private use, thus primary logical and not the aforementioned emotional aspects of packaging are relevant for successful sales in this category.

⁸ Also see chapter 2.4.3 Use of Shapes in general Packaging, p.38.

⁹ Also see Tab.1, p.13.

Integral parts	Perceived values	International aspects	Technical values
brand name	create incentive to buy	Multilingual labeling	color uniformity at different materials (standards)
trademark	arouse expectations and interest towards the product	consideration of taboo colors/symbols in other cultures	light fastness
product colors	modernity	country-specific legal requirements	
fonts	signal effect (recognition)		
manufacturer notice	suitability for TV advertising		
legal requirements	brand profile		
ingredients list	product adequacy		
opening and resealing notes	self-service accessibility		
use instructions	corporate identity features		
scanner code			
expiration date			

Tab. 1: *Example of a Checklist for Development and Evaluation of Consumer Packaging*

Source: author's illustration based on Hüttel (1998)

Packaging, as far as relevant for this thesis, can often be described by different packaging levels, which have their reason in different process steps and hence different target users. These are makers and packers of products; distributors; carriers and warehousemen; retailers and customers, the last of these being the final consumers (Paine & Paine, 1992). Primary packaging has direct contact with the product and is therefore the initial/major protective barrier from moisture or other factors (Singh & Singh, 2013). To avoid a migration of toxic chemicals to the product, government regulations for materials and printing inks used in this level are often very strict, especially when the packaged product is food (Singh & Singh, 2013). Secondary packaging contains the primary packaging to protect and unitize it throughout the handling and transportation process (Singh & Singh, 2013). Both primary and secondary packaging are often meant for private use. Tertiary packaging contains secondary packaging and is especially used for shipment and warehousing purposes (Singh & Singh, 2013). Quaternary packaging finally unitizes tertiary packages. A typical example for the packaging levels is a pallet-load, which is shown in Fig.2, p.14.

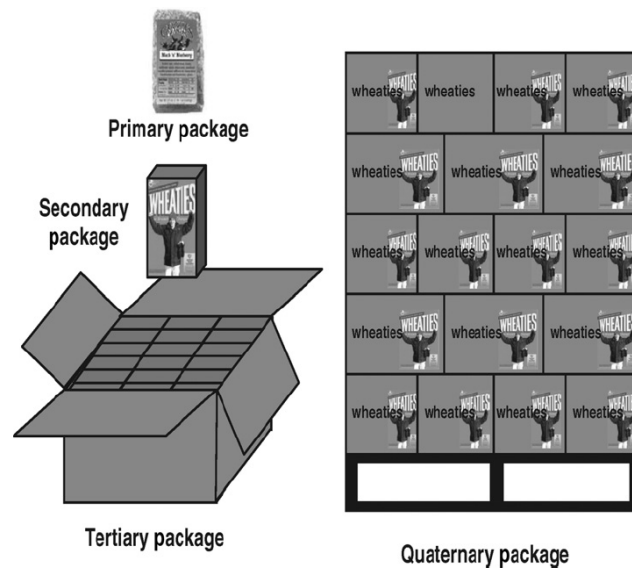


Fig. 2: Layers of Packaging

Source: Singh & Singh (2013)

2.2.3 Importance of Packaging for Marketing

Customers often decide within 20 seconds which product they purchase and in doing this ignore up to two thirds of all products in the same category being offered (Mininni, 2011).

In actuality a customer's decision for a product is usually not based on a time costing comparison of all alternatives but on his confidence that his emotional feelings and his perceptions are accurate (Young, 2012). Correspondingly a study by Wells et al. (2007) showed that 73 per cent of the test persons consciously rely on packaging when making their purchase decision.

A customer will in that order notice, purchase, store, use, and perhaps reuse a product's packaging (Napolitano, 2012). Therefore packaging actually generates more customer contact than any advertising (Vaih-Baur, 2010). Besides that, 80% of the products in supermarkets are neither advertised on TV nor on posters or ads, which makes packaging the only advertising for these products (Scheier et al., 2012).

Furthermore, to increase consumption of a product it is generally more efficient, longer lasting and less costly to provide a thoughtful packaging design than to advertise in a classical way (Deng & Srinivasan, 2013, Napolitano, 2012). Packaging can thus often be described as the most efficient marketing investment (Napolitano, 2012) or a commercial on the shelf respectively 'packvertising' (Scheier et al., 2012).

Still packaging design also is a critical factor that always requires compromises between marketing, manufacturing, R&D, quality control, engineering, logistics and others (Paine & Paine, 1992). For example, optimal presentation of a product could lead to minimal protection and maximum manufacturing costs. Hence development of a promising packaging requires a coordinated process, which due to its complexity is highly vulnerable for overlooking relevant aspects¹⁰.

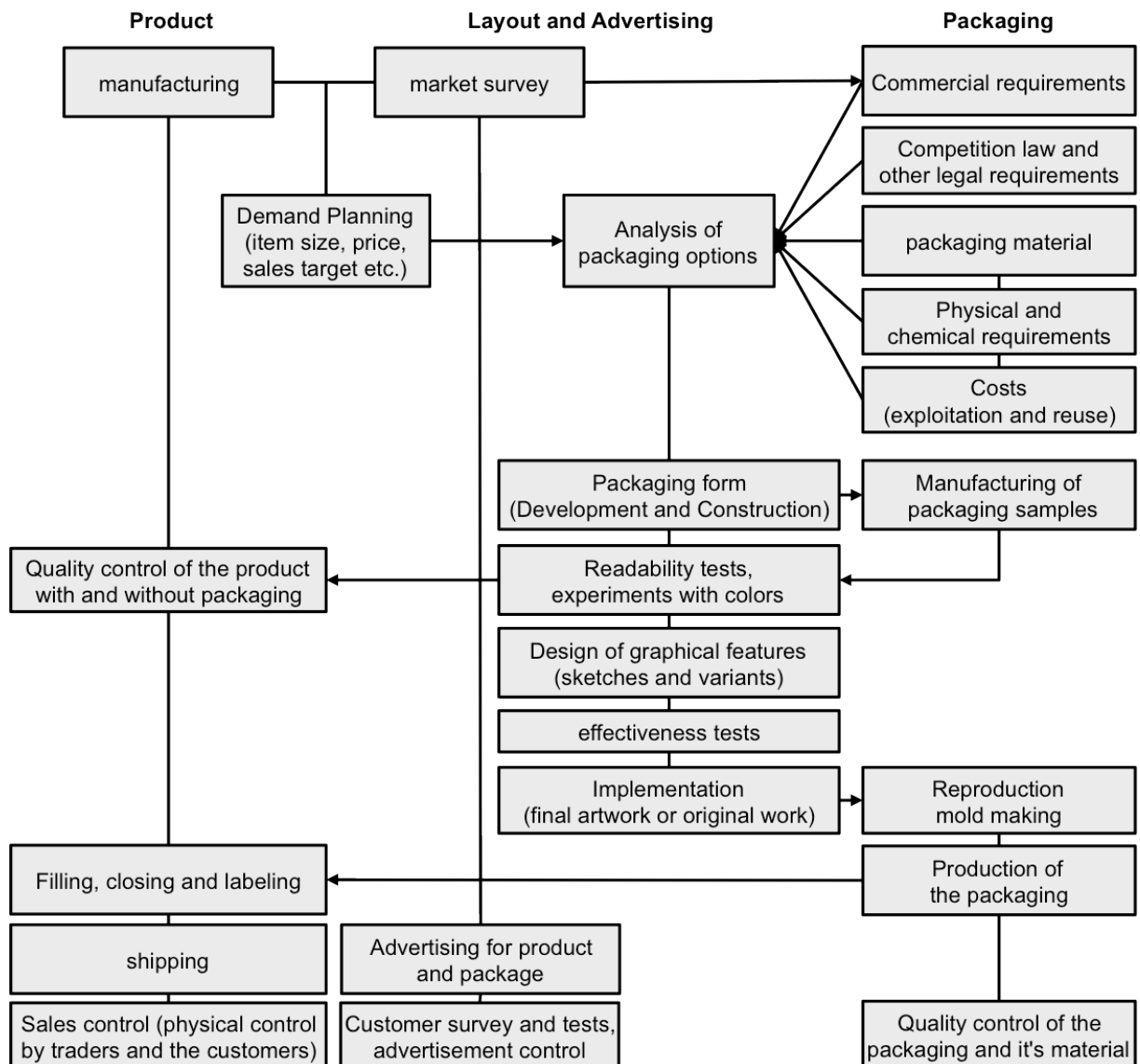


Fig. 3: Schematic Representation of the Production Process of a Packaging

Source: author's illustration based on Wills (1960)

¹⁰ See Fig.3.

But packages also raise expectations that need to be met (Moser, 2002). In this customers often use the packaging of a product to evaluate it in the context of its quality (McDaniel & Baker, 1977) or healthiness (Coelho de Vale et al., 2008; Scott et al., 2008) and to decide how much they consume of it (Bublitz et al., 2010). Following on from this, packaging is highly relevant for the purchase decision and post-purchase food consumption (Deng & Srinivasan, 2013) and this in turn is relevant for rebuys. Deficient packaging design thus often has a dramatic impact on the sale of a product (Scheier et al., 2012). Accordingly Kanouse & Hanson (1971) showed that negative information has a bigger impact on the rating of an object than positive.

To understand which packaging is convenient one has to keep in mind that a customer not only sees it. To perceive an environment a person makes use of all senses. This is true for packaging as well (Vaih-Baur, 2010). As a result the companies' valuation of packaging designs should consider material, form including size, colour, typography as well as photos and/or graphic elements and all other aspects that are perceivable (Seeger, 2009)¹¹.

Parameter	look	feel	hear	smell	taste
consistency	x	x	(x)		
transparency	x				
unity	x	x			
weight	(x)	x	(x)		
surface	x	x			
color	x				
gloss	x				
smoothness	x	x			
temperature	(x)	x			
electricity		x			
flavor		x		(x)	x
odor				x	x
sound		(x)	x		

brackets stand for conditional perceptibility

Tab. 2: Relationships between Parameters and their Perceptibility without Synaesthesia

Source: author's illustration based on Schmitz-Maibauer (1976)

¹¹ See Tab.2.

All these aspects move the consumer to be less logical but even more emotional in his decision. Often this goes along with the customer's attempt to rationalize his acquisition not before but after purchase (Young, 2012). A simple rule for packaging is that if it allows the customer to navigate through the shelves and product range easier and to make decisions faster the corresponding product will be sold more often (Young, 2012)¹². Finally packaging also is the most important tool for branding since it is the basis for brand identification (Napolitano, 2012; Maucher, 1998) and plays a crucial role in emphasizing the adequateness of the price and 'true value' of the product (Sonsino, 1990).

2.2.4 Use of optical Factors in general Packaging

Approximately 80% of all sensory impressions of a human being pass the eye (Medeyros, 1982) and 90% of all purchases are made after the customer only visually examined the packaging's front rather than actually having the product in his hands (Clement, 2007).

Ucherek (2000) showed a clear crossmodal correspondence as by improving the overall visual packaging impression the taste perception of the packaged food was improved as well. Agreeably Hamstra (1993) showed that the expected flavour of a food product will be rated higher the more appealing its packaging looks and vice versa¹³.

Since optical factors of packaging hence at least to some extent seem to have specific meanings they can be described as signs. Signs are all perceivable and interpretable patterns like colours or shapes (Linxweiler, 1998). They can be analysed out of three perspectives that refer to different levels of communication - all of which are relevant for packaging design.

These are syntactics (denotation), semantics (connotation) and pragmatics (evocation).

Syntactics refers to the sign itself and to the relationship between several signs (Linxweiler, 1998). In this a sign has no more meaning than an aesthetical. Consumers especially decide for more beautiful and more beautifully-packaged products, if the offered products are perceived similar in quality and price (Vaih-Baur, 2010).

Semantics refers to the substantive meaning, which is the concrete meaning of the sign e.g. an arrow showing a direction (Linxweiler, 1998).

¹² This could e.g. be the case if a product is perceived more tasty due to its packaging.

¹³ This in combination with the halo effect could be a highly valuable tool for marketing purposes.

Behrens (1982) specifies semantics as consisting of 4 separated semantic classes, which differ in the way a meaning is communicated:

a) signs, which are directly pointing to a certain meaning (e.g. EXIT¹⁴)

b) signs, which by association are linked to a certain meaning (e.g. blue colour appears cold)

c) signs which have a meaning by convention (arrow)

d) signs that are interpreted in the desired direction by advertising (e.g. a brand logo is interpreted as a seal of quality).

Referring to b) in practice a clear identifiability of food products can often be achieved by making use of colour, form and graphics on the packaging (Moser, 2002; Piqueras-Fiszman & Spence, 2011; Young, 2012)¹⁵.

Referring to d) it is common to showcase “consumption partners” for food products on the packaging (e.g. cornflakes with milk) while mentioning a wide range of compatible products in written form to communicate that the product can be part of everyday life (Madzharov & Block, 2010).

The interaction of all four semantic classes leads to common identification schemes and stereotypes, which are decisive factor for form codes, colour codes, graphical elements, surfaces and others (Linxweiler, 1998). For example wine bottles, milk cartons, soap dispenser and chocolate foil will all be recognized as such without any information on them. Often these schemes and stereotypes are stable for a long period of time (Linxweiler, 1998) and are used by customers to fill gaps of missing information (Deliza & MacFie, 2001; Becker et al., 2011). A product's packaging that matches a certain scheme will often make the consumer conclude analogical properties of the product (Vaih-Baur, 2010). But if the scheme digresses from typical it increases attention (Vaih-Baur, 2010; Clement, 2007).

Attention can for example be created by distinctiveness of shape, colour, contrast or size of a packaging and is independent of brand preferences (Clement, 2007). But the same “tools” are also usable to position a product on a price and quality level (Boesch, 1989). Further Folkes and Matta (2004) proved that packaging which gets more attention is often judged to contain more. Though Young (2012) believes that in general it is better to leverage established schemes, which partwise accompanies results by Piqueras-Fiszman & Spence (2011). Still this seems overhasty since innovation also is a major factor for progress in packaging.

¹⁴ In this words are interpreted as the most direct way of optical communication. Of course single alphabetic characters are signs, which have a meaning by convention.

¹⁵ Also see chapters 2.3.3 Colour Ramifications and Connotations, p.24; 2.3.4 Use of Colour in general Packaging, p.29; 2.5.3 Use of Colour in Food Packaging, p.40.

The third meaning of signs (pragmatics) refers to the communicative impact of signs on the information receiver (Linxweiler, 1998). In the case of packaging this means how the single customer understands, interprets and rates the packaging.

In conclusion signs have an aesthetical level (syntactics), a level that deals with what shall be communicated (semantics) and a level that describes what information the addressee actually receives (pragmatics). All of these need to be considered for packaging design.

2.2.5 Consumer Deception by Packaging Design

To avoid customer dissatisfaction or even fines or litigation the packaging must correspond to the relevant law principles. Even established packaging therefore has to be continuously monitored concerning its compliance especially with laws relating to consumer deception and health aspects. Latter being examined in chapter 2.5.2 the EU and the Federal Trade Commission (FTC) have defined very precisely how a fair packaging and the labelling of such can be guaranteed (European Parliament, 2011; FTC, 2014). Both focus on packaging size, necessary information and misleading information on packaging. In this packaging must not contain any unnecessary void volume, especially has to contain information on the ingredients, expiry date and amount but also has to comply with all other legal requirements such as those mentioned in chapter 2.2.1. Companies that did not follow these laws in the past have often incurred severe damage due to public reactions and financial impacts (Stewart, 2007). Especially a false impression of a product should hence be prevented (Vaih-Baur, 2010). Not explicitly included in these laws are associations of colours or shapes with consumer deception.

2.3 Colour and Transparency

In the following chapter general and specific information on colour and transparency will be given, which are especially essential for understanding the research set up in chapter 5.

2.3.1 Definition of Colour

Colour can be defined physically and optically. Any definition of colour always requires a definition of light in advance. Light belongs to the electromagnetic waves (radio, television, mobile communications, microwaves, infrared and ultraviolet radiation, X-rays or gamma rays) (Paasch, 2001). All electromagnetic waves have certain wavelengths (λ), which cause their different effects, e.g. the wavelength for microwaves is 1mm while for radio it can be

between 1m and 1km (Zwimpfer, 2012).

For light visible to human beings the wavelengths are within a span of 380-780 nanometres (nm), while those between 380-400nm and 700-780 can barely be perceived and 1nm is 0,000000001m (Welsch & Liebmann, 2003; Paasch, 2001). Most colours are mixtures out of several wavelengths (polychromatic) within this visible spectrum except for laser lights, which are monochromatic (Paasch, 2001).

In contrast to the physical perspective each colour can also be defined by three separately perceivable factors (the colour space), which by changing them enable transforming any colour into any other. These are value (also known as lightness or tone), saturation (also known as colourfulness or chroma) and hue (Thompson et al., 1992; Chattopadhyay et al., 2010; Zollinger, 2005).

The value of a colour describes the intensity of brightness or darkness that a colour has compared to a neutral scale from pure black to pure white (Gorn et al., 1997). Colours get brighter (higher value) by adding white and darker (lower value) by adding black to it (Moser, 1990). Colours with white content are called tint, colours with black content are called shade (Ambrose & Harris, 2005).



Fig. 4: *Differences in Value: Hue and Saturation held constant*

Source: author's illustration

Saturation refers to the amount of pigment that a colour has in comparison to its amount of grey (Gorn et al., 1997; Ambrose & Harris, 2005). Colours with high saturation and more pigment are richer and deeper, purer and perceived less grey (Gorn et al., 1997; Ambrose & Harris, 2005). On the other hand low saturated colours with a high percentage of grey appear dull, muted and form pastels (Gorn et al., 1997; Ambrose & Harris, 2005).



Fig. 5: *Differences in Saturation: Value and Hue held constant*

Source: author's illustration

The hue of a colour does not refer to the amount of pigment that a colour has but to the sort of pigments which it consists of. Depending on the hue a colour can be defined as for example red (mainly 600-750nm), blue (mainly 460-480nm), green (mainly 520-565nm) or yellow (mainly 565-575nm) (Gorn et al., 1997). Though scientists differ in their statements some believe the human eye can theoretically distinguish between up to 10 million hues (Eco, 1985). Hue is the colour dimension which has been researched most frequently and which also has been of highest interest to managers concerning their products (Chattopadhyay et al., 2010). The focus of this research will be set on hues as well, but also on different transparency intensity values¹⁶.

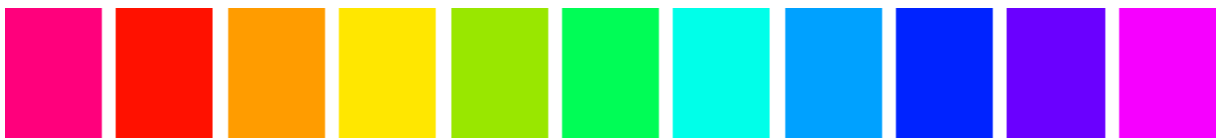


Fig. 6: *Differences in Hue: Value and Saturation held constant*

Source: author's illustration

To give an impression of all three colour dimensions at a time and to name colours adequate the so-called Munsell system was established in 1898 by Albert Henry Munsell (Gilbert et al., 1996). Today in psychological research on colour this colour calibration system is the most used (Gorn et al., 1997). For example cheese products of Kraft foods are tested consulting the Munsell system (Gorn et al., 1997). Though this research will focus on the physical description of colours and hence the transmitted wavelengths of the tested foils since mathematical discussions are only in this way performable.

¹⁶ See chapter 2.3.5 Definition of Transparency, p.30.

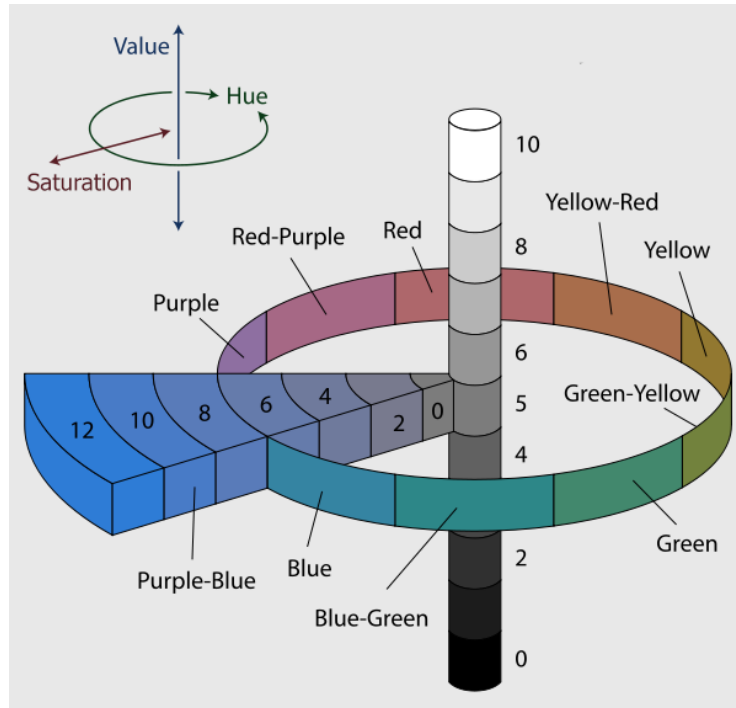


Fig. 7: Munsell Colour System

Source: author's illustration based on a graphic from Wikipedia.org

2.3.2 Colour Measurement and Perception

Even though physical properties of colours are measurable, this is not true for subjective colour perception (Zwimpfer, 2012; Singh, 2006). The human colour perception takes place as light-sensitive cells or receptors in the human eye are hit by light and then send signals to the brain via the optic nerve (Paasch, 2001). These receptors can be distinguished as rods and cones, of which rods assure light/dark distinction and cones colour perception (Paasch, 2001). Further three different types of cones exist of which one is sensitive for long (reds), medium (greens) and short (blues) wavelengths (Paasch, 2001). Since their perceivable wavelengths are overlapping, mixtures of these three colours, such as yellow, can be perceived as well (Paasch, 2001)¹⁷. If all cones are equally stimulated this creates an achromatic colour perception (black, grey, white depending on the stimulation strength) (Paasch, 2001). If a person is so called colourblind and hence cannot see all colours this indicates that the cones or the information transfer to the brain do not work properly (Kohl et al., 2002). It becomes clear that for colour perception many biological factors are relevant so that colours will be perceived slightly different depending on the person (Jacobs et al., 1991).

¹⁷ See further below to find explanations for colour mixing.

But other factors also have an impact on colour perception and colour measuring.

To examine an undefined colour physically the wavelengths of light that either is transmitted through a medium, or is emitted by a light source or is reflected by a material are measured (Gerbino, 1994; Zollinger, 2005; Welsch & Liebmann, 2003). In this two types of colours exist: emitted colours caused by light (light colours which are measured in colour temperature kelvin) and colours of objects that are not luminous (object colours) (Paasch, 2001; Zwimpfer, 2012). Object colours arise if a material absorbs those wavelengths that the reflected or transmitted colour does not have (Singh, 2006). E.g. a green apple is green because it absorbs and hence does not reflect blue, red and others but not green. Still no material exists that would reflect all light (perfect white) or absorb it completely (perfect black) (Paasch, 2001; Zwimpfer, 2012). In that context so called reflexion or transmission curves show how much of the single wavelengths from the impacting light are reflected or transmitted (Paasch, 2001). This means for transparent materials especially the transmission curves are relevant whereas for opaque materials the reflexion curve counts^{18,19}.

It is important to know that both types of colour (light colour and object colour) mix differently and influence each other. While light colours mix so-called additively and always combine to lighter new colours (green mixed with red becomes yellow), object colours mix so-called subtractively and always combine to darker new colours (green mixed with red becomes black) (Welsch & Liebmann, 2003; Zwimpfer, 2012). If light colours and object colours mix this happens subtractively (Zwimpfer, 2012)²⁰. The different mixing effects are caused by the fact that either specific wavelengths are suspended accessorially (subtractive mixing) or that specific wavelengths are added accessorially (additive mixing). This is relevant since the light conditions in rooms often tend to be slightly yellow or blue and hence influence the colour of objects. If the light colour is strong enough (say yellow) this can lead to that two colours which would be perceived as very different under neutral daylight conditions are then perceived as the same (white and yellow; red and pink; black and blue) (Paasch, 2001, Zollinger 2005, Welsch & Liebmann, 2003). This effect is called remission or metamerism (Zwimpfer, 2012; Paasch, 2001)²¹. Nevertheless under usual room conditions even if the lighting is not neutral this effect is barely relevant since humans still perceive colour consistency (Kobbert, 2011; Zwimpfer, 2012; Paasch, 2001; Francis, 1995). A white sheet of paper will look white outside a house and inside differently lighted rooms.

¹⁸ For definitions of opacity and transparency see chapter 2.3.5 Definition of Transparency, p.30.

¹⁹ Transmission curves will be used in chapter 5 to define the chosen transparent foils for studies 1-4.

²⁰ Also see chapter 2.3.6 Interaction between Transparency and Colour, p.32.

²¹ The effect is used in food testing with red lighting conditions.

This relative colour consistency effect is reasoned as the human brain interprets the predominant lighting as achromatic and contemplates different object colours in comparison with each other (Paasch, 2001)²². Hence still this comparison of object colours can have an influence on colour perception if the objects for comparison and hence the surrounding change. Given that the room lighting stays constant and only the surrounding object colour changes a coloured object can be perceived lighter in a dark and darker in a light surrounding; more colourful in an achromatic than in a colourful surrounding and an achromatic colour can be perceived as complementary to a colourful surrounding (Paasch, 2001). These effects are called simultaneous contrast (Küthe & Küthe, 2002; Bodrogi, 2012; Paasch, 2001).

For a highly professional context (e.g. publishing companies, where slightest differences in lighting could lead to different ink set ups) the ISO 3664 norm was launched to defeat this effect. As far as possible this thesis fulfilled the included recommendations as well, e.g. identical surrounding object colours were guaranteed for the entire process and on the largest realizable scale²³. Still some aspects due to their little relevance and high realization costs have not been considered. E.g. the ISO 3664 norm recommends lighting conditions with ideally 5000 degree Kelvin, which keeping the relative colour consistency in mind, seemed negligible.

2.3.3 Colour Ramifications and Connotations

In the following some general influences that colours can have on human beings as well as common connotations shall be outlined to give the reader an idea about possible knock on effects. In this the three mentioned colour dimensions will be examined.

Value

Adams & Osgood (1973) examined a general tendency within 23 cultures that bright colours are preferred to dark ones, which was confirmed by Kareklas et al. (2014). Accordingly Gorn et al. (1997) showed that higher levels of value increase a feeling of relaxation and the likeability of ads as well. Across most countries a light value is in that respect preferred for associations with calmness, while intensive positive emotions like love and excitement are connected to medium values (Lechner et al., 2008). Negative associations are clearly

²² Still to reach a high quality of the studies similar lighting conditions were ensured for the entire process.

²³ Within the studies the surrounding object colours were constantly white (table, packaging, walls, chair, dish, fork). Only the pen was transparent with a black reservoir.

associated with dark values (Lechner et al., 2008). Consistently Webster et al. (2012) showed that National Hockey League (NHL) players were playing more aggressively when wearing black uniforms than when wearing white ones.

Further the colour value of objects even has an impact on the tactile sense, which clearly can be identified as a crossmodal correspondence. Brighter objects (high value) appear smoother, harder, sharper, lighter and cooler than dark ones (Seeger, 2009).

Very important for this research is a study by Albertazzi et al. (2012), which hints that associations of colours with shapes, which in many studies have been documented (Malfatti et al., 2014; Spector, 2008/2011; Chen, 2014; Dumitrescu, 2003/2011), are determined by the value of a colour even more than by its hue²⁴. Albertazzi et al. (2012) argue that the “natural” lightness or value (Spillmann, 1985), which for example is very low for blue, may be the reason why tested colours are associated with specific shapes.

Saturation

By making use of highly saturated colours feelings of excitement can be increased simultaneously with the likeability of ads (Gorn et al., 1997). This goes along with Ambrose & Harris' (2011) statement that the higher the intensity of a hue the higher is the perceived quality of a product, which also is confirmed for food²⁵. Accordingly highly saturated colours boost the intensity of occurring perceptions (Schifferstein & Tanudjaja, 2004; Valdez & Mehrabian, 1994). For example objects appear further away the more saturated the layer of blue covering them is (Gekeler, 2000; Zollinger, 2005).

Hue

Colour preferences, which usually imply hue preferences, need to be examined in context to a specific object (Grossman & Wisenblit, 1999; Heller, 1994). E.g. although blue is the favourite colour of most people, still most cars are not painted blue (Eysenck, 1981; Heller, 1994). Therefore favourite hues may not always adequately explain product colour choices. One of the very few general observations about hues was made by Antick & Schandler (1993) and confirmed by Valdez & Mehrabian (1994) in showing that the feelings resulting from colour perception will be higher for longer wavelength hues than for shorter ones.

Concerning colour shape associations it has to be mentioned that the existing studies with focus on hues in a wide range correspond in their results. Still to some extent they are also

²⁴ This will be confirmed by results out of studies 2 and 3 in this thesis, which indicate that one specific hue can be associated with different shapes depending on its transparency and hence perceived value.

²⁵ See chapter 2.5.5 Influence of Colour on Food Perception, p.46.

contradictory. For example Albertazzi et al. (2012) documented strong associations between red and round but also angular shapes.

In the following some specific information on the later tested colours will be given.

Yellow

Jacobs & Suess (1975) showed that yellow and red light both lead to higher anxiety states than blue or green. Further Valdez & Mehrabian (1994) showed that yellow and a mixture of green with yellow were perceived the least pleasant of all tested hues. Several studies confirm that yellow is the least preferred colour (Guilford & Smith, 1959; Lechner, 2006) and perceived least pleasurable (Palmer & Schloss, 2010; Valdez & Mehrabian, 1994; Madden et al., 2002). On the other hand together with red yellow is one of the hues that attract attention and stimulate appetite (Singh, 2006).

Albertazzi et al. (2012) showed strong non-random associations between yellow and triangles in western cultures. Similarly Malfatti et al. (2014) showed significant associations between yellow and angular, asymmetric lines. Finally Chen (2014) showed for Japanese participants that yellow will be associated with triangles as well and further with rhombus, cone and pyramid.

A survey containing 1888 western persons came to the result that yellow was associated strongest of all tested colours with the following factors and by the following percentage of people: 50% sourness, 53% envy, 22% optimism, 34% parsimony, 54% jealousy, 31% dishonesty (Heller, 1994). This goes along with results from Hupka et al. (1997).

For Asian countries yellow has been shown to be associated with happiness, progressiveness, authority, royalty and trustworthiness (Jacobs et al., 1991; Schmitt, 1995).

Red

This highly visible hue together with blue is the most researched hue in literature (Chattopadhyay et al., 2010; Gorn et al., 1997; Ambrose & Harris, 2005). Batra et al. (1998) showed that participants' galvanic skin response (GSR) for red indicated higher arousal compared to blue environments. Accordingly Chattopadhyay et al. (2010) compared several colours and came to the conclusion that red elicits the highest level of excitement, which was proved by (Bellizzi & Hite, 1992). Zwimpfer (2012) states that lasting watching of red light will even lead to constriction of the blood vessels, change of the blood pressure and increase of the respiratory activity and pulse. A further study by Adams & Osgood (1973), which took place in 23 cultures, showed that red was perceived as the strongest (potency) and most active colour. A test with 40 art related students by Kobbert (2011) came to the conclusion

that red will be associated with very rounded and curved lines. Similarly Albertazzi et al. (2012) showed strong non-random naturally biased associations between red and circles but also squares. Dumitrescu (2003, 2011) and Chen et al. (2014) showed identical associations of red with circles but not with squares. Finally Malfatti et al. (2014) showed associations between red and angular lines. The different results indicate that in fact the value of a colour rather than the hue could be the determining factor for colour shape associations²⁶.

A survey containing 1888 western persons came to the conclusion that red was associated strongest of all tested colours with the following factors and by the following percentage of people: 53% sexuality, 33% closeness, 26% roundness, 31% loudness, 29% happiness, 61% passion, 90% love, 26% bustle, 51% heat, 36% power, 48% danger, 27% dynamic, 44% energy, 69% erotic, 31% attractiveness, 39% ambition, 58% aggressiveness, 32% activity, 37% allurement, 38% forbidden, 47% warmth and 60% anger (Heller, 1994).

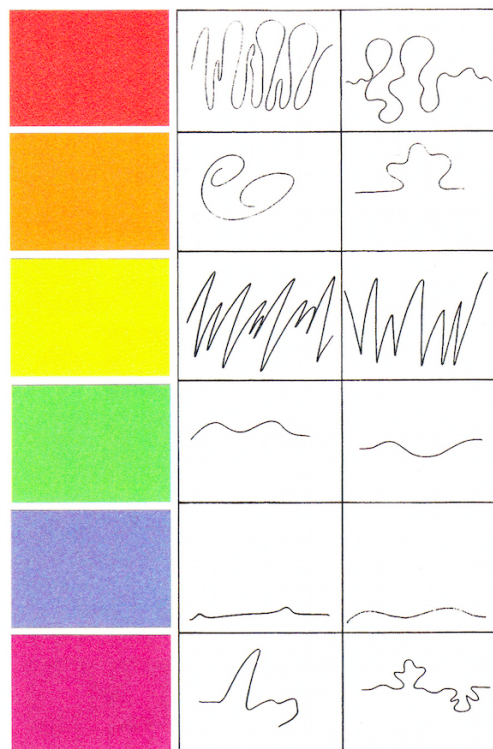


Fig. 8: Lines that best correspond to the shown Colour Shape Associations

Source: Kobbert (2011)

²⁶ This is in line with the results of studies 2 and 3.

Green

Gil & Le Bigot (2014) showed that green conveys positive information and facilitates the processing of emotionally congruent positive facial expressions while interfering with processing incongruent negative facial expressions. Lichtenfeld et al. (2012) examined that green facilitates a higher picture-based and word-based creativity performance of test persons than other colours. Together with blue, green is a colour that calms customers and their appetite thus it encourages leisurely dining (Singh, 2006).

The only documented significant associations of green with shapes seem to be those by Chen et al. (2014). Japanese participants associated green with the same shapes as blue namely square, trapezium, parallelogram, hexagon, truncated pyramid.

A survey containing 1888 western persons came to the result that green was associated most strongly of all tested colours with the following factors and by the following percentage of people: 26% tolerance, 50% sourness, 53% naturalness, 27% safety, 32% calmness, 42% vitality, 41% tartness, 59% hope, 33% youth, 34% healthiness, 68% poisonousness, 63% recovery, 56% pacification, 30% bitterness (Heller, 1994) which was confirmed by Hupka et al. (1997). In Asian cultures it is associated with love, happiness, adventure, sincere trustworthy and dependable but also danger or disease (Ricks, 1984; Jacobs et al., 1991).

Blue

Chattopadhyay et al. (2010) showed that blue elicits the highest level of relaxation of all tested colours. It is perceived as calm, cool and positive (Bellizzi & Hite, 1992; Bellizzi et al., 1983; Kido, 2000). Correspondingly Chattopadhyay et al. (2010) as well as Wieggersma & Van der Elst (1988) and Adams & Osgood (1973) showed that people in all countries have a universal preference for the hue of blue irrespective of cultural heritage. Bellizzi & Hite (1992) examined more retail outcomes, more simulated purchases, fewer purchase postponements and a stronger inclination to shop and browse in blue than in red environments. Furthermore, products presented against blue-coloured backgrounds are preferred to products that are presented against red-coloured backgrounds (Middlestadt, 1989; Bellizzi et al., 1983; Bellizzi & Hite, 1992). Wauters et al. (2014) showed that blue has a more strengthening impact on feelings of severity and susceptibility when used as a background colour for medicine advertising than yellow as people seem to be able to better deal with the communicated messages.

Kobbert (2011) showed for art related students that blue will be associated with straight lines while Chen et al. (2014) showed associations with square, trapezium, parallelogram,

hexagon, truncated pyramid in Asian cultures.

A survey containing 1888 western persons came to the result that blue was associated strongest of all tested colours with the following factors and by the following percentage of people: 25% silence, 32% sympathy, 31% loyalty, 30% desire, 40% sportiness, 26% achievement, 43% masculinity, 34% harmony, 51% coolness, 65% distance, 22% friendliness, 30% friendship, 26% refreshment, 44% trust (Heller, 1994).

2.3.4 Use of Colour in general Packaging

The use of colour in packaging is not only one that aims for aesthetical perfection. In fact 60 to 90% of the purchase decisions are driven by packaging colour (Singh, 2006). Colour can be seen as the attempt to manipulate customers in a way that increases the product likeability and the willingness to pay for the product (Scheier et al., 2012). This works especially via attracting attention, enlivening product and packaging and showing the product more realistically (Moser, 1990; Seeger, 2009; Wells et al., 1992) but further to help the customer imagining what actually is inside the packaging (Solomon, 2013). In this packaging colours can signal specific product categories²⁷ or stimulate culturally typical associations (Stewart, 2007). To a certain degree the packaging colour can also help in achieving heat protective effects that are of relevance for the product (Knoedel, 1978).

The fact that colour is often the first and most important element that is noticed when a customer comes into contact with a product (Seeger, 2009; Cheskin, 1957) and that the customer can not control his emotional reaction consciously (Stewart, 2007; Cheskin, 1957) makes clear that colour can be a mighty but also dangerous tool for a packaging designer (Stewart, 2007). Colours of packaging can even have stronger influence on customers associations for the product than the brand (Piqueras-Fiszman & Spence, 2011). Correspondingly the choice of the right colour for a packaging is a key issue for marketing success (Solomon, 2013).

But also the effect of colours on the overall product perception and hence crossmodal correspondences are widely examined. For example the taste of buns is rated differently for freshness depending on the colour of their packaging (Moser, 2002). A red water bottle will be perceived as more capable, more rough and more exciting than a blue one (Pantin-Sohier et al., 2005) and analgesics sell better if they are packaged in blue instead of red boxes (Kaupinnen, 2004). More extremely, the same detergent packed in blue is perceived as too soft, whereas packed in yellow it is perceived as too aggressive and even capable of

²⁷ For signs and packaging see chapter 2.2.4 Use of optical Factors in general Packaging, p.17.

destroying the clothes (Packard, 1957)²⁸. The examples show clearly that the packaging colour can affect the perceptions of the product inside directly and massively. This fact appears more meaningful realizing packaging colour often is the only basis for conclusions of the consumers on a product's characteristics (Cardello & Sawyer, 1992). Since consumers often want to make quick purchasing decisions and thus do not read information on the packaging of a product they more or less check what they need and buy it (Charters et al., 1999). Because colour maybe the element of a packaging, that leads to the fastest response of the customer (Swientek, 2001), it is a critical factor for identification here. Colour enables the customer amongst others to identify the product itself, its performance and its origin (Knoedel, 1978; Ambrose & Harris, 2011). Many products are designed to fit to this principle; e.g. Migros bulbs with different wattages are sold in red, green or yellow packaging (Wild, 1998). Some colour associations may even result from such typical packaging colours for specific products. Correspondingly Piqueras-Fizman & Spence (2011) show that the identifiability of products can be affected massively by changing the packaging colour. Hence if product expectations, which arise from specific colours and factual product qualities differ, this can result in a critical rejection of the product in the future (Cardello & Sawyer, 1992, Deliza & MacFie, 1996, Piqueras-Fizman & Spence, 2011)²⁹.

Furthermore the colour of the packaging contributes to the identification of the colour that the product inside the package has (Seeger, 2009).

2.3.5 Definition of Transparency

Transparency (also called pellucidity or diaphaneity) is the effect that a visual entity, which occupies a specific volume and has an own colour, largely preserves the optical structure of background objects while seeing through it (Gerbino, 1994; Kaltenbach, 2004). Transparent materials therefore allow light and images to pass through (transmit), while the propagation direction of the light may change (Welsch & Liebmann, 2003). Accordingly an important effect of a transparent material can be a distortion or magnification, which is caused by the curvature of its surface or just by the material itself and allows seeing objects bigger, smaller and/or in wrong proportions (Zwimpfer, 2012). Besides water, glass and air further examples for transparent materials are specific plastics, many liquids and fast enough rotating materials that without rotation would not cover the whole background (Gerbino, 1994).

²⁸ Also see chapters 2.5.5 Influence of Colour on Food Perception, p.46 and 2.5.6 Influence of Shapes on Food Perception, p.50.

²⁹ See unity effect in chapter 2.1.3 Crossmodal Correspondence related Theories but also halo effect in the same paragraph and further chapter 2.5.5 Influence of Colour on Food Perception, p.46.

Translucency, in contrast to transparency, describes the attribute of a material to let light go through but scatter images so that the optical structure of background objects is not preserved (Kaltenbach, 2004).

An opaque material on the other hand is defined by a 0% light transmittance and hence is impervious to the transmission of visible light (Callister & Rethwisch, 2012).

Still a 100% light transmittance contrariwise will only be possible in a vacuum since any transparent material always also reflects and absorbs at least a little percentage of the light (Gerbino, 1994; Zwimpfer, 2012; Callister & Rethwisch, 2012). Transparent materials therefore can have different transparency intensity values (TIVs) with the lowest letting close to 0% and the highest letting close to 100% of the light and images transmit through it (Gerbino, 1994). This percentage of TIV is also named with a capital Y and calculated by integrating the transmission curve³⁰ of a transparent material (Intawiwat et al., 2010).

Since the percentage of the incident light that is transmitting through the transparent material is depending on the degree of absorption (Colour) and reflection that the material has, perceivably coloured transparent materials can never be as transparent as those, which are perceived uncoloured (Callister & Rethwisch, 2012; Intawiwat et al., 2012)^{31,32}.

Depending on the angle of entry, light can also be reflected nearly completely by transparent materials as for example on a water surface (Zwimpfer, 2012). In the case of clouds or waterfalls this effect leads to the perception of white colour since uncountable tiny drops reflect different wavelengths³³ (Zwimpfer, 2012). But also transparent materials, which do not reflect light in a perceivable quantity are not necessarily perceived as transparent. This is because before realizing transparency it is always necessary to judge and in this it is of advantage to have seen the background object without a transparent layer in front plus under various illuminations (Helmholtz, 1962). This makes sense since when seeing a background object through a transparent material several factors are perceived simultaneously³⁴. These are the reflectance of the background object (object colour), the reflectance of the layer (colour of transparent material), the layer transmittance (TIV) and the illumination caused by the surrounding environment (Gerbino, 1994). Further transparency is all the more to be realized the more the coherent form of the background object is interrupted by the

³⁰ For more details on transmission curves see chapters 2.3.2 Colour Measurement and Perception, p.22 and 2.3.6 Interaction between Transparency and Colour, p.32.

³¹ Also see Fig.18, p.62 and Fig.22, p.71 for concrete transmission curves of the foils tested.

³² See chapter 2.3.6 Interaction between Transparency and Colour, p.32.

³³ Also see additive colour mixing in chapter 2.3.2 Colour Measurement and Perception, p.23.

³⁴ See Q in Fig.9, p.33.

transparent object (Metzger, 1975). In this if a transparent angular foil is put over an angular sheet of paper in a way that both shapes do not build a unit³⁵ the foil is perceived as transparent (Gerbino, 1994). This effect becomes stronger the more transparent material and background object differ in shape (Metzger, 1975). In contrast a background object that is put directly behind a transparent material so that no shadows evolve and that occupies exactly the area of the transparent material will barely be perceived as behind such (Metzger, 1975).

2.3.6 Interaction between Transparency and Colour

A transparent object must always have a colour since no object can be colourless in fact (Gerbino, 1994). Perceivably coloured transparent materials selectively absorb specific wavelengths more strongly than others, while if materials are perceived as colourless and transparent they barely absorb any wavelengths and thus their colour is not perceivable (Callister & Rethwisch, 2012). One can prove the actual colour of a transparent material by putting a certain amount of layers of it on each other so that at one point a specific colour will be visible. In the case of glass this often is green while for water and air this is blue depending on its cleanliness. Correspondingly the more uniform the absorption of the visible wavelengths is, the more achromatic (white, grey, black) will the layered transparent material be perceived (Callister & Rethwisch, 2012). According with the above it is important to understand that if a material with a specific colour (certain hue, saturation and value) is made (more) transparent these three colour levels do not change. This is the case because no white or black (value), grey (saturation) or pigment (hue) have been added or subtracted and because the opaque part of the foil still is identical in these factors but has vanished to a certain extent in favour of transparency (Gekeler, 2000). However the increased or added transparency leads to the perception that the material now is lighter (higher value)³⁶. This becomes clear taking a look at oil-based paint colour, which is made more transparent and hence perceived as lighter by adding clear and transparent acetone. The diluted paint colour will only appear lighter because of the light background shining through (Gekeler, 2000). Accordingly for the foils out of studies 1 to 4 the brighter a red, blue, green or yellow foil appears, the more transparent the foil.

³⁵ See Fig.9, p.33.

³⁶ This was confirmed in study 3.

Of further relevance is the fact that if a transparent colour layer superimposes a differently coloured object³⁷ the colour layer cuts off some of the incident light so that both colours mix subtractive and become darker (Zwimpfer, 2012). This can also be comprehended by the four-luminance pattern of Gerbino (1994).

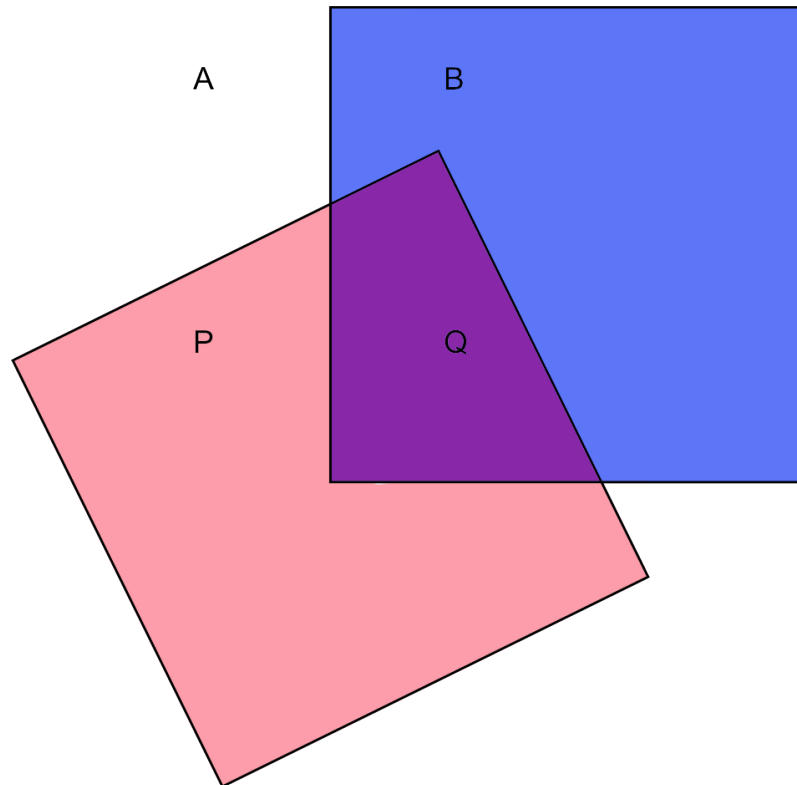


Fig. 9: *The Four-Luminance Pattern*

The transparent layer transforms A and B luminance into P and Q.

A: an empty room with daylight illumination

B: an object with no layer in front has a specific colour

P: no object with a transparent layer in front has the layer colour

Q: a coloured object with a coloured transparent layer in front results in a new colour

Source: author's illustration based on Gerbino (1994)

³⁷ This will happen in study 4 as yellow and blue transparent layers will be put in front of yellow coloured penne pasta. But due to the low enough TIVs the foils still show the same hues.

2.3.7 Use of Transparency in general Packaging

Transparency can be found on many different types of packaging and for very different product categories. Schürmann (2008) believes that the increasing use of transparent packaging in the market is caused by the fact that it addresses the similarly increasing demand from consumers to see what they are buying. Accordingly all the experts whom the author of this thesis talked to in that context agree that the main reason for windows on packaging or overall transparent surfaces of packaging is that customers use them to evaluate the product inside (expert interviews I-VII, 2014). In this context especially unique or unknown products should be packaged transparently so that the customer can rate them better (expert interviews IV Bentley & VI Mukhedkar, 2014; Moser, 2002). Furthermore, windows are more suitable if the product is beautiful and hence visually convincing the potential customer (Eichenauer, 1994). Correspondingly the renowned packaging designer Peter Schmidt often makes use of windows and open packages, as these especially in the midst of several articles show a positive effect (Eichenauer, 1994). These experiences have been confirmed for food (expert interviews I Schmitt & VII Kioroglou, 2014).

The usable transparent materials for packaging typically include different types of plastics and glass (Murphy, 2003). Although these differ in many physical characteristics, the TIVs of most common materials can be similarly high (Murphy, 2003)³⁸. In this, while checking several plastic films for the later studies 1 to 4 of this research, the most transparent foil had a TIV of 95%³⁹.

However, the usability of a material for packaging also depends on the product category the packaging is made for. This is particularly true in context of the material costs and physical requirements⁴⁰ but also in context of the influence on the product perception. A detailed focus will hence be set on the use of transparency in food packaging in chapter 2.5.4.

³⁸ See Tab.3, p.35.

³⁹ See Fig.18, p.62. The foil „CLEAR“ was used for the control groups in studies 1,3 and 4.

⁴⁰ See Tab.3, p.35.

Parameter	PP	PET	PS	PVC	HDPE	PC	Glass
Transparency	=	=	=	=	++	=	=
Cost/unit volume	=	++	+	+	=	++	+
Hot-fill capability	=	++	++	++	++	=	=
Moisture barrier	=	+	++	+	=	++	-
Lower density	=	++	+	++	=	++	++
Taste/Odor transfer	=	+	=	+	+	=	-
Drop impact strength	=	+	++	-	-	-	++
Flexibility	=	=	++	=	=	=	++
Stiffness	=	-	-	-	+	-	-
Chemical resistance	=	+	+	++	=	=	=
Oxygen barrier	=	-	=	-	-	=	-

Key: ++ much better, + better, = comparable, - worse

Tab. 3: Polypropylene (PP) Plastic compared with other transparent Packaging Materials
Source: author's illustration based on Murphy (2003)

2.4 Shapes

As the window shape of food packaging is one of the investigated factors within this thesis that possibly can affect the product perception a brief overview of shape related aspects will be given in the following. In-depth information regarding the Influence of Shapes on Food Perception will be offered in chapter 2.5.6.

2.4.1 Definition of Shapes

The definition of shapes presumes knowledge about colour and vision as the relevant perception of shapes within this thesis is visual⁴¹.

Shapes can be interpreted as large deviations from visual randomness (Desolneux, 2007).

In this shapes are perceptual tools to allow pattern recognition and hence the identification and classification of objects (Goldstein, 2002). Furthermore they are recognizable out of different perspectives and even with a certain degree of perspective distortion (Cao et al., 2008).

⁴¹ See chapters 2.3.1 Definition of Colour, p.19 and 2.3.2 Colour Measurement and Perception, p.22.

A shape always demands a certain space, which it covers visibly and characteristically (Borsuk, 1975; Lord & Wilson, 1986). The spaces in which shapes can occur are always euclidean and hence visibly perceivably two or three dimensional (Belongie et al., 2001). Thus shapes can be defined by perceptual meaningful boundaries that isolate the covered space from the further (Cao et al., 2008; Jagadish, 1991; Ayache & Faugeras, 1986; Wallace & Wintz, 1980; Belongie et al., 2002). These boundaries can be interpreted as closed curves which are continuous and do not have a self-intersection (Younes, 2010; Belongie et al., 2002). The appropriate principle is also described as Jordan curve (Younes, 2010).

Here it is necessary to be very precise as in contrast to theory in real life curves, lines or boundaries are only of no second dimension and hence no shape themselves, if they cannot be distinguished from the shape they define (Cao et al., 2008)⁴². In both cases the more these shape defining boundaries follow a perceivable principle, e.g. are smooth, the better the associated shapes will be definable even if they are covered or barely contrasting with the surrounding (Cao et al., 2008; Attneave, 1954). However the boundaries are also the more meaningful/perceivable the stronger their contrast is compared to their surrounding (Cao et al., 2008; Attneave, 1954; Marr, 1982; Wertheimer, 1923). But if the contrast to the surrounding stays identical the colour of the shape or its lighting has no relevance for shape perception (Cao et al., 2008; Attneave, 1954; Wertheimer, 1923).

The technical extraction of shapes from images of 2D or 3D objects can be implied by using a so-called edge detector that interprets the boundaries of a shape as a set of points: $P = \{p_1, \dots, p_n\}$, $p_i \in \mathbb{R}^2$ (Gavrila & Philomin, 1999; Huttenlocher et al., 1999; Belongie et al., 2001; Belongie et al., 2002). Similarly correspondences between two shapes are described by finding for each sample point on one shape another one on the compared shape, which has a similar shape context (Belongie et al., 2001). Small (1996) describes this in other words as the situation when two data sets can become identical by rigid motion and rescaling of one of these.

Shapes can be round or angular, symmetric or asymmetric.

An object is more round the more the boundaries that define it deviate from being flat or straight, hence the more the shape comes close to that of a circle and in this the more identical angles define the boundaries (Sokolov, 2001). An object is more angular the more its boundaries vary from the above.

⁴² See Fig.10, p.37.

On the other hand an object, as far as relevant for this thesis, is symmetric if it has a symmetry axis that allows replication of the whole shape by mirroring one half of it on this axis (Stewart, 2001). This is not possible for an asymmetric object.

Some concrete shapes (rhombus, square, triangle, rectangle, circle, ellipse, superellipse and reauleaux) will be defined in the preparation of Study 1⁴³.

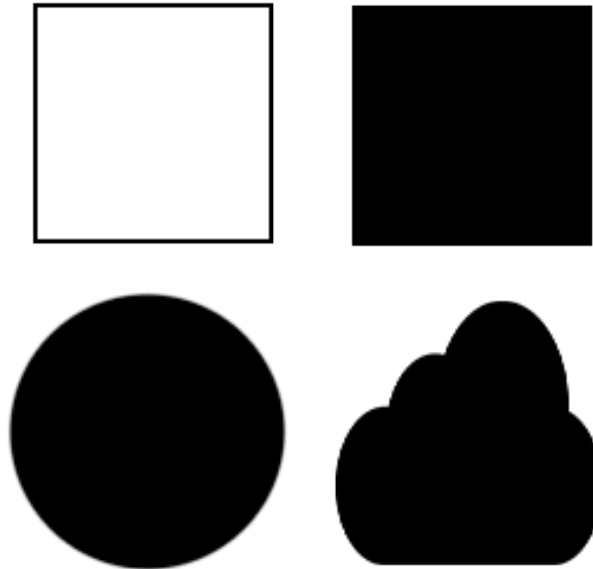


Fig. 10: *Different Shapes and Boundaries*

From left to right: square defined by a boundary that can be separated from the shape, square defined by a boundary that cannot be separated from the shape, circle and asymmetric figure.

Source: author's illustration

2.4.2 Shape Ramifications and Connotations

Bar & Neta (2006), Carbon (2010), Zhang et al. (2006) and Westerman et al. (2012) examined a general preference for rounded forms over angular ones and explain this with the perception of potential physical harm caused by angular shapes. Zhang et al. (2006) showed that rounded logos will be perceived as more harmonious while angular ones can trigger associations with conflict and aggressiveness. Still keeping Fang & Mowen (2005) in mind this may be profitable for certain situations as well. In fact warning labels are typically angular (Riley et al., 1982). On the other hand the preferred shape for a corporate logo is not generally round but dependent on the product (Fang & Mowen, 2005).

⁴³ See Appendix B. Shape Calculations for Study 1, p.165.

Studies have shown symmetrical figures are rather characterized by peace and balance, and are most easily detectable (Seeger, 2009). This applies, for example for circle, isosceles triangle, ellipse, square, rectangle and rhombus. Additionally, the more uniform a shape is the more memorable it is (Jacobi, 1972). A circle indeed is the most memorable shape as it is the most uniform possible (Jacobi, 1972). Central-aligned shapes such as a circle or square further appear dormant, quiet, static, stable, measured, stiff or sober (Seeger, 2009). An upward shape pretends to be gravity overcoming, striving, growing, active. Bottom-heavy figures seem lying, quiet, oppressive, passive (Seeger, 2009). In this it was of major relevance to test pairs of shapes within this thesis that are similar in their direction and proportions⁴⁴.

2.4.3 Use of Shapes in general Packaging

In 2012 Westerman et al. confirmed the presumable general preference for rounded forms over angular ones in context to packaging by testing several combinations of angular and rounded graphics with angular and rounded packaging and different products. This was shown to influence the purchase likelihood as well as the aesthetical rating positively even if just rounded graphics were used on angular packages.

Seeger (2009) observed that specific packaging shapes are used to increase sales by being attention-arousing, promoting curiosity, located in the Zeitgeist and fitting into the product range or if they are so extravagant that people talk about them. Further Rebollar et al. (2012) showed that packaging shapes can influence functional, texture, taste and flavour expectations.

For packaging windows (also called die cut or cut-out windows) it seems that their shapes often are curved to increase product attractiveness (expert interview III Beck, 2014). On the other hand packaging designers also decide for extraordinary partwise angular window shapes depending on the product (Eichenauer, 1994). The window on the packaging for a lamp by Philippe Starck for example is deliberately designed in such a way that it is linked to a maid's room of the 1950s (Eichenauer, 1994).

Despite the results by Bar & Neta (2006), Carbon (2010) and Zhang et al. (2006) that round forms are preferred in general, most packaging in supermarkets has an angular shape for practical reasons like space saving and hence a verifiable preference by retailers of consumer goods (Sonsino, 1990; Seeger, 2009)⁴⁵.

⁴⁴ See study 1, p.61ff.

⁴⁵ Therefore it seems feasible to focus on angular packaging within this research.

Boyette et al. (1996) add that even naturally round fruit will be put into angular boxes to ensure a smooth handling process with only a little loss of space.

Pepels (1998) confirms this and divides packaging shape into three relevant dimensions.

The practical dimension explains the omnipresence of angular shaped packaging since it is easier to use and transport. Though ergonomics could be a focus in this dimension as well and hence could possibly in some cases lead to more rounded packaging shapes.

The aesthetic dimension refers to the perceptual individual impressions caused by the packaging shape⁴⁶.

Finally the symbolic dimension allows communicating by the packaging shape. This goes in hand with a statement by Young (2012) that packaging shape or structure is often intuitively associated with product form, quality level or usage occasion. Similarly Linxweiler (1998) agrees that certain packaging shapes are stereotypes that are learned permanently, so that consumers have internal resistances to associate or accept unfamiliar content⁴⁷.

2.5 Food

In this chapter information concerning food will be presented which have relevance in the research context of this thesis and thus will significantly be considered for the research hypotheses. It will utilise the concepts of the previous chapters to gain specific insights.

2.5.1 Definition of Food

A definition of food seems unnecessary. Still a brief overview of definitions by EU and FDA shall be given to ensure a precise and complete scientific approach. In 2002 the EU (European Parliament, 2002) defined food as *'any substance or product, whether processed, partially processed or unprocessed, intended to be, or reasonably expected to be ingested by humans. "Food" includes drink, chewing gum and any substance, including water, intentionally incorporated into the food during its manufacture, preparation or treatment. It includes water after the point of compliance'*.

The FDA (FDA, 2009) followed with a very similar definition of food as *'a raw, cooked, or processed edible substance, ice, beverage, or ingredient used or intended for use or for sale in whole or in part for human consumption, or chewing gum.'*

⁴⁶ See chapter 2.4.2 Shape Ramifications and Connotations, p.37.

⁴⁷ Also see chapter 2.2.4 Use of optical Factors in general Packaging, p.17.

Further in the same document as above the EU defined substances that are not food: '*feed*', '*live animals unless (...) prepared for (...) human consumption*', '*plants prior to harvesting*', '*medicinal products*', '*cosmetics*', '*tobacco and tobacco products*', '*narcotic or psychotropic substances*' and '*residues and contaminants*'.

In context of this thesis the focus is set on food, which can be purchased in regular supermarkets. Such food is often standardized in terms of quality, size or storage life and even in its colour⁴⁸.

2.5.2 Peculiarities of Food Packaging

Since food often is a sensitive packaging content and moreover one that can directly affect the consumer's health there are certain regulations and requirements which differentiate food packaging from general packaging. These shall be described narrowly to give an idea about relevant aspects while designing a packaging that necessarily not only out of the marketing based view is optimal. Out of customer perspective Paine & Paine (1992) define that food packaging needs to ensure food conservation as far that the product stays sound and consuming it does not make the consumer ill. This is particularly true if packaged food is kept in a larder, refrigerator or freezer and also applies to different seasons, which also shall be no critical factor in keeping the food in good condition. Further, convenience food shall be eatable and preparable inside its packaging. Other factors mentioned by Paine & Paine (1992) such as fair price and not misleading packaging design refer to general packaging as well⁴⁹.

In accordance to the above the FDA and the EU define substances that must not be used for food packaging, specific transportation requirements based on food categories and further under which conditions -referring to temperature, aggregate state, preparation status (raw or processed) - the food product shall be packed (FDA, 2015; FDA, n.y.; European Parliament, 2004). Hence food packaging cannot only be designed with a focus on optical and financial but also on law and health aspects.

2.5.3 Use of Colour in Food Packaging

For some food categories (such as confectionery) certain colours have long been established (Eichenauer, 1994; Stewart, 2007). These are connected with certain food products so much that referring to it as 'psychological colouring' seems appropriate because the sensory

⁴⁸ See chapter 2.5.5 Influence of Colour on Food Perception, p.46.

⁴⁹ See chapter 2.2.5 Consumer Deception by Packaging Design, p.19.

perceptions of taste and colour are seen as a unit and hence form a crossmodal correspondence (Eichenauer, 1994). Similarly Piqueras-Fiszman et al. (2012c) observed two types of associations between packaging colour and flavour types: (a) learned packaging colour association for a specific brand or (b) a packaging colour association that is based on the main ingredients and hence on the colour connotations that fit to them. Well-established conventions on which colours fit to which product category in which culture and where determine the range of colours a packaging designer can choose from (Sacharow, 1970; Wheatley, 1973; Stewart, 2007). Additionally a brand or company may restrict the range of its colour palette to enforce a brand/company product unity (Ambrose & Harris, 2011).

In fact colour selection is one of the most relevant factors for food packaging (Deliza et al., 2003; Hine, 1995; Hutchings, 2003). Particularly when products are very similar as in the case of many food products, the colour and packaging have to differentiate the product from others (Knoedel, 1978) or to integrate it to the existing colour palette (Ambrose & Harris, 2011) depending on what strategy the company follows. Penne from Barilla for example are packaged in unique boxes with windows and a specific blue colour that is complementary to yellow and hence will increase the perceived saturation of the penne⁵⁰. Cheap penne without branding are often packaged very simply in yellow pastel-tones or white since this plain design can signal cheapness (Stewart, 2007; Ambrose & Harris, 2011). On the other hand the “me-too” effect describes the motivation of no-name brands to copy the colours of brand products with the aim of benefiting from the corresponding associations (Ambrose & Harris, 2011). To avoid such image theft many colours are registered as a utility patent or design patent (Knoedel, 1978).

The use of colours that are unusual for the product segment is accepted in the first place for cheap and short-lived food as well as products without personal relation (Seeger, 2009).

But the absence of colour can also indicate dietary products (e.g. Diet Coke) or cheap items (Stewart, 2007). Further cheap food products are often packaged white with only one added colour to show a reduction of costs for the packaging. In fact the cost difference is mostly negligible (Stewart, 2007). Though for high standard package design a minimal use of colour can also appear exclusive (Stewart, 2007; Seeger, 2009).

Once the company has fixed the colouring for a product even minimal changes of the packaging colour for a food product can result in dramatic emotional reactions of consumers (Piqueras-Fiszman & Spence, 2011). This may be particularly true for food products where a

⁵⁰ See definition of simultaneous contrast, p.24.

lifelong loyalty between customer and product can evolve easily due to a frequent contact.

2.5.4 Use of Transparency in Food Packaging

Referring to a statement of Deng and Srinivasan (2013) there are barely studies existent concerning transparent packaging and food marketing besides theirs, though at least some additional information with relevance for this thesis seem important. Several authors believe that the visibility of food can initialize consumption (Tuomisto et al., 1998; Wang et al., 2004, Wansink 2004). This at least to some extent can be assured by transparent food packaging which simultaneously is usable as a trust-building tool to ensure the customer that he actually is buying a specific product of specific quality (Raymond et al., 2008; expert interview V Zack, 2014). Approvingly Beck (expert interview III, 2014) notes that food packaging windows are mainly used for rating the product and refers to cheese where customers even strongly expect a window to count its holes and to estimate their sizes. This rating possibility apparently is an essential marketing tool when processing techniques for preservation are as yet not well established (expert interview VI Mukhedkar, 2014) but also when the transparency is usable to encourage the impression of a "natural" product (expert interview V Zack, 2014). In particular Mukhedkar (expert interview VI, 2014) reports, that in India even plain products like rice, wheat, salt and sugar are sold in transparent packaging while due to improving technology and hence increased product safety (nitrogen filled polypacks or vacuum sealed packs) these are now being replaced by opaque packaging. Additionally, concerning the expectance on transparently packaged products, Lange et al. (1999, 2000) showed that in case of orange juice it will be higher when using a transparent than when using an opaque packaging. This behaviour could be of relevance if it appears in combination with a halo effect, that triggers customers to believe their first positive impression was right and hence changes their actual product perception in that direction⁵¹. Accordingly all relevant participants of an international survey by the author of this thesis make use of transparent windows on some of their food packaging designs (expert interviews I-VII, 2014). Schmitt, Zack, and Jutharath (expert interviews I, II, V, 2014) state that generally for fresh products as much insight as possible is required to achieve best sales. Based on their experience Schmitt, Zack and Bentley (expert interviews I, IV, V, 2014) further agree that e.g. fresh meat must be packaged with transparent material so that window sizes often are about 2/3 of the surface area while only 1/3 is reserved for branding.

⁵¹ See chapter 2.1.3 Crossmodal Correspondence related Theories, p.10f.

This can even further strengthen the perception of freshness (expert interview V Zack, 2014). Similarly Sonsino (1990) notes that a product aiming for emphasising freshness and flavour necessarily needs to be visible to encourage purchases.

In 2012 Argo and White showed that people low in appearance self-esteem will buy and eat more snacks if they are sold in small transparent packages. Deng and Srinivasan (2013) examined potato chips, cookies, crackers and nuts since they were among the top ten most sold food products in the US and stood for about \$25.7 billion in sales in 2011. They found that 40% of all consumer packaging in these categories was fully transparent or partially transparent, whereas nuts were most often sold in transparent packaging (77%) and potato chips rarest (20%). This discrepancy can be explained by the fact that some food products are not sightly enough to be packaged transparently while others are simply too sensitive (expert interviews IV Bentley, VI Mukhedkar, VII Kioroglou, 2014).

For example light exposure, the forming of crumbs, temperature changes and breakage of the product, which is sometimes caused by the customer, but also the destruction of the window through the food product itself can be major problems in that context which besides technical limitations need to be considered (expert interviews I-VII, 2014). Kioroglou (expert interview VII, 2014) gives the example of a product containing chocolate that melted and hence impurified the transparent window, which made that product unsaleable⁵².



Fig. 11: D: Example of the inappropriate Use of Windows on Food Packaging (1)

Source: author's photography



Fig. 12: D: Example of the inappropriate Use of Windows on Food Packaging (2)

Source: author's photography

⁵² Most of the aforementioned negative aspects are apparently no issue for uncooked penne pasta.

Deng & Srinivasan (2013) also showed that transparent packaging, irrespective of whether fully transparent or partially transparent (windows), can enhance food salience, which often increases consumption but also consumption monitoring that often decreases consumption. They prove that for small visually attractive food the monitoring effect is low and the so-called salience effect, which creates attention, dominates so that consumption is increased. In their study people consumed 69% more of the small attractive food from a transparent package than from an opaque. Correspondingly Hershey's Kisses candies in clear jars are consumed more quickly than those in opaque jars (Wansink et al., 2006). Schmitt, Kioroglou and Jutharath (expert interviews I, II, VII, 2014) agree that partially transparent packages perform above average for some food products.

On the other hand Deng and Srinivasan (2013) show that for small visually plain food the salience effect has no impact since the product is not significantly attractive but the monitoring hence also has no relevance. Further for large attractive food the monitoring effect is high which leads to decreasing consumption. On the other hand for large plain, often healthy food a high salience effect has been documented which dominates but also decreases consumption (Deng & Srinivasan 2013). Therefore Deng and Srinivasan (2013) suggest to only sell small food in transparent packages and large food in opaque to increase postpurchase consumption. Following that, this thesis focuses on small visually plain food, in this case penne pasta as a food stimulus. These in practice are often packaged in small packages, which also usually are transparent or have a transparent window.

2.5.4 Use of Shapes in Food Packaging

Most food products that require packaging are sold and handled in angular and as such in cuboid packaging (Sonsino, 1990; Seeger, 2009, Boyette et al., 1996). Though in some cases for example when the packaging shape is relevant for the brand image and brand awareness this principle is abandoned in favour of unique packaging designs as in the case of triangular Toblerone chocolate packaging (Brucker et al., 2005). Some food products thus have different aims on how to generate brand awareness and as such focus on specific colours (Milka) while using generic packaging shapes or focus on specific shapes (Toblerone) to reach high recognition value (Brucker et al., 2005; Knoedel, 1978). Accordingly most experts (expert interviews II, III, V-VII, 2014) believe that the window shape on food packaging can attract attention and thus increase sales⁵³.

⁵³ This could validate the different window shapes used for food packaging. See Fig.13-16, p.45.



Fig. 13: USA: Window Shapes on Packaging Target Supermarkets Archer Product Line
Source: De-oh.com



Fig. 14: GB: Window Shapes on Packaging Dorset Cereals
Source: Davidbirdphotography.co.uk



Fig. 15: CH: Window Shapes on Packaging Migros Sélection Product Line
Source: Thedieline.com



Fig. 16: F: Window Shapes on Packaging Carrefour Penne Rigate
Source: Shoptimize.fr

On the other hand Schmitt and Bentley (expert interviews I, IV, 2014) do not believe in the importance of the window shape on food packaging. Still all experts agree that the packaging design and hence graphics, logos and other elements are and should be the determining factor for window shapes on food packaging (expert interviews I-VII, 2014).

In this context it has been documented that a broad range of different shapes is used within food packaging design for the packaging itself but also for graphics and logos (Nancarrow et al., 1998). In fact one of the main packaging attributes to influence food product choice e.g. besides colour are the shapes used (Silayoi & Speece, 2007). Often elongated packaging shapes are perceived to contain a larger amount of the food even if the customer had different experiences in the past (Raghubir and Krishna, 1999; Silayoi & Speece, 2007). As a result this proportional principle is widely used for food packaging such as once again certain snacks or chocolate bars but also spices or others, which are sold in elongated packaging although several other shapes would be usable. For this kind of packaging the shape often

conveys a better value for money but also a higher quality of the product (Silayoi et al., 2003; Silayoi and Speece, 2004). Silayoi & Speece (2007) showed that the packaging shape of food products in fact can have an influence of up to 19% on the purchase likelihood.

Interestingly and contrary to the results by Bar & Neta (2006) and others concerning a general preference for round shapes, Silayoi & Speece (2007) showed that angular shapes of food packaging have a higher and more positive effect on the rating of product characteristics than round. The result is in line with those by Becker et al. (2011) and Ngo et al. (2011) who also showed more positive effects for angular than for round shapes in food context. Silayoi & Speece (2007) explain the phenomenon by the high familiarity with angular shapes and thus the frequent use of angularity in food packaging.

2.5.5 Influence of Colour on Food Perception

As this research will seemingly change the colour of the test product by making use of coloured windows, an insight to the possible effects of food colours and surrounding colour on food perception shall be given. Some of the following can be identified as crossmodal correspondences.

Food Perception based on Food Colour

It is self-evident that different foods have different colours. Still food colour in general significantly influences the gazing behaviour and the purchase intention for food products as Jantathai et al. (2013) showed making use of eye tracking. For fruit and vegetables Lee et al. (2013) showed that the preferred colour is always more highly saturated than naturally expected which is confirmed for other foods and beverages as well (Ambrose & Harris, 2011; Spence et al., 2010; Clydesdale et al., 1992; Johnson & Clydesdale, 1982).

This effect is sometimes used at meat counters by illuminating the products with red light and hence increasing purchase intentions (Kobbert, 2011). The outcome is comparable to that of a coloured transparent packaging since the product inside such a packaging seems to have another (possibly more saturated) colour before it is bought and finally prepared⁵⁴. Imram (1999) agrees that products may be perceived differently in supermarket shelves than on a plate at home.

Since many fruits have the highest saturated colour when ripened and lose it when decomposing, this circumstance provides a possible reason for the general preference in

⁵⁴ If a yellow foil is put in front of yellow penne which are lower saturated they are also seemingly higher saturated.

highly saturated foods (Lee et al., 2013). In this context as many fruits also change their hue from green to red while ripening for those a red hue is preferred (Willson & Whelan, 1990) which several studies also prove to be associated with sweetness (Küthe & Küthe, 2002; O'Mahony, 1983; Clydesdale et al., 1992).

Other colours are contrarily often associated with sourness (green, yellow), tartness (green), bitterness (brown, green), refreshment (blue) and salinity (white), which seems to be explainable by similar connotations with primal foods or beverages (fruit, vegetables, water, salt) and their consumability rating as well (Heller, 1994; Zellner & Durlach, 2003; Pangborn, 1960; Wei et al., 2012a; Zellner & Durlach, 2003; Guinard & Souchard, 1998).

In this, colour often can be interpreted as a quality indicator and in fact for many food products quality measuring by colour is reasonable and effective - but especially if it is conducted technically. In many cases proper information regarding e.g. ripeness (Rodríguez-Pulido et al., 2013) or carotenoid content (Francis, 1995) can be given by machines due to the food colour. Francis (1994) reported that for at least 57 different foods such colourimeters already have been established, some of which focus on tomatoes (Hunter & Yeatman, 1961) and citrus fruits (Hunter, 1967). Still the human perception is not always as reliable so that, as in the case of hamburger patties, the colour has been shown to be interpreted wrongly significantly (Trinkaus, 1995; Engelage, 2002).

But colour is not only a passive quality indicator. It can also influence the quality perception actively. Ambrose & Harris (2011) and Roth et al. (1988) showed that a less flavourful product due to its colour can be perceived as better tasting than one with stronger flavour. Lavin & Lawless (1998) showed that dark red beverages are rated sweeter than light red while light green beverages are rated sweeter than dark green beverages. This is consistent with the above example of ripening fruits as these often change their colour from dark green to light green to light red and finally to dark red. Garber et al. (2000) further showed that the perception of olfactory cues of food can also be influenced or outweighed by colour perception. Even more remarkably, it has been shown that based on the colour people expect and perceive different consistency for syrup (Britt, 1960) or butter (Rohm et al., 1997) or different wholemeal portion and healthiness of bread (Peterson, 1977). In fact it has to be asked which sensory attribute - taste or colour - is more important for the perception of a food product and its rating.

Morrot (2001) proved that the smell and taste both are less important for the identification of a wine as white wine and its rating by sommeliers than if it is coloured white or red.

In 1990 Engel, Blackwell, & Miniard dyed vanilla pudding brown so that it looked like chocolate pudding. Participants had to rate the chocolate flavour compared to a real chocolate pudding. Not only did none of the participants realise that he was eating vanilla pudding but also the vanilla pudding was rated as having the better chocolate taste. Similar tests by Hoegg & Alba (2007) and Wei et al. (2012a) showed that the same orange juice tastes better the more the yellow colour changes to orange and hence red.

Downham & Collins (2000), DuBose et al. (1980) and Zampini et al. (2007, 2008) confirm that the seen colour clearly indicates the flavour of the product. In line with this Delwiche (2004) concludes that the more a specific colour and a specific flavour are associated with each other, the more the colour will influence the flavour rating. Similarly yellow lemon solutions, green mint solutions and brown vanilla solutions were expected to be stronger tasting than the same solutions coloured differently (Zellner & Durlach, 2003) which also refers to the previously mentioned unity effect⁵⁵. Also Hall (1958) and DuBose et al. (1980) showed that people can identify flavours of food and drinks much more precisely if their colours match them. Going one step further Shankar et al. (2009) showed that brown M&Ms were perceived significantly more chocolatey than green M&Ms just because of their colour. Furthermore 37% of the participants in a study by DuBose et al. (1980) even perceived cherry juice as lemon juice since it was yellowish green. Accordingly Garber et al. (2000) showed that colour impression dominates over flavour information in form of taste but also labelling.

Another aspect of colours that Rolls et al. (1982) and Welsch & Liebmann (2003) showed is that they can actively enhance the appetite⁵⁶. Still if the mismatch of expected sensory attributes (colour) and actually perceived ones (flavour) is strong enough to realize it consciously then the chances the customer will like the product or even rebuy it diminish heavily (Ngo et al., 2013; Peterson & Ross, 1972; Pinson, 1986; Piqueras-Fiszman & Spence, 2012a; Schifferstein, 2001; Spence, 2012; Yeomans et al., 2008; Wei et al., 2012b). The resulting negative perception will remain for a long time after the consumption and is more lasting than a positive perception would be (Cardello, 1994; Deliza & MacFie, 1996; Deliza et al., 2003; Schifferstein, 2001; Yeomans et al., 2008). Possibly this behaviour is often caused by the instinct to avoid the risk of poisoning (Koza et al., 2005; Piqueras-Fiszman & Spence, 2012a; Wheatley, 1973). Affirmatively Hall (1958) showed that sorbet with an untypical colour in context to the flavour led to the worst, a white colour to a better

⁵⁵ See chapter 2.1.3 Crossmodal Correspondence related Theories, p.10.

⁵⁶ See chapter 2.3.3 Colour Ramifications and Connotations, p.24.

and the expected colour to the best product rating. Also if the colour of a food is perceived as unacceptable, the flavour and texture are likely not to be judged at all (Francis, 1995).

Still some astounding practical examples like the recent successful introduction of black and white hamburgers in Japan by Burger King and McDonald's, but also the unsuccessful launching of clear Colas by Coca Cola and Pepsi in the early 1990s show that unacceptability is relative (Czienskowski, 2014; Rai, 2014; Francis, 1995; Cardello, 1993; Stanton et al., 1994).

The aforementioned shows clearly that colour can influence the expectation, the perception and hence the rating of foods and beverages. Hoegg and Alba (2007) showed that colour can even influence the perception of beverages more than branding or pricing.

Hence it becomes comprehensible why many food products are coloured artificially.

Still some further factors need to be considered besides the aim to increase colour saturation and to generate the ideal hue due to the product's ingredients and consumer expectations (Otterstätter, 1999; Lundahl, 2012). For instance colourants help to achieve a uniform look for products with varying quality or colour intensity (e.g. vegetables), to compensate colour loss during manufacturing processes (e.g. fruits) and to give products without predefined colour the ideal colour (e.g. margarine, candies, dessert products) (Otterstätter, 1999). Further, colourants help in reducing costs - as they are usually cheaper than flavourings (Francis, 1995) - and to disguise products of low quality (Downham & Collins, 2000). However, the use of colourants can also lead to new problems as the colourants need to be light resistant, edible, temperature stable and appropriate to the products' ingredients (chemical reactions) (Otterstätter, 1999). Also they need to have an appropriate shelf life (Otterstätter, 1999) and furthermore customers seem to evolve a tendency to reject obviously artificially coloured food (Francis, 1995).

Underpinning this, there is a discrepancy between the wish for highly saturated products with ideal hues and the tendency to increasingly prefer natural not artificially coloured products.

A solution to this dilemma could possibly be the use of coloured transparent packaging as will be tested in Chapter 5.

Food Perception based on surrounding Colour

Besides the food colour itself colours that to some extent relate to food products can also influence their perception.

Piqueras-Fiszman et al. (2012b) showed that flavour intensity, sweetness, quality and liking for strawberry mousse are rated significantly higher if served on white than if served on black

dishes⁵⁷. Tu et al. (2014) similarly showed that the more the packaging colour of candy was liked the sweeter it was perceived. But not only the perceived sweetness of foods or beverages can be enhanced, also the perceived sourness of beverages has been documented to be influenceable by adding only small percentages (15%) of yellow to overall green coloured 7-up soft drink cans (Hine, 1995). Deliza et al. (2003) showed that even the refreshing intensity of soft drinks can be enhanced by giving the packaging a white background colour. Finally Deliza & MacFie (2001) showed that referring to soft drinks consumers expected a higher level of juice sweetness for orange compared to white packaging and hence adjusted their taste ratings to that direction. Very interesting for this research are studies by Guéguen (2003) and Ross et al. (2008) that clearly indicate that transparent but coloured glasses (blue, red, green and yellow) can influence the perception of beverages being drunk out of them. Drinks were perceived as most thirst-quenching when served in blue glasses.

2.5.6 Influence of Shapes on Food Perception

Similar to the different effects that colours can have on food perception, different effects caused by shapes of surrounding materials have been documented that often can be identified as crossmodal correspondences. These are relevant for this research, as it will examine the influence of window shapes on the product perception. Since the food shape seems to have no relevance for this research because the used food stimulus penne pasta is perceived neutral (Adams et al., 2014) the influences it can have on food perception will not be examined explicitly.

Several connections between specific shapes and specific tastes have been shown similar to those of colours and specific tastes. In 2013 Ngo et al. showed for example that sour tasting juices (i.e., passion fruit, lulo, and feijoa) will constantly be matched to angular shapes and high-pitched sounds like takete and kiki. Sweet juices on the other hand have been shown to be matched to round shapes, typefaces and lower-pitched words (Velasco et al., 2014; Ngo et al., 2013). Ngo et al. (2011) tested chocolate with different cocoa content and proved that the more bitter it was the more it was connected to angular shapes and vice versa. Similarly Spence & Gallace (2011) and Ngo et al. (2012) showed that carbonation of sparkling water in western cultures is associated with angular shapes and still water with round shapes. In addition to the aforementioned examples associations of angular shapes with cranberry

⁵⁷ See definition of simultaneous contrast, p.24.

juice, salt and vinegar crisps (potato chips), Maltesers chocolate and in general carbonation, bitterness, sourness, and crispness/crunchiness have been documented (Spence & Gallace, 2011; Cytowic & Wood, 1982; Harrison, 2001; Gallace et al., 2011b). In contrast associations of round shapes with Brie, Caramel Nibbles, non-carbonated, sweet, and creamy foods in general have been examined (Spence & Gallace, 2011; Spence et al., 2013b; Spence, 2012; Dichter, 1971).

Spence et al. (2013b) documented that the associations of different cheeses with specific shapes were based on their taste rather than on their smell or texture. This may accord with results by Deroy & Valentin (2011) who showed that different beers (Adelscott, 1664, and Bitburger) are reliably matched with different shapes out of a given a range of 34 different 2D and 3D shapes. Further, Gallace et al. (2011b) compared related and unrelated products to each other showing that salt and vinegar chips were associated more with angular shapes than cheddar cheese, yoghurt, or blueberry jam. Also they showed that chocolate with mint chips and crisps were perceived as more angular than standard chocolate. Though Bremner et al. (2013) have shown that such associations as stated above can be culturally learned as e.g. they cannot all be documented for the Namibian Himba population as well.

In addition to the aforementioned, an active influence of shapes on the food perception has been documented as well. Most of these studies show that the presence of angular shapes (packaging or graphics) can influence the perception of a product and hence e.g. its flavour intensity (Becker et al., 2011; Ngo et al., 2011). Gal et al. (2007) documented that by showing test persons angular shapes prior to serving them cheddar cheese they rated its taste as 7% "sharper" than if they had been shown round shapes. Becker et al. (2011) confirm this result by showing that associations for packaging shapes are influencing the taste perception of design sensitive people and as a result the evaluation and price expectation of a food product⁵⁸. The persons perceived angular yoghurt cups as more attractive and more expensive but also the yoghurt as more intense tasting. However the perception of strawberry mousse was not significantly affected by the shape of the dishes it was served on (Piqueras-Fiszman et al., 2012b). But for vessels, which often show a combination of angular and round shapes⁵⁹, it has been documented that their shape can influence the perceived refreshing intensity of a drink significantly (Spence & Wan, 2015).

⁵⁸ A similar test will be conducted within study 4.

⁵⁹ The bezel nearly always ends in a straight line and hence forms an angle with the bowl.

Taken together the above results indicate that while certain food perceptions are associatively connected to certain shapes they also can influence the food perception directly. Some authors therefore believe that packaging even in its smallest details needs to fit to these crossmodal correspondences. This is to achieve an ideal product perception that is agreeable with the likely qualities of a food product concerning taste, flavour, and/or other sensory attributes (Spence, 2012; Piqueras-Fiszman et al., 2012b).

3 Hypotheses and Conceptual Model

In the following chapter the research questions from chapter 1.2 will be considered to formulate corresponding hypotheses.

3.1 General Hypotheses

Q1. Does the shape of food packaging windows have an influence on product perceptions?

Q2. Does the colour of food packaging windows have an influence on product perceptions?

For opaque packaging it has been widely documented that the colours and shapes used can have significant crossmodal correspondence effects on the product perceptions (e.g. Linxweiler, 1998; Stewart, 2008; Spence, 2011). Keeping in mind that window colour and window shape could virtually merge with the product they cover, it seems natural to expect that the documented effects of colours and shapes on opaque packaging are again to be documented for food packaging windows. The results by Spence & Wan (2015) indicate that glass shapes have an influence on beverage perception so that for transparent windows on food packaging similar effects can be expected. Further results by Guéguen (2003) and Ross et al. (2008) which prove significant effects for differently coloured glasses indicate that differently coloured food packaging windows could have significant effects on the product perceptions.

In accordance with this Jutharath, Beck, Zack, Mukhedkar and Kioroglou (expert interviews II, III, V, VI, VII, 2014) state their belief in such effects. Prof. Dr. Spence (expert interview VIII, 2014), who has been working in the field of packaging design and crossmodal correspondences as well believes in possible influences on the product perception caused by the window shape and colour. Further distantly related studies show effects of coloured glasses on human behaviour (Döhnert & Engler, 2003). Thus the following hypotheses can be formulated.

H1. The window shape will have a significant influence on the product perceptions. H2.

The window colour will have a significant influence on the product perceptions.

3.2 Influence of the Window Shape on the Product Perception

Q1a. Will a perceived round in contrast to an angular window shape lead to different product perceptions?

Westerman et al. (2012) showed that for various types of packaging rounded shapes in general are preferred to angular ones and lead to better product perceptions. This result has been confirmed by most other studies (e.g. Bar & Neta, 2006). But to some extent different examinations have been made as well (Silayoi & Speece, 2007; Becker et al., 2011; Ngo et al., 2011). The latter also confirm different effects for different shapes but come to the conclusion that angular shapes can trigger stronger and/or more positive perceptions.

Fang & Mowen (2005) found out that the ideal shape for brand logos is not dependent on the shape itself but on the product it is connected to. In this considering a possible interaction of the window shape with the product attributes it has to be mentioned that the tested product (penne) will not favourably be matched to a specific shape as it is perceived neutral in shape (Adams et al., 2014). Having practical feedback Beck (expert interview III, 2014) agrees with Westerman et al. (2012) and Bar & Neta (2006) that food packaging window shapes shall never be stiff but curved and round to attract customers. It seems thus feasible to hypothesize the following.

H1a. A round as opposed to an angular window shape will lead to different product perceptions for food products with neutral shape.

H1all. A round as opposed to an angular window shape will lead to better product perceptions for food products with neutral shape.

Q1b. Will the window shape have an influence on the product perception after seeing and eating the unpackaged food product?

Q1c. Is the possible effect of the window shape on the product perception after seeing and eating the unpackaged food product identical with the effect before?

Gal et al. (2007) documented that the pure presence of a certain shape prior to eating a food product can influence its perception even if the stimulus is not related to it. As the window shape to some extent was related to the food product before seeing and eating it unpackaged, this effect could possibly be even stronger.

Supposing that the window shape is perceived consciously or subconsciously prior to eating the food product it is relevant to define the perceptual difference resulting from then seeing

the product without a shaped window in front of it. Depending on the strength of this discrepancy as documented by Koza et al. (2005), Piqueras-Fiszman & Spence (2012a), Wheatley (1973) and others a halo effect could occur or be impossible due to the extreme perceived difference. Thus if the impression prior to eating the product was subconsciously influenced by the window shape, the effect could even similarly continue until the moment when the “true” product becomes visible.

In contrast to the window colour the window shape does not change the visible shape of the penne while the window colour does change the visible colour. Hence even if the window shape influenced the product perception prior to eating the penne the consumers will not be able to consciously argue their belief that the penne had another shape. However, subconsciously the window shape might have affected their ratings of the product, which seems to strengthen the possibility that due to halo effects these manipulated perceptions stay even after seeing and eating the unpackaged food product. Hence the following can be stated.

H1b. The window shape will have an effect on the product perception after seeing and eating it unpackaged.

H1c. The window shape will have an effect on the product perception lasting from prior to after seeing and eating it unpackaged.

3.3 Influence of the Window Colour on the Product Perception

Q2a. Does the matching of expected food colour and window colour have relevance for the product perception?

To hypothesize the correct answer to this question it is certainly necessary to have a look at colour associations for the examined food products and to see whether a general antipathy for specific product colour combinations exists. Prof. Dr. Spence (expert interview VIII, 2014) in this context formulated the expectation that the effect of window colour might be depending on the fit with the product it is used for. Garber et al. (2008) agree that new colours for packaging are not successful just because they are new, but because they evoke a meaning that is fitting to the favourable product performance. Similarly Zack (expert interview V, 2014) refers to the ‘carrot bag trick’, which due to an orange opaque background colour of transparent packaging gives the impression that the packaging contains more carrots and that those are more orange and hence more appetizing.

Furthermore, it is documented that an increased saturation of food triggers appetite and taste perception (e.g. Lee et al., 2013). On the other hand for example Hall (1958) and Francis (1995) showed clearly that a mismatch of product colour and product expectations will lead to negative product perceptions. Thus most experts that the author of this thesis talked to agree that due to this risk food packaging windows should not be coloured at all (expert interviews I-III, V-VII, 2014). Bentley (expert interview IV, 2014) formulates this differently stating that windows in general should showcase the product at its best. In this respect an effective method of using the halo effect could be generated if the customer, due to the window colour which is appropriate to the product colour has a positive first impression, which might be kept even after confrontation with the pure product⁶⁰. Hence the following hypotheses can be formulated.

H2a1. If the window colour is contradictory to the expected product colour it will be less accepted than other window colours.

H2a11. A window colour that virtually increases the product colour saturation will be preferred against others.

Q2b. Will a perceived round in contrast to an angular window colour lead to different product perceptions?

Similarly to the statements for perceived round window shapes, perceived round window colours could lead to more positive product perceptions. In this for colours it is necessary to first analyse which ones are actually perceived as being round in context to transparent food packaging windows since the existing research in that context is not yet extensive. Though the possible outcomes referring to H2a. need to be kept in mind, if for example perceived round window colours are in contrast to the out of consumer perspective acceptable window colours. Again it has to be mentioned that penne are perceived as neutral in shape so that no unity perception with any angular or round window colours is possible (Adams et al., 2014)⁶¹. Agreeably with the hypothesis for window shapes it seems feasible to assume that perceived round window colours will be preferred against angular window colours as it has been the case for factual shapes like graphics or packaging surfaces. Hence the following hypothesis can be formulated if a round window colour is not in contrast to the perceived acceptable window colours for the food product.

⁶⁰ See Q2c further below.

⁶¹ A possible unity perception with the window shape will be examined in chapter 3.4 Influence of Window Shape and Colour on the Product Perception, p.57.

H2bl. A round as opposed to an angular window colour will lead to different product perceptions for food products with neutral shape.

H2blI. A round as opposed to an angular window colour will lead to better product perceptions for food products with neutral shape.

Q2c. Will the window colour have an influence on the product perception after seeing and eating the unpackaged food product?

Q2d. Is the possible effect of the window colour on the product perception after seeing and eating the unpackaged food identical with the effect before?

In many cases it has been documented that crossmodal correspondences can occur even if a colour stimulus is not directly related to the food products' attributes (e.g. Shankar et al., 2009). Thus if the window colour is perceivable consciously or subconsciously prior to seeing and eating the unpackaged food product it can be expected that it has an influence on the product perception afterwards. As stated in Q1b and Q1c it is relevant to define the strength of the perceptual difference resulting from then seeing the product without a coloured window in front of it to again hypothesize whether changes in the product perception are to be expected or not. If the difference is strong enough to be perceived consciously it could be that after seeing and eating the unpackaged food product its ratings decrease or increase significantly depending on the direction of the new impression because halo effects are unlikely. This might be the case as consciously expected product colour and factual product colour could differ due to the use of coloured windows and will be stronger the more product colour and window colour distinguish themselves. Hence the following hypotheses can be formulated.

H2c. The window colour will have an effect on the product perception after seeing and eating it unpackaged.

H2d. The window colour will have an effect on the product perception that changes from prior to after seeing and eating it unpackaged.

3.4 Influence of Window Shape and Colour on the Product Perception

Q3a. Is the unity theory also feasible for a combination of perceived same shaped window colour and window shape?

Several studies prove that if two different sensual stimuli convey the same associations there will be a mutual reinforcement with clearer associations.

Amongst others this principle called unity theory has been documented for shape and colour of brand logos (Seeger, 2009). The theory is determined by the fact that an impression of one attribute is confirmed by another one, which increases the belief that this impression of both might also be relevant for further aspects of the product.

Hence if a certain window shape is combined with a window colour that is perceived as similar in shape the overall perception of the packaging or product might be more clearly defined. However it could be that one effect is perceived so much more strongly than the other one that the effect resulting from the fact that both convey the same associations vanishes due to the omnipresence of the stronger factor and hence reduced relevance of the other. Focusing on the perceived shape of both window shape and window colour it seems natural to expect such a difference for both. Thus the following hypothesis seems feasible.

H3a. Depending on the impact strength of both factors shape–colour congruency (an angular shape combined with an angular window colour or a round shape combined with a round window colour) will lead to a more positive overall product perception compared to shape–colour incongruence.

Q3b. Which factor has a stronger impact on the product perception - window shape or window colour?

In difference to the previous hypothesis where the focus is set on a perceived shape congruency, it is interesting to examine independently of any congruencies which factor has a stronger impact on the product perceptions. Thus it is asked which factor is more relevant to the consumer. For brand logos colour has been shown to have a dominant influence on the connotations associated with the logo shape (Seeger, 2009). Accordingly Prof. Dr. Spence (expert interview VIII, 2014) stresses that the window shape might fall into background concerning an influence on the product perception.

On the other hand Linxweiler (1998) states that colours can influence the effect of brand images as strongly as their shapes. And again, contrastingly, the packaging designer

Jutharath (expert interview II, 2014) believes that the window shape has a strong impact while the window colour does not. Though keeping in mind the ramifications that colours can cause and the high importance of colours for food packaging and especially the food itself it seems feasible to follow the statements by Seeger (2009) and Prof. Dr. Spence (expert interview VIII, 2014). Thus the following hypothesis is formulated.

H3b. The influence of window colours on the product perception will be stronger than the influence that window shapes have on the product perception.

3.5 Conceptual Model

To simplify the overall understanding of the above hypotheses a conceptual model has been constructed. It describes the way in which window colour, window shape and the interaction of both are influencing the product perception before and after testing the product. For each factor, a relevance to the contextualized aspect needs to be evaluated consciously or subconsciously. In this a non-perception of a factor is interpreted to be identical with the rating of it as being not relevant. Thus only relevant factors will have an influence on the researched product perceptions.

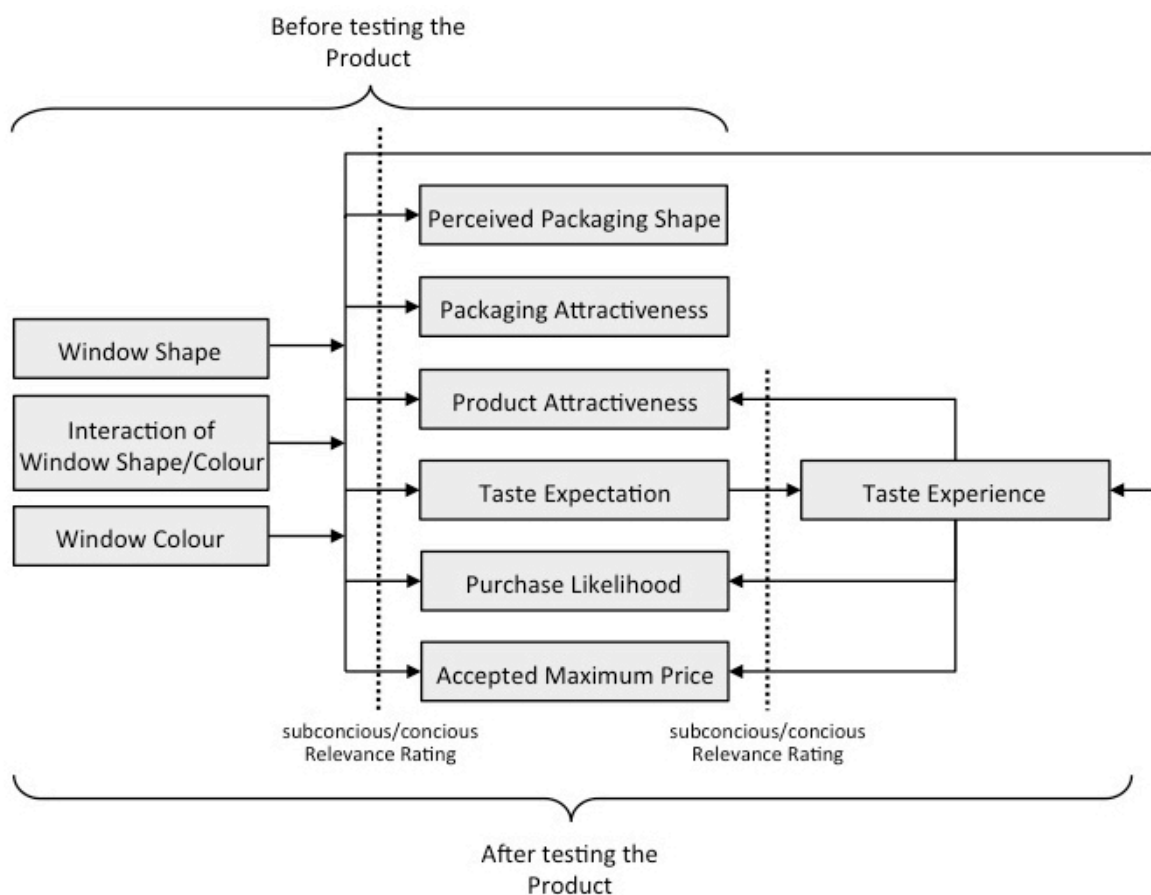


Fig. 17: Conceptual Model – Influencing the Consumer by Window Shape and Colour

Source: author's illustration

4 Practical Studies

In the following chapter the conducted practical studies will be presented. Because of the high number of separate analyses each study includes its own abstract of the analyses as well as its own table of contents to simplify the navigation through the document.

4.1 Study 1 (Pretest)

4.1.1 Aim of the Study

A pretest was conducted with the aim of finding two window shapes that are perceived to differ similarly strongly from neutral in perceived angularity/roundness but in opposite directions and as strongly as possible. Further, these pairings had to be similar in their surface proportions and identical in their surface size. Finally if possible the perceived usability, preference and estimated usage possibility for food packaging should be similar to ensure that results in later studies are only caused by the difference in perceived angularity/roundness but not other shape specific factors.

4.1.2 Set up of the Study

Participants

30 students of University Hasselt (mean age 21,0667; SD = 2,95872; ranging from 17 to 28 years; 15 women and 15 men) participated in the test. The participants took part in this study by volunteering and did so for study 2 as well. None of them participated in study 3 or study 4. All participants reported normal or corrected-to-normal vision and to have no defective colour vision.

Materials

8 white boxes (12cmx12cmx6.5cm) were used which had windows in different shapes but of same surface area. 4 pairings were calculated with two shapes having similar proportions⁶². The tested shapes were rhombus, square, triangle, rectangle, circle, ellipse, superellipse and reuleaux. Since the window placement on a packaging has relevance e.g. due to crumbs and disintegration (expert interviews IV Bentley & VII Kioroglou, 2014) the windows were placed in the middle of the boxes. The window foil was clear and had a TIV of 95%⁶³ (Clear95). It was in this close to common food packaging windows.

⁶² See Appendix B. Shape Calculations for Study 1, p.165.

⁶³ See Fig.18, p.62.

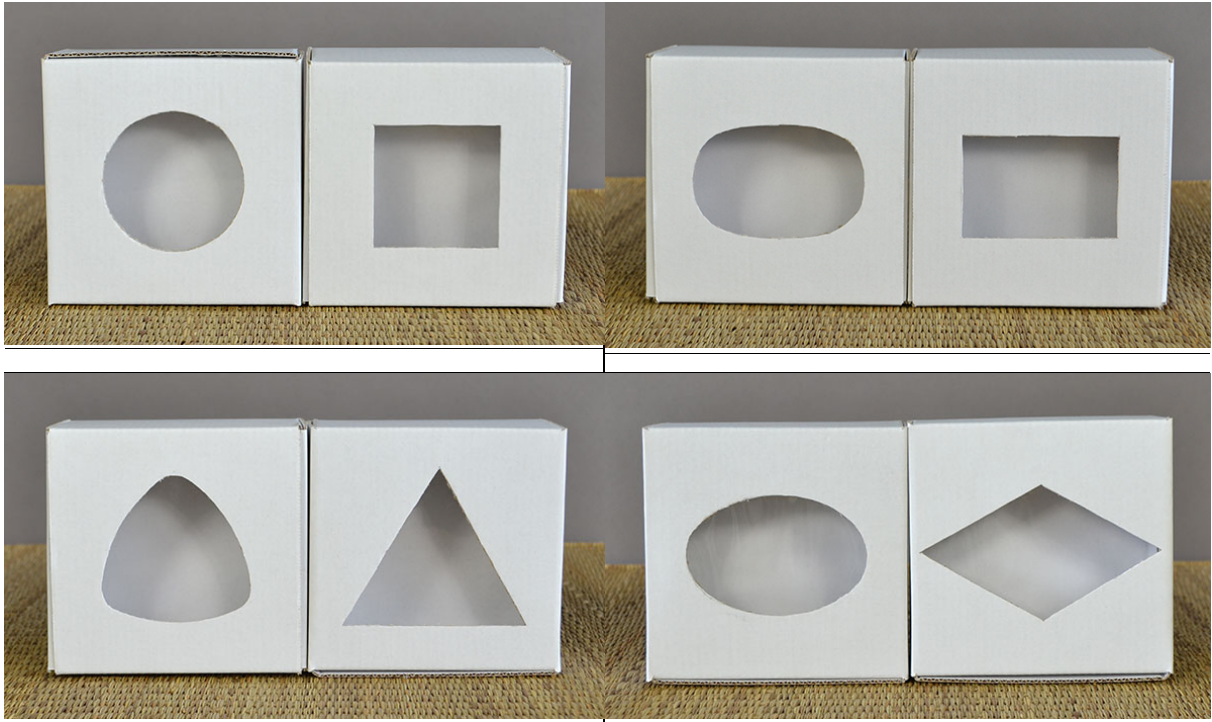


Fig. 18: *Window Shapes tested within Study 1*

Source: author's photography

Procedure

The participants were seated at a table in an artificially illuminated testing room equidistant from the light overhead but, to avoid reflection, not directly under it. Written instructions were given to the participants before the test. The participants had to rate each window on five Visual Analogue Scales (VAS) of 9 cm length. Four scales had two opposing words on each side of which one was high-pitched and the other one low-pitched (Lula/Ruki; Maluma/Takete; Decter/Bobolo; Kiki/Bouba). The fifth scale had one rounded shape as opposed to an angular shape on each side. Then the participants were requested to judge for each window if the window shape is generally usable for food packaging and to estimate a usage possibility in %. Finally the test persons were asked to decide which round shape and which angular shape they would prefer for food packaging. The test was conducted in English and lasted for about 8 minutes. All boxes were shown in random order. The tables' surface that the boxes were evaluated on was white.

Data analysis

For all scales the distance from midpoint to the marks by the participants were measured with millimetre accuracy. If the distance of the mark to high-pitched words or the angular shape was smallest the difference from the midpoint to this mark was noted with a minus in front and with a plus if the difference was lower towards the round shape or the low-pitched word. If the mark was identical with the midpoint a 0 was noted. Yes and no answers for the usability ratings were transformed into 1 (=yes) and 0 (=no), ranking positions were transformed into corresponding numbers and given usage possibility estimations were transferred into the Software as they were.

A list containing the replies of each person was the basis for the statistical analysis, which was performed using SPSS version 21 for Macintosh (IBM Corporation, Armonk, USA).

4.1.3 Abstract of the Analyses & Conclusion

As the main objective was to find two window shapes that are perceived to differ similarly strongly from neutral in perceived angularity/roundness but in opposite directions and as strong as possible this task was best fulfilled by the pairing triangle/reauleaux. The high discrepancy in perceived shape for the pairings square/circle and rectangle/superellipse excluded them for the further studies while rhombus/ellipse also had a very low discrepancy. The absolute value of the paired distances to a theoretical neutral shape were comparably high for rhombus/ellipse and triangle/reauleaux. The number of preferences for the shapes was significantly different for triangle/reauleaux and nearly significantly different for rhombus/ellipse. Since the usability rating as well as the estimated usage possibility were significantly different for rhombus/ellipse but not for triangle/reauleaux the latter will be used for the further studies to exclude most possible factors that could influence the ratings.

Result	S1(rhombus)/ S7(ellipse)	S2(square)/ S5(circle)	S3(triangle)/ S6(reauleaux)	S4(rectangle)/ S8(superellipse)
Absolute distance to neutral shape	$ -11,38 + 11,64 = 23,02$	$ -8,71 + 14,28 = 22,99$	$ -11,36 + 11,27 = 22,63$	$ -7,11 + 10,18 = 17,29$
Similar distance to neutral shape	Discrepancy = 0,26	Discrepancy = 5,57	Discrepancy = 0,09	Discrepancy = 3,07
Preference frequency	(Nearly significant difference, $p=0,58$)	No significant difference	Significant difference	Significant difference
Usability rating (yes/no)	Significant difference	No significant difference	No significant difference	Significant difference
Estimated usage possibility in %	Significant difference	No significant difference	No significant difference	Significant difference

Tab. 4: Comparison of the Results for all Window Shapes

4.1.4 Detailed Analyses - Table of Content

Analysis of the perceived Shapes	64
Analysis of the Preference Rankings.....	65
Analysis of the Usability Ratings	67
Analysis of the Estimated Usage Possibilities	68

4.1.5 Analysis of the perceived Shapes

Since all shapes have been rated by the same persons paired samples t-tests were required to examine significant differences between all relevant combinations of shapes. Here it needs to be mentioned again that only certain pairings were relevant for the studies as only those had comparable proportions⁶⁴. It turned out that in all relevant cases these pairings were perceived as significantly different in angularity/roundness as p always was 0,0.

⁶⁴ See chapter 2.4.2 Shape Ramifications and Connotations, p.37.

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	shape_1_rhombus - shape_7_ellipse	-23,01667	11,83481	2,16073	-27,43586	-18,59747	-10,652	29	,000
Pair 2	shape_2_square - shape_5_circle	-22,99667	9,77708	1,78504	-26,64749	-19,34584	-12,883	29	,000
Pair 3	shape_3_triangle - shape_6_reauleaux	-22,62667	10,52982	1,92247	-26,55857	-18,69477	-11,770	29	,000
Pair 4	shape_4_rectangle - shape_8_superellipse	-17,29333	9,93305	1,81352	-21,00239	-13,58427	-9,536	29	,000

Tab. 5: Perceived Shape – Paired Samples Test for all relevant Window Shape Pairings

Hence the appropriate mean values for each shape were relevant to define the significant differences between two shapes.

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
shape_1_rhombus	30	-21,60	12,10	-11,3767	8,29618
shape_2_square	30	-20,90	10,00	-8,7133	7,21472
shape_3_triangle	30	-22,20	-,80	-11,3567	5,43162
shape_4_rectangle	30	-20,50	4,40	-7,1100	6,70503
shape_5_circle	30	7,20	22,50	14,2833	4,47523
shape_6_reauleaux	30	-8,80	21,80	11,2700	7,18965
shape_7_ellipse	30	-5,00	21,50	11,6400	5,66846
shape_8_superellipse	30	-5,20	21,00	10,1833	6,55976
Valid N (listwise)	30				

Tab. 6: Perceived Shape - Descriptive Results for all Window Shapes

Conclusion

The differences of fitting pairs were as follows ('-' stands for angularity '+' for roundness):
 rhombus and ellipse $|-11,38| + 11,64 = 23,02$; discrepancy = 0,26;
 square and circle $|-8,71| + 14,28 = 22,99$; discrepancy = 5,57;
 triangle and reauleaux $|-11,36| + 11,27 = 22,63$; discrepancy = 0,09;
 rectangle and superellipse $|-7,11| + 10,18 = 17,29$; discrepancy = 3,07.

4.1.6 Analysis of the Preference Rankings

To compare if the frequencies of preferred shapes for general food packaging windows differ significantly, a Chi² test was conducted. This test assumes that the frequencies are equal. In both cases (round and angular) this null hypothesis was rejected, so that the frequencies of preferred window shapes differ for both round (p=0,030) and angular (p=0,002) shapes significantly.

Preference_comparison_round

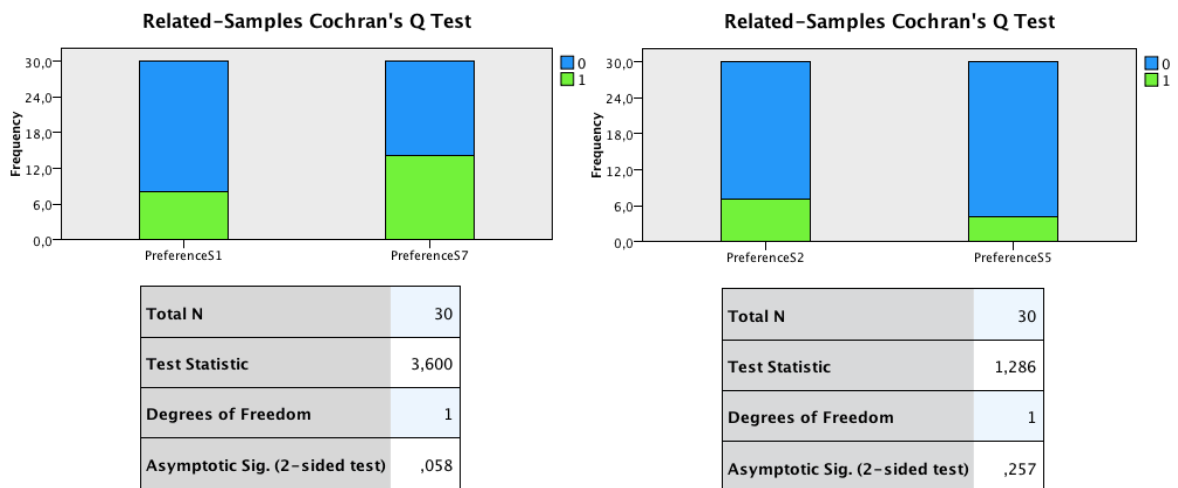
	Frequency	Percent	Valid Percent	Cumulative Percent
Valid 5,00	4	13,3	13,3	13,3
6,00	8	26,7	26,7	40,0
7,00	14	46,7	46,7	86,7
8,00	4	13,3	13,3	100,0
Total	30	100,0	100,0	

Preference_comparison_angular

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid 1,00	8	26,7	26,7	26,7
2,00	7	23,3	23,3	50,0
4,00	15	50,0	50,0	100,0
Total	30	100,0	100,0	

Tab. 7: Preferences - Descriptive Results for all Window Shapes

To test whether the relevant shape pairings differ significantly in their preference frequencies the data was transformed so that 1 was the value for a preference within round or angular shapes (1=is preferred) and 0 the value for no preference (0=not preferred). Thus if one shape was valued 1 all other shapes in that category (round or angular) were valued 0 but this did not affect the comparison category. To check whether the frequency of a positive rating (=is preferred) differs for the relevant window shape pairings Cochran's Q Tests were conducted. The tested null hypothesis is that for different window shapes the frequency of preference (=1) and no preference (=0) is identical.



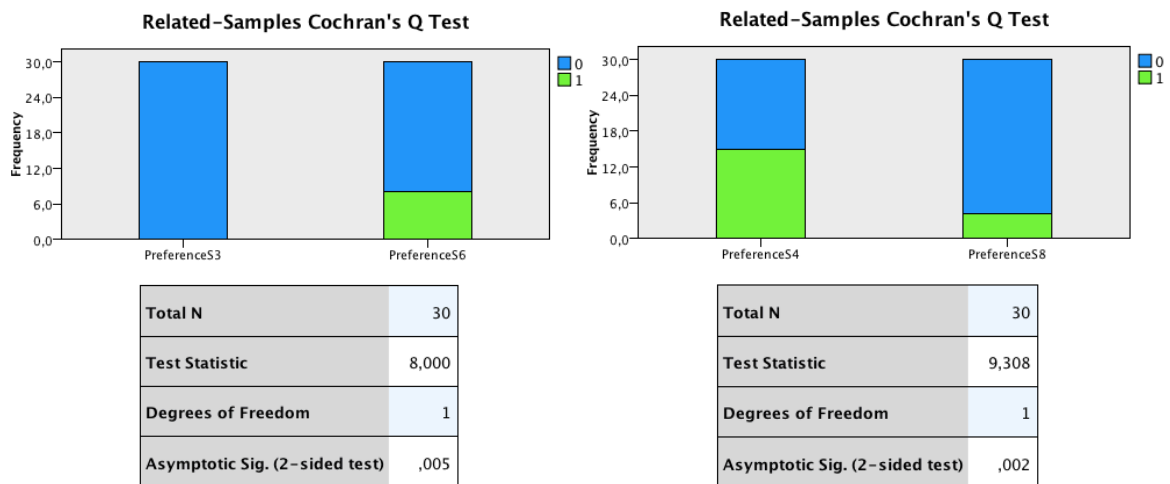


Fig. 19: Preferences – Cochran's Q Test for all relevant Window Shape Pairings

Conclusion

For the pairings S3(triangle)/S6(realeaux) ($p=0,005$; 2-sided) and S4(rectangle)/S8(superellipse) ($p=0,02$; 2-sided) the null hypothesis was rejected so that the frequencies of preferences differ for these window shapes. For the pairings S1(rhombus)/S7(ellipse) ($p=0,058$; 2-sided) and S2(square)/S5(circle) ($p=0,257$; 2-sided) there was no significant difference. Though S1(rhombus)/S7(ellipse) were nearly significantly different.

4.1.7 Analysis of the Usability Ratings

To check whether the frequency of a positive usability rating (=yes) differs for the relevant window shape pairings Cochran's Q Tests were conducted. The tested null hypothesis is that for different window shapes the frequency of yes (=1) and no (=0) is identical.

For the pairings S1(rhombus)/S7(ellipse) ($p=0,02$; 2-sided) and S4(rectangle)/S8(superellipse) ($p=0,021$; 2-sided) the null hypothesis was rejected so that the frequencies of a positive usability rating differ for these window shapes.

For the pairings S2(square)/S5(circle) ($p=0,414$; 2-sided) and S3(triangle)/S6(realeaux) ($p=0,109$; 2-sided) there was no significant difference.

Conclusion

The ellipse was significantly more often rated as usable than the rhombus, and the rectangle was significantly more often rated as usable than the superellipse. For square and circle as well as triangle and realeaux there was no significant difference.

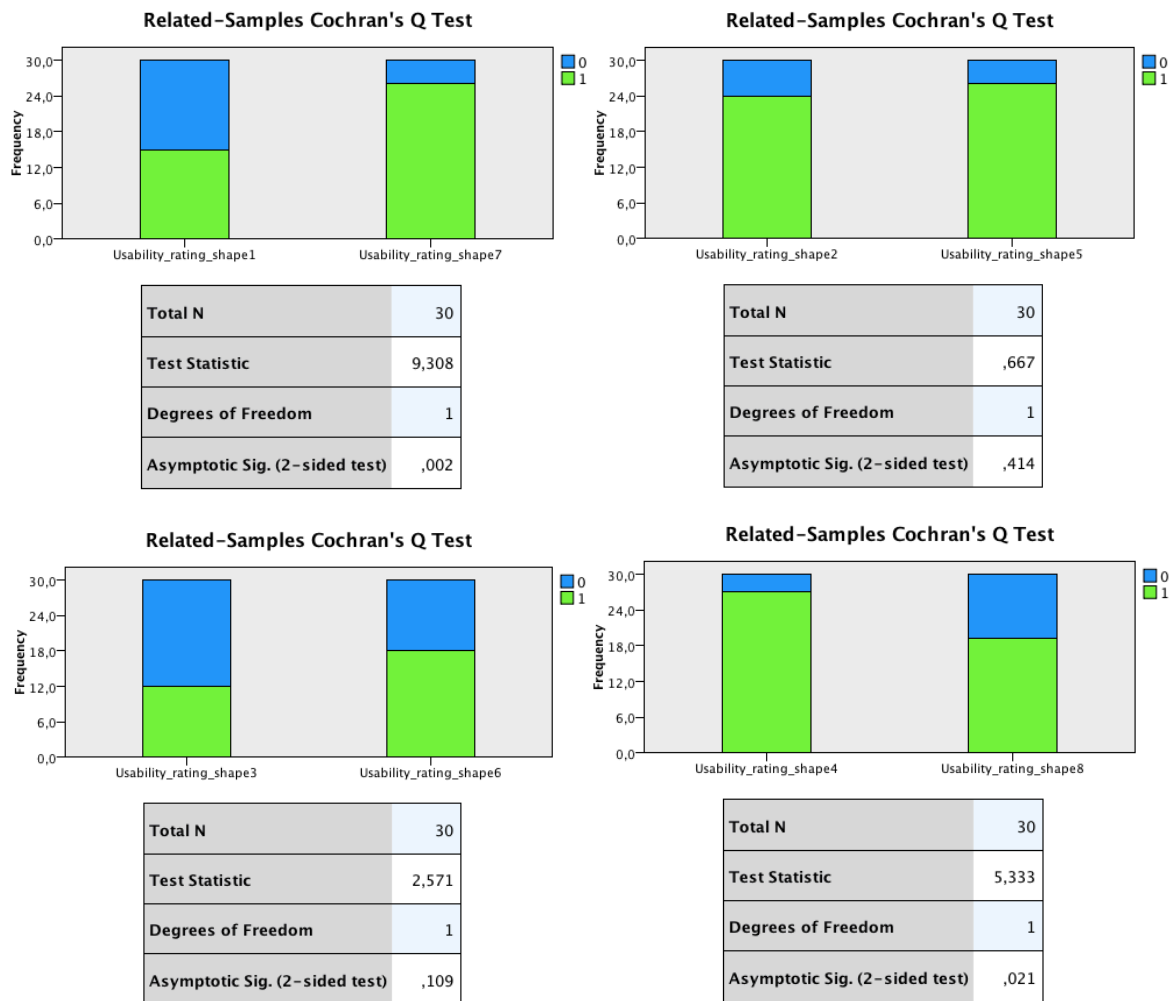


Fig. 20: Usability Rating – Cochran's Q Test for all relevant Window Shape Pairings

4.1.8 Analysis of the estimated Usage Possibilities

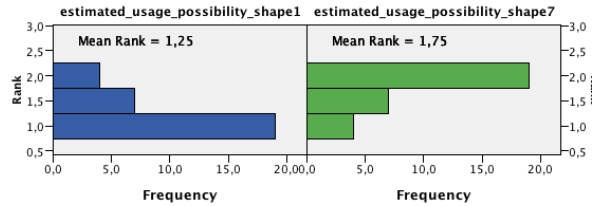
To analyse whether the estimated usage possibilities in percentage for the relevant shape pairings are different a Friedman Test was conducted. This test puts the given percentages in order. Higher percentages are hence of a higher rank.

The Friedman Test resulted in significant differences within the pairings S1(rhombus)/S7(ellipse) ($p=0,002$; 2-sided) and S4(rectangle)/S8(superellipse) ($p=0,034$; 2-sided). No significant differences were examined for S2(square)/S5(circle) ($p=0,239$; 2-sided) and S3(triangle)/S6(reuleaux) ($p=0,414$; 2-sided).

Conclusion

The ellipse was significantly more often estimated to have a high usage possibility than the rhombus, and the rectangle was significantly more often estimated to have a high usage possibility than the superellipse. For square and circle as well as triangle and reuleaux there was no significant difference.

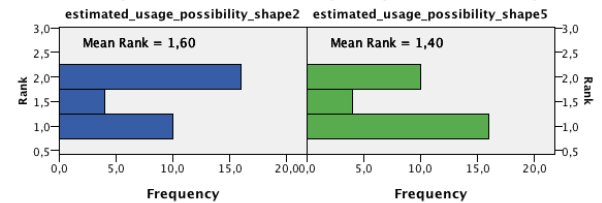
Related-Samples Friedman's Two-Way Analysis of Variance by Ranks



Total N	30
Test Statistic	9,783
Degrees of Freedom	1
Asymptotic Sig. (2-sided test)	,002

1. Multiple comparisons are not performed because there are less than three test fields.

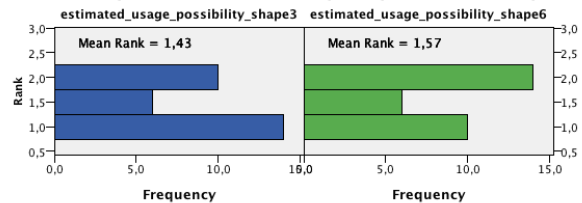
Related-Samples Friedman's Two-Way Analysis of Variance by Ranks



Total N	30
Test Statistic	1,385
Degrees of Freedom	1
Asymptotic Sig. (2-sided test)	,239

1. Multiple comparisons are not performed because the overall test retained the null hypothesis of no differences.

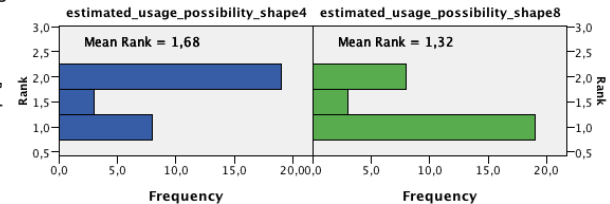
Related-Samples Friedman's Two-Way Analysis of Variance by Ranks



Total N	30
Test Statistic	,667
Degrees of Freedom	1
Asymptotic Sig. (2-sided test)	,414

1. Multiple comparisons are not performed because the overall test retained the null hypothesis of no differences.

Related-Samples Friedman's Two-Way Analysis of Variance by Ranks



Total N	30
Test Statistic	4,481
Degrees of Freedom	1
Asymptotic Sig. (2-sided test)	,034

1. Multiple comparisons are not performed because there are less than three test fields.

Fig. 21: Estimated Usage Possibility – Friedman Test for relevant Window Shape Pairings

4.2 Study 2 (Pretest)

4.2.1 Aim of the Study

A pretest was conducted with the aim to find two coloured transparent foils that are perceived to differ similarly strongly from neutral in perceived angularity/roundness but in opposite directions and as strongly as possible. Further these pairings had to be similar in their TIV to ensure the later results were not influenced by their differences in this respect. Finally if possible the perceived usability, preference and estimated usage possibility for food packaging should be similar to ensure that results in later studies are only caused by the difference in perceived angularity/roundness but not by general preferences for a specific colour. In this it also aimed to find out if the TIV has a general effect on these factors.

4.2.2 Set up of the Study

Participants

30 students of University Hasselt (mean age 21,0667; SD = 2,95872; ranging from 17 to 28 years; 15 women and 15 men) participated in the test. The participants took part in this study by volunteering and did so for study 1 as well. None of them participated in study 3 or study 4. All participants reported normal or corrected-to-normal vision and to have no defective colour vision.

Materials

8 colour effect lighting filters by Lee filters Worldwide have been chosen for the test.

Since red and blue have been shown to differ in their associated shapes⁶⁵ these two colours were chosen for the experiment. Each foil had a size of 9 x 4cm. For each red foil with a certain TIV a corresponding blue foil was presented with a similar TIV so that 4 different TIVs were tested with 2 different hues. The chosen red foils were: Red75 = No.154 PALE ROSE, Y=73,4%; Red52 = No.176 LOVING AMBER, Y=50,2%; Red18 = No.164 FLAME RED, Y=18%; Red6.5 = No.029 PLASA RED, Y=5,8%.

The chosen blue foils were: Blue75 = No.503 QUARTER NEW COLOUR BLUE, Y=74,5%; Blue52 = No.(HT)063 PALE BLUE, Y=54,4%; Blue18 = No.712 BEDFORD BLUE, Y=17,9%; Blue6.5 = No.723 VIRGIN BLUE, Y=7%.

⁶⁵ See chapter 2.3.3 Colour Ramifications, p.24.

Each foil was given a number for the test. To ensure that the test persons would identify the given number correctly and would not contaminate the foils, each foil had a white paper jacket (1,5x4cm) at one side with the appropriate number in the middle.

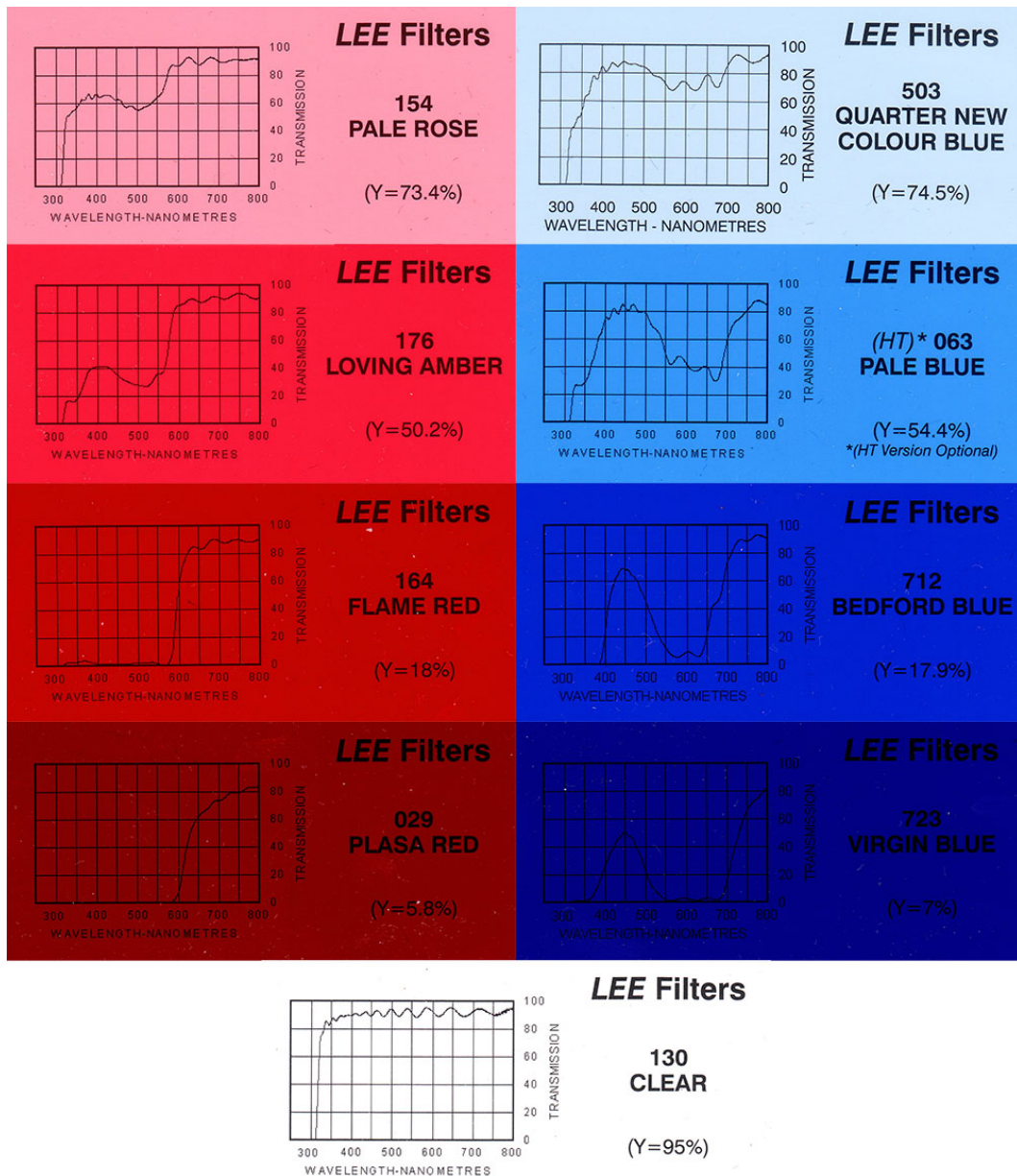


Fig. 22: Window Colours tested within Studies 1 and 2

Source: author's illustration

Procedure

The participants were seated at a table in an artificially illuminated testing room equidistant from the light overhead but, to avoid reflection, not directly under it. Written instructions were given to the participants before the test. The participants had to rate each foil on five Visual Analogue Scales (VAS) of 9 cm length. Four scales had two opposing words on each side of which one was high-pitched and the other one low-pitched (Lula/Ruki; Maluma/Takete; Decter/Bobolo; Kiki/Bouba). The fifth scale had one rounded shape opposed to an angular shape on each side. Additionally, the participants were requested to judge for each foil if it is generally usable for food packaging and to estimate a usage possibility in %. Finally the test persons were asked to decide which blue foil and which red foil they would prefer for food packaging. The test was conducted in English and lasted for about 8 minutes. All foils were shown in random order. The surface of the table that the foils were evaluated on was white.

Data analysis

For all scales the distance from midpoint to the marks by the participants were measured with millimetre accuracy. If the distance of the mark to high-pitched words or the angular shape was smallest the difference from the midpoint to this mark was noted with a minus in front and with a plus if the difference was lower towards the round shape or the low-pitched word. If the mark was identical with the midpoint a 0 was noted. Yes and no answers for the usability ratings were transformed into 1 (=yes) and 0 (=no), ranking positions were transformed into corresponding numbers and given usage possibility estimations were transferred into the Software as they were.

A list containing the replies of each person was the basis for the statistical analysis, which was performed using SPSS version 21 for Macintosh (IBM Corporation, Armonk, USA).

4.2.3 Abstract of the Analyses & Conclusion

Red and blue foils do not differ in their perceived shape due to their hue but due to their different TIVs. Hence further hues need to be tested to possibly find a pair of two hues with same TIV but different perceived shapes. Also it became clear that more transparent foils of both red and blue are more preferred for food packaging and rated to have a higher usability for food packaging. Hence these are of primary relevance for this thesis.

Comparison of the results for red and blue	
Perceived shape	No significant differences within same TIV
Preference rankings	Both significantly increasing with TIV
Usability ratings	Both significantly increasing with TIV
Estimated usage possibilities	Both significantly increasing with TIV

Tab. 8: Comparison of the Results for red and blue

4.2.4 Detailed Analyses - Table of Content

Analysis of the perceived Shapes	73
Analysis of the Preference Rankings.....	75
Analysis of the Usability Ratings	75
Analysis of the estimated Usage Possibilities	76

4.2.5 Analysis of the perceived Shapes

Since all foils have been rated by the same persons paired-samples t-tests were required to examine significant differences between all possible combinations of foils.

It turned out that in no case were red and blue of same TIV (6,5%, 18%, 52%, 75%) perceived as significantly different ($p > 0,05$). However, within each hue several significant differences in the perceived shape have been documented for different TIVs.

Conclusion

It was not verifiable that two different foils of same transparency level are perceived as different in roundness or angularity. Still, there are reportedly significant differences between several foils of different TIVs. This indicates that in fact the TIV and hence as will be shown the perceived lightness of a colour is more relevant for the perception of angularity/roundness than the hue.

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
red_75a	30	-10,60	16,40	6,0433	6,88976
red_52a	30	-17,90	15,00	2,7167	8,63194
red_18a	30	-20,10	15,80	-3,8533	9,26554
red_6.5a	30	-20,10	19,80	-2,2533	9,60498
blue_75a	30	-9,60	18,70	6,7633	7,63271
blue_52a	30	-6,10	16,30	5,1200	6,71305
blue_18a	30	-22,50	18,70	-5,6400	9,90697
blue_6.5a	30	-20,70	19,10	-3,2433	11,16669
Valid N (listwise)	30				

Tab. 9: Perceived Shape – Descriptive Results for red and blue Window Colours

Parameter Estimates

Dependent Variable	Parameter	B	Std. Error	t	Sig.	95% Confidence Interval		Partial Eta Squared	Noncent. Parameter	Observed Power ^a
						Lower Bound	Upper Bound			
red_75a	Intercept	6,043	1,258	4,804	,000	3,471	8,616	,443	4,804	,996
red_52a	Intercept	2,717	1,576	1,724	,095	-,507	5,940	,093	1,724	,385
red_18a	Intercept	-3,853	1,692	-2,278	,030	-7,313	-,394	,152	2,278	,596
red_6.5a	Intercept	-2,253	1,754	-1,285	,209	-5,840	1,333	,054	1,285	,237
blue_75a	Intercept	6,763	1,394	4,853	,000	3,913	9,613	,448	4,853	,997
blue_52a	Intercept	5,120	1,226	4,177	,000	2,613	7,627	,376	4,177	,981
blue_18a	Intercept	-5,640	1,809	-3,118	,004	-9,339	-1,941	,251	3,118	,854
blue_6.5a	Intercept	-3,243	2,039	-1,591	,122	-7,413	,926	,080	1,591	,337

a. Computed using alpha =

Tab. 10: Perceived Shape – Parameter Estimates for red and blue Window Colours

Paired Samples Test

		Paired Differences				t	df	Sig. (2-tailed)	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower				Upper
Pair 1	red_75a - red_52a	3.32667	9.71650	1.77398	-.30153	6.95487	1.875	29	.071
Pair 2	red_75a - red_18a	9.89667	12.37022	2.25848	5.27755	14.51578	4.382	29	.000
Pair 3	red_75a - red_6.5a	8.29667	14.28526	2.60812	2.96246	13.63087	3.181	29	.003
Pair 4	red_75a - blue_75a	-.72000	9.79044	1.78748	-4.37581	2.93581	-.403	29	.690
Pair 5	red_75a - blue_52a	.92333	9.40483	1.71708	-2.58849	4.43515	.538	29	.595
Pair 6	red_75a - blue_18a	11.68333	14.38718	2.62673	6.31107	17.05560	4.448	29	.000
Pair 7	red_75a - blue_6.5a	9.28667	15.90120	2.90315	3.34906	15.22427	3.199	29	.003
Pair 8	red_52a - red_18a	6.57000	12.14556	2.21747	2.03477	11.10523	2.963	29	.006
Pair 9	red_52a - red_6.5a	4.97000	13.57186	2.47787	-.09781	10.03781	2.006	29	.054
Pair 10	red_52a - blue_75a	-4.04667	10.79590	1.97105	-8.07792	-.01541	-2.053	29	.049
Pair 11	red_52a - blue_52a	-2.40333	8.30893	1.51700	-5.50594	.69927	-1.584	29	.124
Pair 12	red_52a - blue_18a	8.35667	15.42782	2.81672	2.59582	14.11751	2.967	29	.006
Pair 13	red_52a - blue_6.5a	5.96000	17.28888	3.15650	-.49577	12.41577	1.888	29	.069
Pair 14	red_18a - red_6.5a	-1.60000	8.89184	1.62342	-4.92027	1.72027	-.986	29	.332
Pair 15	red_18a - blue_75a	-10.61667	13.86235	2.53091	-15.79296	-5.44038	-4.195	29	.000
Pair 16	red_18a - blue_52a	-8.97333	11.94502	2.18085	-13.43368	-4.51299	-4.115	29	.000
Pair 17	red_18a - blue_18a	1.78667	14.18194	2.58926	-3.50896	7.08229	.690	29	.496
Pair 18	red_18a - blue_6.5a	-.61000	14.13249	2.58023	-5.88716	4.66716	-.236	29	.815
Pair 19	red_6.5a - blue_75a	-9.01667	14.03850	2.56307	-14.25873	-3.77461	-3.518	29	.001
Pair 20	red_6.5a - blue_52a	-7.37333	11.23992	2.05212	-11.57039	-3.17628	-3.593	29	.001
Pair 21	red_6.5a - blue_18a	3.38667	13.43163	2.45227	-1.62879	8.40212	1.381	29	.178
Pair 22	red_6.5a - blue_6.5a	.99000	14.31455	2.61347	-4.35514	6.33514	.379	29	.708
Pair 23	blue_75a - blue_52a	1.64333	10.10608	1.84511	-2.13034	5.41701	.891	29	.380
Pair 24	blue_75a - blue_18a	12.40333	14.20948	2.59428	7.09743	17.70924	4.781	29	.000
Pair 25	blue_75a - blue_6.5a	10.00667	13.22607	2.41474	5.06797	14.94536	4.144	29	.000
Pair 26	blue_52a - blue_18a	10.76000	11.60739	2.11921	6.42573	15.09427	5.077	29	.000
Pair 27	blue_52a - blue_6.5a	8.36333	13.76373	2.51290	3.22387	13.50280	3.328	29	.002
Pair 28	blue_18a - blue_6.5a	-2.39667	8.03889	1.46769	-5.39844	.60510	-1.633	29	.113

Tab. 11: Perceived Shape – Paired Samples Test for red and blue Window Colours

4.2.6 Analysis of the Preference Rankings

To compare if the frequencies of preferred TIVs differ significantly, a Chi² test was conducted. This test assumes that the frequencies are equal. In both cases (red and blue) this null hypothesis was rejected (p=0,0; 2-sided), so that the frequencies of preferred TIVs differ within red and blue. For red foils the preference frequencies increase with TIVs and in this differ from equal distribution. The situation is similar for blue foils. The more transparent a blue foil is, the more it will be preferred for food packaging. In this it has to be mentioned that blue 6.5 was not once chosen as the preferred foil.

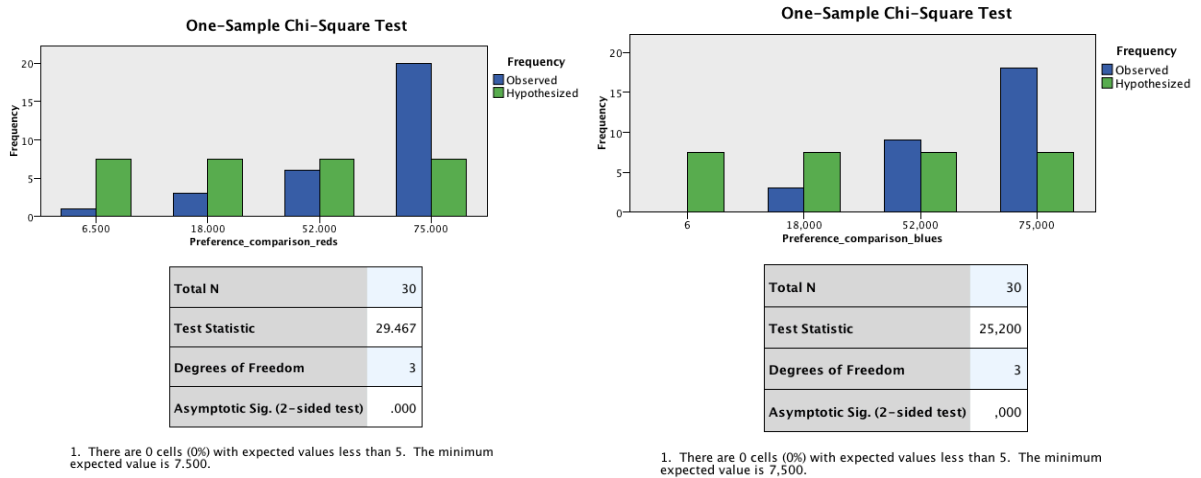


Fig. 23: Preferences – Chi² Test for red and blue

Conclusion

For both hues it was shown that the higher the TIV the more often they were preferred for food packaging windows.

4.2.7 Analysis of the Usability Ratings

To check whether the frequency of a positive usability rating (=yes) increases together with TIV a Cochran's Q Test was conducted. This test assumes the null hypothesis that for different TIVs the frequency of yes (=1) and no (=0) is identical.

The null hypothesis was rejected for both red and blue (p=0,0; 2-sided) so that the frequencies of a positive usability rating differ for different TIVs.

For red it was shown that with increasing TIV the frequency of a positive usability rating increases. So that the more transparent a red foil is the more people believe in a usability of red foils for food packaging windows.

For blue this effect was confirmed until TIV 52. So that a higher transparency did not increase the usability rating any further. Keeping the Analysis of the Preference Rankings in mind, this variation seems to be accidental.

Conclusion

For both hues it was shown that until a TIV of 52% the higher the TIV the more usable they will be rated for food packaging windows. For red this effect remained until a TIV of 75 as well, while for blue a slight decrease was documented.

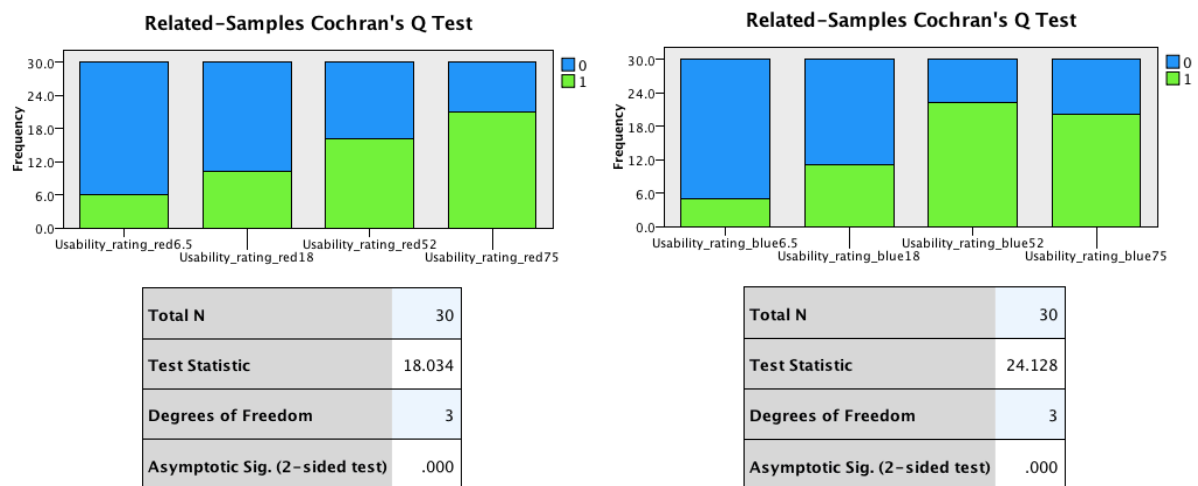


Fig. 24: Usability Rating – Cochran’s Q Test for red and blue

4.2.8 Analysis of the estimated Usage Possibilities

To analyse whether the estimated usage possibilities in percentage for general food packaging are influenced by the TIV a Friedman Test was conducted. This test puts the given percentages in order. The Friedman Test resulted in significant differences for red (p=0,0; 2-sided) and blue (p=0,0; 2-sided) so that the estimated usage possibilities differ between different TIVs.

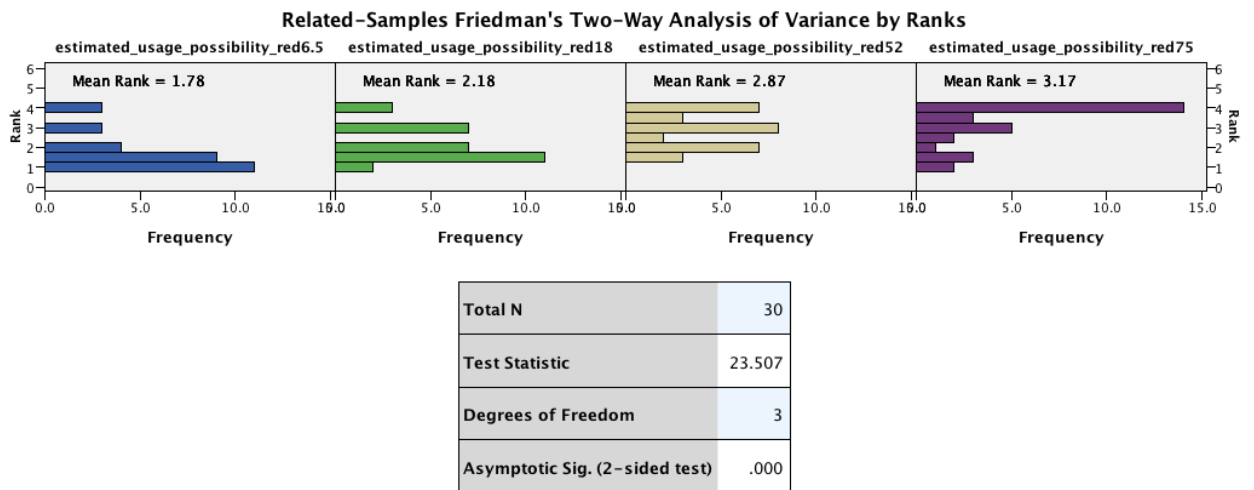


Fig. 25: Estimated Usage Possibilities – Friedman Test for red

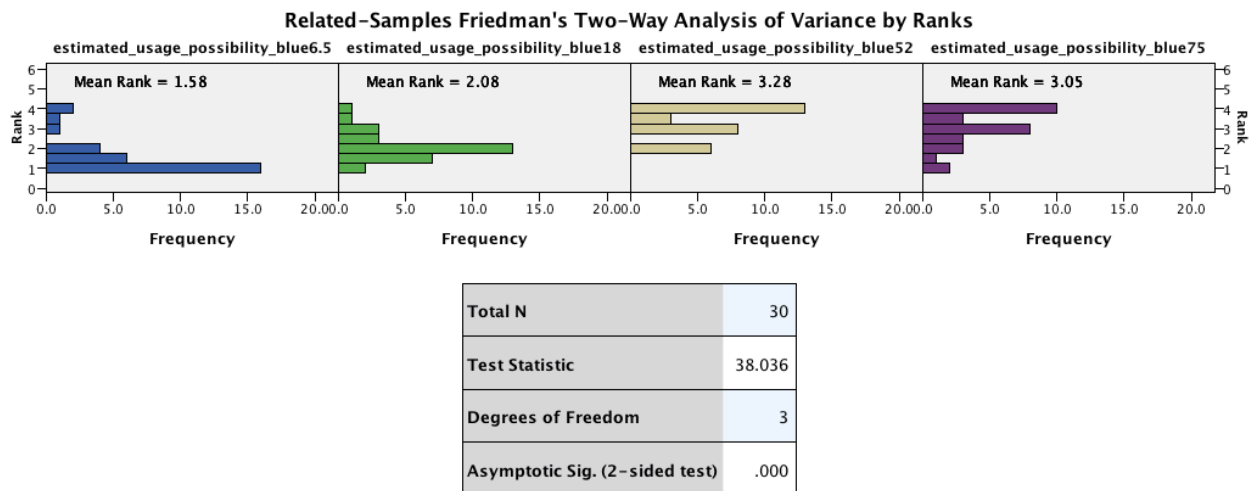


Fig. 26: Estimated Usage Possibilities – Friedman Test for blue

By examining the mean ranks it becomes visible that these increase together with TIV. Hence the estimated usage possibilities in percentage increases the more transparent a foil is. Though similar to the result of the Cochran's Q Test before for blue, the ranks only increase until blue 52. Therefore a higher TIV for blue leads to no increasing usage possibilities in percentage. In fact it decreases slightly. To get more precise results pairwise comparisons were conducted.

It turned out that for blue the foils blue6.5/blue18 ($p=0,802$; 2-sided) and Blue75/blue52 ($p=1,0$; 2-sided) are not significantly different in their estimated usage possibilities in percentage. Generally it can be said that the higher the difference in the TIVs was, the more significant was the difference in the usage possibility rating and hence the lower went p.

Further, this situation was identical for red so that foils red6.5/red18 ($p=1,0$; 2-sided) and Red75/red52 ($p=1,0$; 2-sided) are not significantly different in their estimated usage possibilities in percentage. Additionally red18 vs. red52 ($p=0,242$; 2-sided) did also not differ significantly. All other combinations were significantly different. Like for blue it can be said for red that the higher the difference in the TIVs was the more significant was the difference in the usage possibility rating and hence the lower went p.

Conclusion

The higher the difference in TIV for red and blue, the more will the more transparent foil be rated to have a higher usage possibility.

4.3 Study 3 (Pretest)

4.3.1 Aim of the Study

As it turned out that blue and red foils of same TIV are perceived as similarly angular or round, further colours were required to be tested. The aim was again to find two coloured transparent foils that are perceived to differ similarly strongly from neutral in perceived angularity/roundness but in opposite directions and as strongly as possible. Further these pairings had to be similar in their TIV to ensure the later results were not influenced by their differences in this respect. Especially the focus was set on highly transparent foils as study 2 has shown that those will generally be preferred and rated as better usable than less transparent foils. It was however decided to also examine darker than the ideal TIVs to confirm the results out of study 2. To enlarge the usability of the further results the reference foil Clear95 was also included to test if it differs significantly from the coloured foils.

4.3.2 Set up of the Study

Participants

30 students of University Hasselt (mean age 18,9333; SD = 1,17248; ranging from 17 to 21 years; 15 women and 15 men) participated in the test. The participants took part in this study by volunteering. None of them participated in studies 1, 2 or 4. All participants reported normal or corrected-to-normal vision and to have no defective colour vision.

Materials

11 colour effect lighting filters by Lee filters Worldwide have been chosen for the test.

Two of these foils have been tested in Study 2 to be most preferred for general food packaging within the range of foils offered (Blue75 = No.503 QUARTER NEW COLOUR BLUE, Y=74,5%; Red75 = No.154 PALE ROSE, Y=73,4%;). Further, to get comparable results yellow and green foils were chosen with TIVs similar to the foils tested in Study 2.

In this discrepancies of up to 6,1% were accepted. Since for yellow only two of these TIVs existed, two different ones were tested instead. Finally a neutral clear foil (Clear95) was tested that was also used for study 1 and was closest to usual food packaging windows.

Each foil had a size of 9 x 4cm.

The chosen yellow foils were:

Yellow86.5 = No.(HT)010 MEDIUM YELLOW, Y=86,5%; Yellow75 = No.101 YELLOW, Y=80%; Yellow68.5 = No.767 OKLAHOMA YELLOW, Y=68,9%; Yellow52 = No.768 EGG YOLK YELLOW, Y=55,5%.

The chosen green foils were:

Green75 = No.138 PALE GREEN, Y=79,9%; Green52 = No.(HT)122 FERN GREEN, Y=51,5%; Green18 = No.(HT)139 PRIMARY GREEN, Y=11,9%; Green6.5 = No.736 TWICKENHAM GREEN, Y=7,2%.

The chosen clear foil was Clear95 = No.130 CLEAR, Y=95%.

Each foil was given a number for the test. To ensure that the test persons would identify the given number correctly and would not pollute the foils, each foil had a white paper jacket (1,5x4cm) at one side with the appropriate number in the middle. Additionally, a white porcelain dish (22cm diameter, 4 cm height) was used which contained uncooked penne pasta.

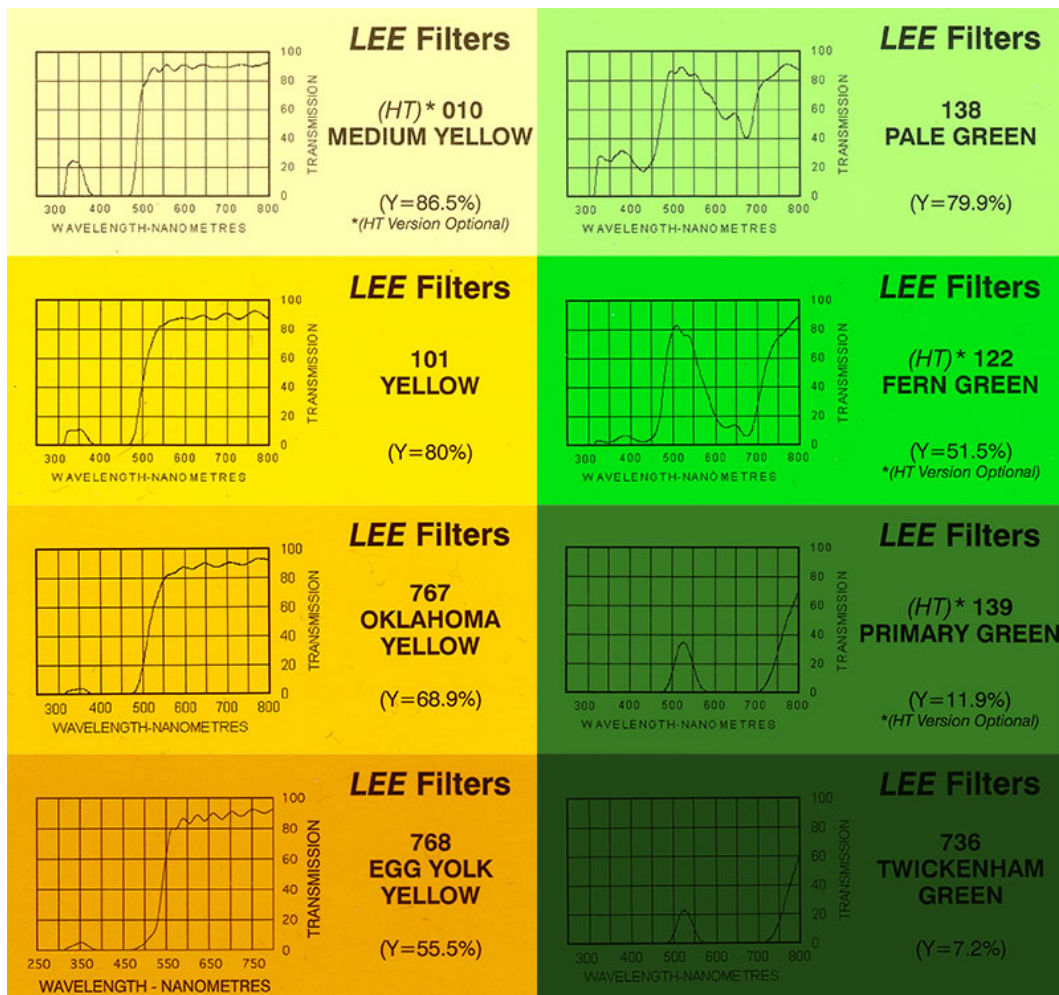


Fig. 27: New Window Colours tested within Study 3

Source: author's illustration

Procedure

The participants were seated at a table in an artificially illuminated testing room equidistant from the light overhead but, to avoid reflection, not directly under it. Written instructions were given to the participants before the test. The participants had to rate each foil on five Visual Analogue Scales (VAS) of 9 cm length. Four scales had two opposing words on each side of which one was high-pitched and the other one low-pitched (Lula/Ruki; Maluma/Takete; Decter/Bobolo; Kiki/Bouba). The fifth scale had one rounded shape opposed to an angular shape on each side.

The participants were also asked to judge for each foil if it is generally usable for food packaging windows or penne pasta packaging windows and to estimate a usage possibility in %. For this they were allowed to hold the foils in front of the provided penne pasta.

Besides the above the test persons were asked to rate all green, all yellow and all highly transparent coloured foils from the most to the least preferred for general food packaging and for penne pasta packaging. Finally the participants had to put all 11 tested foils in order from the lightest to the darkest foil.

The test was conducted in English or Dutch depending on the participants' preferences and lasted for about 10 minutes. All foils were shown in random order except for the comparison rankings where the relevant foils were shown at once. The tables' surface that the foils were evaluated on was white.

Data analysis

For all scales the distance from midpoint to the marks by the participants were measured with millimetre accuracy. If the distance of the mark to high-pitched words or the angular shape was smallest the difference from the midpoint to this mark was noted with a minus in front, and with a plus if the difference was lower towards the round shape or the low-pitched word. If the mark was identical with the midpoint a 0 was noted. Yes and no answers for the usability ratings were transformed into 1 (=yes) and 0 (=no), ranking positions were transformed into corresponding numbers and given usage possibility estimations were transferred into the Software as they were.

A list containing the replies of each person was the basis for the statistical analysis, which was performed using SPSS version 21 for Macintosh (IBM Corporation, Armonk, USA).

4.3.3 Abstract of the Analyses & Conclusion

Concerning the perceived shape Clear95 is a proper comparison foil as it is close to being perceived as neutral. Furthermore, owing to a lack of highly transparent foils with perceived angularity only Yellow86.5 and Yellow75 were possible candidates in this matter.

However, Yellow75 was perceived as only slightly angular. The only highly transparent foil that was perceived as comparably round was Blue75, which was in this closer to Yellow86.5. Still Yellow86.5 had a higher TIV, which could have influenced the test persons and hence could have lead to biased results. Since Yellow75 was perceived as less transparent than Blue75 while Yellow86.5 was perceived as not different to it, Yellow86.5 was chosen as angular foil for the further tests.

The decision was confirmed as the usability ratings for penne pasta packaging compared between Blue75 and both yellows did not differ significantly. This was also the case for the estimated usage possibilities for both packaging types (general/penne). On the other hand for general food packaging Blue75 was preferred more often than Yellow86.5. But this was not the case for penne pasta packaging, hence this difference is not relevant.

Additional analyses indicated again that different TIVs of green were rated differently usable for food packaging or penne pasta packaging. Again more transparent foils were rated better. This on the other hand was not the case for yellow. But preferred yellow foils for food packaging were also more transparent.

Finally it has been shown that high TIVs are equalized with light colours.

	Green	Yellow
Preference Rankings (general)	Lighter TIVs always significantly more preferred	Lighter TIVs in most cases significantly more preferred
Usability Rating (general)	Lighter TIVs rated significantly more often usable	No significant differences for different TIVs
Estimated Usage Possibility (general)	Lighter TIVs estimated significantly more usable	No significant differences for different TIVs
Lightness Ranking	Higher TIVs were always perceived as significantly lighter	Higher TIVs were always perceived as significantly lighter

Tab. 12: Comparison of the Results for green and yellow

	Red75	Green75	Blue75	Yellow75	Yellow86.5	Clear95
Perceived Shape	Perceived as round + significant difference to Clear95	No significant difference to Clear95	Perceived as round + significant difference to Clear95	Perceived as angular + No significant difference to Clear95	Perceived as angular + Nearly significant difference to Clear95	---
Perceived Lightness	---	---	Perceived as same value as Yellow86.5	Perceived as significantly darker than Blue75	Perceived as same value as Blue75	Lighter than all coloured foils
Preference (general)	---	---	Significantly more preferred than Red75, Green75, Yellow86.5	Not tested	---	Significantly more preferred than Red75, Green75, Yellow86.5, Blue75
Preference (Penne)	---	---	---	Not tested	Significantly more preferred than Green75	Significantly more preferred than Red75, Green75, Yellow86.5, Blue75
Usability Rating (general)	---	---	---	---	---	Not tested
Usability Rating (Penne)	---	---	---	---	Significant difference to Green75 and Red75 but not Blue75	Not tested

Usability Rating (Comparison)	Significantly less usable for penne than for general food	Significantly less usable for penne than for general food	Significantly less usable for penne than for general food	---	---	---
Estimated Usage Possibility (general)	---	---	---	---	---	Significantly higher usage possibility than all other foils
Estimated Usage Possibility (Penne)	Significantly lower usage possibility than Yellow75	---	---	---	---	Significantly higher usage possibility than all other foils
Estimated Usage Possibility (Comparison)	Significantly lower usage possibility for penne than for general food	Significantly lower usage possibility for penne than for general food	Significantly lower usage possibility for penne than for general food	---	---	---

Tab. 13: Comparison of the Results for all highly transparent Foils

4.3.4 Detailed Analyses - Table of Content

Analysis of the perceived shapes	85
Analysis of the Lightness Ratings.....	87
Interaction between Lightness and factual TIV.....	87
Comparison of perceived Lightness of Yellow75, Yellow86.5 and Blue75.....	88
Analysis of the Preference Rankings.....	88
Preferred green Foils for general Packaging.....	88
Preferred yellow Foils for general Packaging.....	89
Preferred highly transparent coloured Foils for general Packaging.....	89
Preferred highly transparent coloured Foils for Penne Pasta Packaging.....	89
Analysis of the Usability Ratings	90
Influence of TIV on the Usability Ratings (general) for Green and Yellow	90
Comparison of the Usability Rating (general) for all highly transparent coloured Foils	91
Comparison of the Usability Rating (Penne) for all highly transparent coloured Foils.....	91
Comparison between Usability Rating (general) and Usability Rating (Penne) for all Foils	92
Analysis of the estimated Usage Possibilities	93
Influence of TIV on the estimated Usage Possibility (general) for green and yellow.....	93
Comparison estimated Usage Possibility (general) for all highly transparent coloured Foils.....	94
Comparison estimated Usage possibilities (general/Penne) for all highly transparent coloured Foils.....	95

4.3.5 Analysis of the perceived Shapes

To analyse the perceived shapes of the foils tested a repeated measures ANOVA was conducted. From the parameter estimates it became visible that the uncoloured foil (Clear95) is neutral in shape (mean=0,49; $t(29)=0,352$; $p=0,727$; 2-sided). As this foil is used for comparison two coloured foils are searched that differ from the benchmark and hence from 0,490 in two opposing directions (angularity/roundness). To prevent confounding effects between angularity/roundness and the magnitude of deviance from the neutral point it is aimed to find two foils that have similar deviance from the neutral point. For this the pairwise comparisons need to be examined that include Clear95. Since only two foils with high TIV have strong negative mean values only these are possible candidates for the angular coloured foil: Yellow_86.5b: mean difference=-4,457; $p=0,054$ (significant at 90%, but if one-

tailed, so $p=0,027$, hence also significant at 95%) and yellow_75b: mean difference=-1.837; $p=0,352$ which hence is not significantly different to Clear95.

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
yellow_86.5b	30	-19,90	16,90	-3,9667	8,85404
yellow_75b	30	-21,30	20,30	-1,3467	8,90636
yellow_68.5b	30	-18,50	19,60	,7267	9,37123
yellow_52b	30	-15,80	11,50	-,3067	7,36525
green_75b	30	-14,20	20,70	3,5100	10,03578
green_52b	30	-18,90	21,20	-,1100	10,08404
green_18b	30	-14,00	21,40	-,1733	9,97576
green_6.5b	30	-18,60	20,80	-2,5733	9,72416
clear_95b	30	-21,80	15,10	,4900	7,62393
red_75b	30	-10,40	20,60	9,7000	7,91951
blue_75b	30	-19,90	20,80	5,3300	9,67286
Valid N (listwise)	30				

Tab. 14: *Perceived Shapes – Descriptive Results for diverse Colours*

Pairwise Comparisons

Measure: MEASURE_1

foils	(I) foils	(J) foils	Mean Difference (I-J)	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
						Lower Bound	Upper Bound
yellow_86.5b	9	1	4,457	2,218	,054	-,080	8,993
yellow_75b		2	1,837	1,940	,352	-2,131	5,804
yellow_68.5b		3	-,237	2,369	,921	-5,082	4,609
yellow_52b		4	,797	1,567	,615	-2,408	4,001
green_75b		5	-3,020	2,529	,242	-8,192	2,152
green_52b		6	,600	2,140	,781	-3,777	4,977
green_18b		7	,663	2,601	,801	-4,657	5,984
green_6.5b		8	3,063	2,681	,262	-2,419	8,546
clear_95b		10	-9,210*	2,295	,000	-13,904	-4,516
red_75b		11	-4,840*	1,827	,013	-8,576	-1,104

Tab. 15: *Perceived Shapes – Excerpt of the pairwise Comparisons for diverse Colours*

Further, to find the matching round foil once again the pairwise comparisons are examined. In this once again only foils with high TIV but also significant difference to Clear95 and a comparable mean difference to Clear95 are searched. The only foil that fulfils these tasks is Blue75b (mean=4,840; $p=0,013$; significant at 95% 2-tailed, hence surely significant if 1-tailed). A paired samples t-test indicates an equal magnitude (mean=-0,38; SD=15,43, $t(29)=-0,136$; $p=0,893$).

Conclusion

The ideal pairing in terms of angularity/roundness is yellow_86.5/Blue75b.

However, this possibly leads to a possible contradiction between angularity/roundness and TIV (86.5% vs. 75%). To solve this problem the analysis "Comparison of perceived Lightness of Yellow75, Yellow86.5 and Blue75" will examine if Yellow75 needs to be tested as third coloured foil within study 4 or if the perceived transparency of Yellow86.5 and Blue75 are similar so that the factual difference can be ignored. Further tests will also focus on additional differences between these foils.

In contrast to Study 2 the difference between red and blue with transparency level of 75% was significant ($p=0,034$; 2-tailed). Though the tendential perception of the foils Red75 and Blue75 was similar to the results from study 2, as in both studies these were perceived as strongly round. The deviation can be explained by the different experimental set-ups since participants of study 2 have not been confronted with green, yellow and clear foils. Further, they were shown each 4 red and blue foils while participants of study 3 were mainly confronted with yellow and green (each 4 foils), one red foil, one blue foil and one clear foil. Therefore the perceptions of participants in study 2 and 3 could possibly have been shifted. Generally speaking the results of both study 2 and 3 do not give evidence that foils differ in their perceived roundness/angularity only due to their colour. The TIV or perceived lightness (see following tests within this study) seems to be the most important factor on the rating of angularity/roundness as even within the same colours the perceptions differ significantly with a tendency (except for yellow) that foils with lower transparency level are perceived as more angular than others.

4.3.6 Analysis of the Lightness Rankings

Interaction between Lightness and factual TIV

A Friedman test was conducted to verify that significant differences in the lightness ranking of the foils have been shown. In this it was examined if more transparent foils are perceived as lighter. Three test persons were excluded from the analysis of this ranking as one rated the same foil twice and two persons rated the obviously darkest foil as lightest.

The significance was $p=0,0$ so that significant differences were documented.

To test how and which foils differ significantly a Wilcoxon Signed Ranks Test was conducted. To eliminate possible effects of the different hues on the lightness perception only

differences between foils of the same hue were compared. These in all cases for green and yellow were significantly different since $p < 0,05$. Further in all cases foils with higher TIV were perceived as significantly lighter than all foils with lower TIV but same hue. Finally for all coloured foils including Red75 and Blue75 the foil Clear95 was perceived as significantly lighter than any coloured foil.

Conclusion

Within one colour the foils with higher TIV were always perceived as significantly lighter. Thus it can be assumed that the higher the TIV is the higher is the perceived lightness.

Comparison of perceived Lightness of Yellow75, Yellow86.5 and Blue75

Based on the Friedmann test from "Interaction between perceived Lightness and factual TIV" a Wilcoxon Signed Ranks Test was conducted to check whether the relevant foils Blue75, Yellow75 and yellow 86.5 differ from each other in their perceived lightness. This was relevant to decide whether to test both Yellow75 and Yellow86.5 in Study 4.

It turned out that Blue75 and Yellow75 significantly differed in their perceived lightness ($p = 0,046$; 2-tailed). On the other hand Blue75 and Yellow86.5 did not differ significantly in their perceived lightness ($p = 0,176$; 2-tailed). After examining the data it became clear that Yellow75 was perceived to be darker than Blue75.

Conclusion

As only Yellow86.5 and Blue75 do not differ in their perceived lightness it is feasible to exclude Yellow75 since its use due to its perceived lower lightness and hence lower perceived transparency would result in biased outcomes for study 4.

4.3.7 Analysis of the Preference Rankings

Preferred green Foils for general Packaging

A Friedman test was conducted to verify that significant differences in the ranking of the green foils have been examined. The significance was $p = 0,0$ so that significant differences were documented.

A Wilcoxon Signed Ranks Test was conducted to check whether all foils differ from each other. All foils except the pairing Green52/Green18 ($p = 0,501$; 2-tailed) have been confirmed to differ significantly from each other.

Conclusion

In all significant cases lighter green foils were preferred against darker ones for general food packaging windows. This result is similar to the results of blue and red within Study 2.

Preferred yellow Foils for general Packaging

A Friedman test was conducted to verify that significant differences in the ranking of the yellow foils have been examined. The significance was $p=0,0$ so that significant differences were documented. A Wilcoxon Signed Ranks Test was conducted to check whether all foils differ from each other. All foil except the pairings yellow68.5/Yellow86.5 ($p=0,057$; 2-tailed) and Yellow75/Yellow86.5 ($p=0,661$; 2-tailed) have been confirmed to differ significantly from each other (always $p=0,0$; 2-tailed).

Conclusion

In all significant cases lighter yellow foils were preferred against darker ones for general food packaging windows. This result is comparable to those of green within this study and to those of red and blue within study 2.

Preferred highly transparent coloured Foils for general Packaging

A Friedman test was conducted to verify significant differences in the ranking of the highly transparent coloured foils. The significance was $p=0,0$ so that significant differences were documented.

A Wilcoxon Signed Ranks Test was conducted to check which foils differ from each other. All foils except the pairings Green75/Red75 ($p=0,723$; 2-tailed), Yellow86.5/Red75 ($p=0,938$; 2-tailed) and Yellow86.5/Green75 ($p=0,814$; 2-tailed) have been confirmed to differ significantly from each other as $p < 0,05$ was true.

Conclusion

Blue75 is significantly more often preferred for general food packaging windows than: Red75, Green75, Yellow86.5. Clear95 is significantly more often preferred for general food packaging windows than Red75, Green75, Yellow86.5 and Blue75.

Preferred highly transparent coloured Foils for Penne Pasta Packaging

A Friedman test was conducted to verify that significant differences in the ranking of the foils have been examined. The significance was $p=0,0$ so that significant differences were documented.

A Wilcoxon Signed Ranks Test was conducted to check whether all foils differ from each other. The pairings Blue75/Red75 ($p=0,596$; 2-tailed), Green75/Red75 ($p=0,741$; 2-tailed), Yellow86.5/Red75 ($p=0,75$; 2-tailed), Green75/Blue75 ($p=0,291$; 2-tailed) and Yellow86.5/Blue75 ($p=0,22$; 2-tailed) did not differ significantly. All other foils have been confirmed to differ significantly from each other as $p < 0,05$ was true.

Conclusion

Yellow86.5 is significantly more often preferred for penne pasta packaging windows than Green75. Clear95 is significantly more often preferred for general food packaging windows than Red75, Green75, Yellow86.5 and Blue75.

4.3.8 Analysis of the Usability Ratings

Influence of TIV on the Usability Ratings (general) for Green and Yellow

To check whether the frequency of a positive usability rating (=yes) increases with increasing TIV for green and yellow a Cochran's Q Test was conducted. This test assumes the null hypothesis that for different TIVs the frequency of yes (=1) and no (=0) is identical.

The null hypothesis was rejected only for green ($p=0,0$; 2-sided test) so that the frequencies of a positive usability rating differ for different green TIVs, while for yellow there is no such difference ($p=0,662$; 2-sided test).

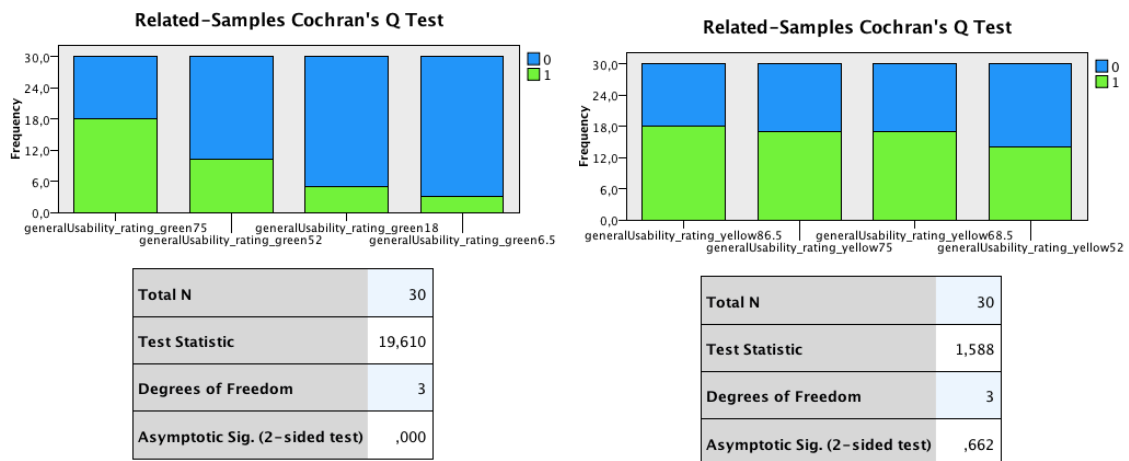


Fig. 28: Usability Rating (general) – Cochran's Q Test for Green and Yellow

Conclusion

Similar to that shown in study 2 for red and blue, the Usability ratings for green are better the more transparent the foil is. For yellow the ratings do not change significantly with different TIV.

Comparison of the Usability Rating (general) for all highly transparent coloured Foils

To see if the highly transparent foils differ from each other in their usability ratings for general food packaging a Cochran's Q Test was conducted with the null hypothesis that the ratings are identical for all foils. Due to its significant difference in the usability ratings compared to the other foils a comparison of different foils including Clear95 would automatically lead to the result that they differ. Hence Clear95 was excluded from this comparison.

Finally since Yellow86.5 and Yellow75 have been shown to not differ significantly from each other in the usability ratings⁶⁶ but still have different variabilities for both yellow foils the test was conducted separately. This was necessary because the Cochran's Q Test considers the variability within each person as the samples are related. Hence the testing of only one yellow foil could have lead to different results than for the other yellow foil.

Conclusion

The null hypothesis was retained for general food packaging in both cases ($p_{\text{Yellow75}}=0,634$; $p_{\text{Yellow86.5}}=0,767$) so that there are no significant differences in the usability ratings for general food packaging within the foils Red75, Blue75, Green75, Yellow75 and Yellow86.5.

Comparison of the Usability Rating (Penne) for all highly transparent coloured Foils

To see if the highly transparent foils differ from each in their usability ratings for penne pasta packaging a Cochran's Q Test was conducted with the null hypothesis that the ratings are identical. Again due to its significant difference in the usability ratings compared to the other foils Clear95 was excluded from this comparison. Also the test has been conducted for both Yellow86.5 and Yellow75 separately for the same reasons as before. For Yellow75 the variability is relatively higher ($Q= 7.165$) than for Yellow86.5 ($Q = 7.909$). As a result the p-values differed correspondingly. The null hypothesis was rejected for penne pasta packaging only in case of Yellow86.5 ($p=0,48$; 2-sided test) but not in case of Yellow75 ($p=0,067$; 2-sided test).

⁶⁶ See Comparison Usability rating (general) with Usability rating (penne) for all Foils tested in Study 3, p.92f.

To check if the foils Blue75 and yellows 86.5, 75 respectively, differ explicitly from each other another Cochran's Q Test was conducted. In both cases Blue75 did not differ significantly from the yellow foils ($p_{\text{Yellow86.5}}=0,166$; $p_{\text{Yellow75}}=0,225$).

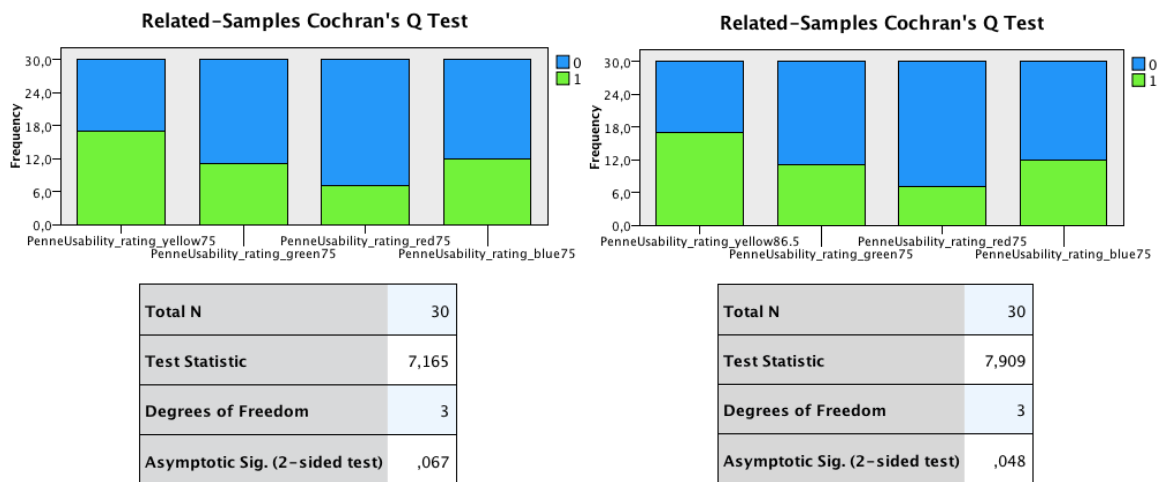


Fig. 29: Comparison Usability Rating (penne) – Cochran's Q Tests for all highly transparent coloured Foils

Conclusion

Yellow86.5 is rated significantly better usable compared to the overall highly transparent coloured foils but not explicitly compared to Blue75. On the other hand Yellow75 is not rated significantly better usable than the overall highly transparent coloured foils or Blue75.

Comparison between Usability Rating (general) and Usability Rating (Penne) for all Foils

To check if for the highly transparent (and hence relevant) foils the usability rating changes from general food packaging towards a penne pasta packaging a Cochran's Q Test was conducted. The tested null hypothesis was that for different usage (penne/general packaging) the frequency of yes (=1) and no (=0) is identical.

The null hypothesis was retained for Yellow86.5 ($p=0,705$; 2-sided test), Yellow75 ($p=1,0$; 2-sided test) and Clear95 ($p=0,317$; 2-sided test) but rejected for Green75 ($p=0,008$; 2-sided test), Blue75 ($p=0,003$; 2-sided test), Red75 ($p=0,002$; 2-sided test).

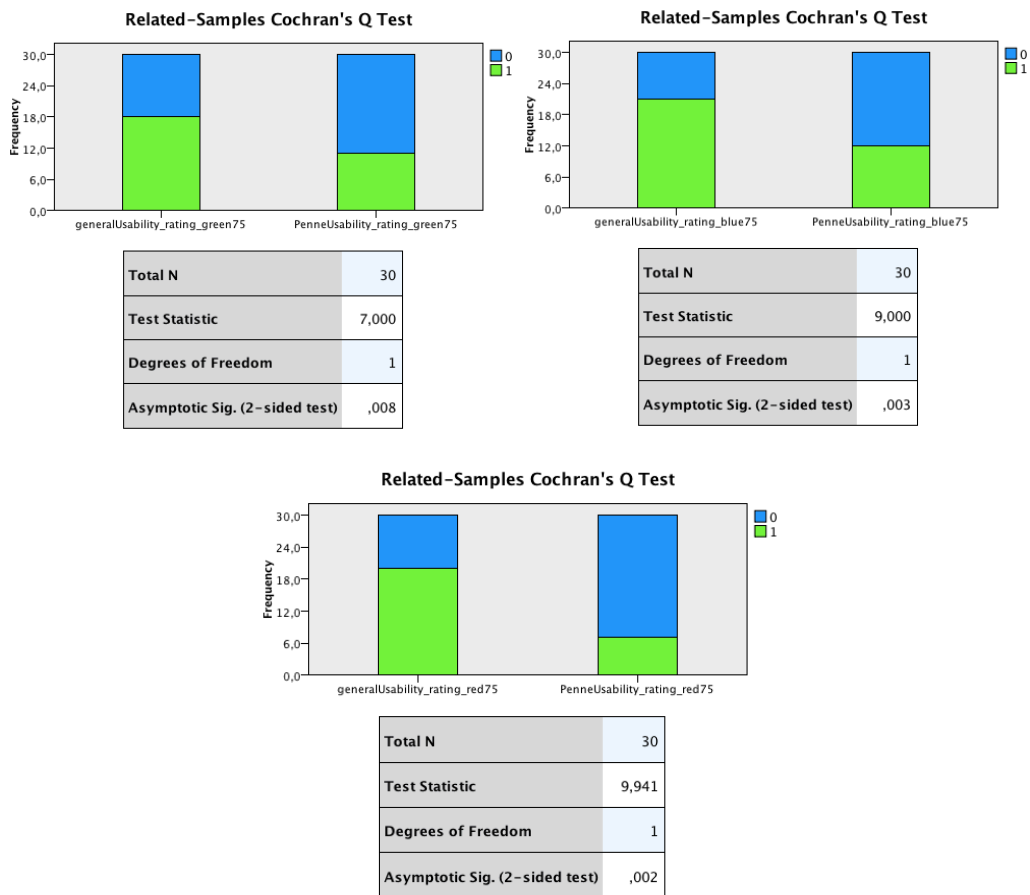


Fig. 30: Comparison Usability Rating (general/penne) – significant Cochran's Q Tests

Conclusion

It was shown that for Green75, Blue75 and Red75 the usability rating decreases from general packaging to penne pasta Packaging while Yellow75 Yellow86.5 and Clear95 have the same usability ratings independent of the potential use.

4.3.9 Analysis of the estimated Usage Possibilities

Influence of TIV on the estimated Usage Possibility (general) for green and yellow

To analyse whether the estimated usage possibilities in percentage for general food packaging are influenced by the TIV a Friedman test was conducted. In this it was examined if the TIVs are significantly connected to different ranks. The Friedman test resulted in significant differences for green ($p=0,0$; 2-sided test) but not for yellow ($p=0,08$; 2-sided test). Therefore for green the percentages of estimated usage possibility differ significantly between different TIVs. Still it needs to be considered that the TIVs for yellow had smaller

differences than those tested for red, green and blue. Hence if ignoring the results for Yellow68.5 and thus enlarging the gap between Yellow75 and yellow52 to the same amount that red, blue and green had, the results for yellow are significant ($p=0,049$; 2-sided test) and hence show an identical principle so that the lighter the yellow foil was the higher was its estimated usage possibility. For green as well as for yellow the mean ranks are higher the more transparent the foils are. To get more precise results pairwise comparisons were conducted. It turned out that the foils Green6.5/Green18 ($p=0,882$; 2-sided), Green75/Green52 ($p=1,0$; 2-sided) are not significantly different in their estimated usage possibilities. This result is identical to that of blue from study 2 and hence very similar to the results for red. All other combinations of green were significantly different. For yellow no significant differences between the foils could be confirmed.

Conclusion

As shown before for red and blue within study 2 the estimated usage possibility was higher for green the more transparent the foil was. For yellow in contrast this effect was not significant but also descriptively observed.

Comparison estimated Usage Possibility (general) for all highly transparent coloured Foils

To find out whether the estimated usage possibilities differ for the relevant foils a Friedman test was conducted with the null hypothesis that the foils do not differ. For general food packaging significant differences between the relevant foils were examined ($p=0,0$; 2-sided).

To examine the concrete differences Pairwise comparisons have been conducted.

Significant differences for the estimated usage possibilities for general food packaging were only examined between Clear95 and each coloured foil (always $p=0,0$; 2-sided). The coloured foils did not differ significantly from each other (always $p=1,0$; 2-sided).

Conclusion

Clear95 was significantly more often estimated to have a higher usage possibility for general food packaging than the coloured foils, while those did not differ from each other.

Comparison estimated Usage Possibility (Penne) for all highly transparent coloured Foils

To find out whether the estimated usage possibilities differ for the relevant foils a Friedman test was conducted with the null hypothesis that the foils do not differ.

Significant differences for the foils were examined ($p=0,0$; 2-sided).

To examine the concrete differences pairwise comparisons have been conducted.

Once again significant differences were examined between Clear95 and each coloured foil (always $p=0,0$; 2-sided test). Additionally a significant difference between Red75 and Yellow75 was examined ($p=0,032$; 2-sided).

Conclusion

Clear95 was significantly more often estimated to have a higher usage possibility for penne pasta packaging than the coloured foils. Red75 was rated significantly less probable than Yellow75. The further coloured foils did not differ significantly from each other.

Comparison estimated Usage possibilities (general/Penne) for all highly transparent coloured Foils

To analyse whether the estimated usage possibilities in percentage for general food packaging and for penne pasta packaging differ a Friedman Test was conducted. The test had the null hypotheses that the estimated usage possibilities are equal.

No significant differences between the estimated usage possibilities for general food packaging and penne pasta packaging were given for Clear95 ($p=0,59$; 2-sided), Yellow75 ($p=0,162$; 2-sided) and Yellow86.5 ($p=0,549$; 2-sided). Significant differences were examined for Red75 ($p=0,002$; 2-sided), Blue75 ($p=0,0$; 2-sided) and Green75 ($p=0,0$; 2-sided).

Conclusion

Red75, Blue75 and Green75 were rated as significantly less usable for penne pasta packaging than for general food packaging. Clear95, Yellow75 and Yellow86.5 were perceived as identically usable for penne pasta packaging and for general food packaging.

4.4 Study 4 (Main test)

4.4.1 Aim of the Study

The main test was conducted with the aim of verifying the hypotheses stated in chapter 3 and hence to answer the questions noted in chapter 1.2. In doing so it was based on the findings from studies 1, 2 and 3 and thus integrated the verified relevant window foils (Yellow86.5, Blue75, Clear95) and relevant window shapes (triangle, reauleaux) in a 2x3 factorial design. The interpretation of the outcomes of study 4 and hence of the overall results of this thesis in comparison to the hypotheses will be presented in chapter 6 so that the conclusions within this study are primarily descriptive and summarizing as for the preceding studies.

4.4.2 Set up of the Study

Participants

186 students of University Hasselt (mean age 19,9032; SD = 2,14383; ranging from 17 to 31 years; 92 women and 94 men) participated in the test. Three additional participants were excluded from the analysis as they reported defective colour vision. All others reported normal or corrected-to-normal vision and to have no defective colour vision. The students took part in this study by volunteering or else to fulfil the partial requirement to gain 1 credit for a marketing course. None of students participated in studies 1, 2 or 3.

Materials

Six uncoloured boxes (12cmx12cmx6.5cm) which were identical with those used for study 1 were prepared. The window shapes chosen were those suggested by the results of study 1 (triangle, reauleaux) while the window colours chosen were those suggested by study 3 (Yellow86.5, Blue75, Clear95). All boxes were filled with 400gr uncooked penne pasta. Further, cooked penne pasta were provided which were prepared in a consistent manner⁶⁷, had the same room temperature (ca. 20°C) and were stored under such controlled conditions that they were of identical quality for all test persons. Finally white paper dishes and white plastic forks were used.

⁶⁷ See Appendix C. Penne Pasta Preparation, p.168.



Fig. 31: *Window Colour – Window Shape Combinations tested within Study 4*

The colour impression naturally is not identical with real life.

Source: author's photography

Procedure

The participants were seated at a table in an artificially illuminated testing room equidistant from the light overhead but, to avoid reflection, not directly under it. The room was part of the Retail Research Laboratory, Hasselt University, Belgium.

Written instructions were given to the participants before the test, which was divided in two parts, the first of which was conducted prior to letting the test persons test the cooked penne pasta. Each person was handed one of the six boxes. The participants were asked to keep in mind they were about to evaluate a packaging that is in its development stage and to rate the box on diverse Visual Analogue Scales (VAS) of 10 cm length. Four scales had two opposing words on each side of which one was high-pitched and the other one low-pitched (Lula/Ruki; Maluma/Takete; Decter/Bobolo; Kiki/Bouba). One scale had a rounded shape opposed to an angular shape on each side.

Additionally, the following VAS were used with the title referring to them in front of the brackets: Packaging attractiveness (bad vs. good; unattractive vs. attractive); Product attractiveness (bad vs. good; unattractive vs. attractive); Expected taste (bad vs. good; not appetizing vs. appetizing; not tasty vs. tasty); Purchase likelihood (low vs. high).

Also the participants were asked to state a maximum price they would pay for the product. After having finished the first part of the test it was removed so that the participants could not see anymore what they had answered.

The participants were handed the second part of the test and were served 3 cooked penne on a dish accompanied by a fork. The box was not removed from the table.

The second part of the test again contained diverse VAS. These were: Taste comparison (worse vs. better); Product attractiveness (bad vs. good; unattractive vs. attractive); Actual taste (bad vs. good; not appetizing vs. appetizing; not tasty vs. tasty); Purchase likelihood (low vs. high). Again the participants were asked to state a maximum price they would pay for the product.

As a final instruction the participants were requested to fulfil some tasks in the artificial supermarket connected to the testing room. These tasks had no relevance and were only used to reduce the probability that test persons would talk to each other about the boxes. The test was conducted in English or Dutch depending on the participants' preferences and lasted for about 10 minutes.

Data analysis

For all scales the distance from midpoint to the marks by the participants were measured with millimetre accuracy. If the distance of the mark to the high-pitched words, the angular shape or an unsatisfied feedback was smallest the difference from the midpoint to this mark was noted with a minus in front, and with a plus if the difference was lower towards the round shape, the low-pitched word or a satisfied feedback. If the mark was identical with the midpoint a 0 was noted. The stated maximum prices were transferred into the Software as they were. A list containing the replies of each person was the basis for the statistical analysis, which was performed using SPSS version 21 for Macintosh (IBM Corporation, Armonk, USA).

4.4.3 Abstract of the Analyses & Conclusion

The research showed significant effects for window shape and window colour, though the window shape had more often significant effects. This goes along with the fact that window shape in most of the examined effects was stronger than window colour. Particularly this was true for the perceived packaging shape where the window shape explained 11% of the variance but the window colour none.

The few effects that have been documented for window colour primarily refer to the blue

window. In this the perception of the participants after seeing and eating the unpackaged penne was that the expected taste was significantly lower than the actual taste. In fact the expected taste for blue windows was not significantly lower than the expected taste for uncoloured or yellow windows. But the actual taste perception of blue windows was significantly higher than that for uncoloured or yellow windows. This is to some extent explainable by a halo effect so that the positive impression that the taste is much better than expected is also expanded to the actual taste impression.

In general angular windows lead to more positive ratings than round and did so in a wide range of the examined areas. This clearly contradicts the theory that rounded shapes are generally preferred against angular.

As no interaction effects have been documented there is no evidence for a possible unity perception that could have increased specific effects. However in some cases particularly those combinations of window colour and window shape with identical shape perceptions lead to interesting but often conflicting results.

4.4.4 Detailed Analyses - Table of Content

Analysis of Variance - Overview	99
Existence of significant Effects	100
Evaluation of the Effect Strength	102
Significant Effects for one specific Factor	102
Significant Effects for two specific Factors - fixed Window Colour	104
Significant Effects for two specific Factors - fixed Window Shape	107
Repeated measures - Analysis of effect changes	110

4.4.5 Analysis of Variance - Overview

A two factor analysis of variance (ANOVA) was performed for each variable. For this it was first examined whether the necessary conditions could be fulfilled.

Based on box plots no strong outliers () were detected. Furthermore, a normal distribution of the residuals can be assumed since each group was ≥ 30 and because no extremely skewed or exceptional distributions were detected. In addition the sample sizes were nearly equal.

Finally homogeneity of variance was also fulfilled since sample sizes were almost identical.

After this it was checked with Cronbach's Alpha tests whether the several variables belonging to one scale could be combined without distorting the outcomes.

In all cases (A. packaging attractiveness; B. product attractiveness; C. expected taste of the penne; H. product attractiveness; I. actual taste of the penne) Cronbach's Alpha was higher than 0,7. Hence the variables were combined by generating their averages. These were used for the following analysis.

The two-factor analysis of variance reviewed three global effects. These were the main effects (shape and colour) and their interaction. In the case of shape a significant main effect indicates a difference of the mean values in the groups round and angular.

In the case of colour a significant main effect indicates that non-specified colours differ significantly. Hence pairwise comparisons need to be used to specify these differences. Pairwise comparisons will also be used to determine further specific and significant differences within all 6 examined groups. Hence the analysis will be performed in the above order and thus starts with inspecting for which factors unspecified but significant effects occurred. After this the concrete effects will be examined.

4.4.6 Existence of significant Effects

From the between-subjects effects it becomes clear that shapes as well as colours have significant influences. Though for the interactions of shape and colour there has been no significant effect.

Shapes have been shown to significantly influence the following factors prior to seeing and eating the unpackaged penne: A. packaging attractiveness ($p=0,011$), C. expected taste of the penne ($p=0,048$), D. purchase likelihood ($p=0,036$) and F. perceived packaging shape ($p=0,0$).

Additionally shape had a significant influence after seeing and eating the unpackaged penne on: I. actual taste of the penne ($p=0,005$) and J. purchase likelihood ($p=0,039$).

Colours have been shown to significantly influence the following factors after seeing and eating the unpackaged penne: G. taste comparison ($p=0,032$) and I. actual taste of the penne ($p=0,041$). For J. purchase likelihood colour is close to have a significant influence ($p=0,055$).

	Window shape	Window colour
Before seeing and eating the unpackaged penne		
A. packaging attractiveness	significant effect	---
B. product attractiveness	---	---
C. expected taste of the penne	significant effect	---
D. purchase likelihood	significant effect	---
E. maximum accepted price	---	---
F. perceived packaging shape	significant effect	---
After seeing and eating the unpackaged penne		
G. taste comparison	---	significant effect
H. product attractiveness	---	---
I. actual taste of the penne	significant effect	significant effect
J. purchase likelihood	significant effect	nearly significant effect
K. maximum accepted price	---	---

Tab. 16: *General significant Effects of Window Colour and Window Shape*

Conclusion

Shape had significant effects for 6 different variables, while colour only had significant effects in two, respectively three if the p-value of 0,055 was still accepted.

4.4.7 Evaluation of the Effect Strength

From the tests of between-subjects effects for the significant factors the following percentaged effects on the examined variances have been documented (partial eta squared).

	Window shape	Window colour
Before seeing and eating the unpackaged penne		
A. packaging attractiveness	3,5%	---
C. expected taste of the penne	2,1%	---
D. purchase likelihood	2,4%	---
F. perceived packaging shape	11,0%	---
After seeing and eating the unpackaged penne		
G. taste comparison	---	3,8%
I. actual taste of the penne	4,2%	3,5%
J. purchase likelihood	2,3%	(3,2%)

Tab. 17: Strength of general significant Effects of Window Colour and Window Shape

Conclusion

Due to comparison of the partial eta squared results while including if the factor was significant it became clear that in all cases except for the taste comparison (G.) shape has had a stronger influence than colour.

4.4.8 Significant Effects for one specific Factor

From pairwise comparisons it becomes clear that the window shape generated the following concrete and significant effects.

Before seeing and eating the unpackaged penne

A. packaging attractiveness: angular windows lead to significantly better ratings than round windows (Mean: 0,394 vs. -0,396) (p=0,011).

C. expected taste of the penne: angular windows lead to significantly better ratings than round windows (Mean: 1,739 vs. 1,235) (p=0,048).

D. purchase likelihood: angular windows lead to significantly better ratings than round windows (Mean: 0,503 vs. -0,188) ($p=0,036$).

F. perceived packaging shape: angular windows were perceived as significantly more angular than round (Mean: -5,538 vs. 0,856) ($p=0,0$).

After seeing and eating the unpackaged penne

I. actual taste of the penne: angular windows lead to significantly better ratings than round windows (Mean: 1,608 vs. 0,840) ($p=0,005$).

J. purchase likelihood: angular windows lead to significantly better ratings than round windows (Mean: 1,151 vs. 0,474) ($p=0,039$).

For colours the following concrete significant effects appeared.

After seeing and eating the unpackaged penne

G. taste comparison: blue windows had significantly higher ratings in comparison with the expected taste than uncoloured windows (Mean: 1,128 vs. 0,280) ($p=0,011$).

I. actual taste of the penne: blue windows had significantly better ratings than uncoloured windows (Mean: 1,683 vs. 0,853) ($p=0,013$).

(Given J. purchase likelihood would be significant blue windows would have had significantly better ratings than uncoloured windows (Mean: 1,161 vs. 0,261) ($p=0,025$).

Conclusion

In all significant cases the angular window lead to more positive ratings than the round window. In those cases where colour had an effect this was in comparison of blue and uncoloured windows. Interestingly people who saw a blue window experienced, after having eaten the penne, a higher difference of expected and actual taste than those with uncoloured windows. But in fact the expected taste was not significantly different prior to eating the penne to what other groups expected. Furthermore for those with a blue window the actual taste was significantly higher than for uncoloured windows and had a nearly significantly higher purchase likelihood as well. The further tests will show if the above effects are generic or apply only to specific shapes and colours.

	Window shape		Window colour		
Before seeing and eating the unpackaged penne	Angular	Round	Uncoloured	Yellow	Blue
A. packaging attractiveness	better	worse	---	---	---
C. expected taste of the penne	better	worse	---	---	---
D. purchase likelihood	higher	lower	---	---	---
F. perceived packaging shape	more angular	more round	---	---	---
After seeing and eating the unpackaged penne					
G. taste comparison	---	---	worse than blue	---	better than uncoloured
I. actual taste of the penne	better	worse	worse than blue	---	better than uncoloured
J. purchase likelihood	higher	lower	(lower than blue)	---	(higher than uncoloured)

Tab. 18: Concrete significant Effects of Window Colour and Window Shape in general

4.4.9 Significant Effects for two specific Factors - fixed Window Colour

Some further significant effects within specific colour-shape pairings have been examined using pairwise comparisons. In this for one-tailed tests (unidirectional hypotheses) the p-values can be divided by 2. Hence the following significant differences between specific pairs have been documented.

Before seeing and eating the unpackaged penne

A. packaging attractiveness:

Yellow angular windows had significantly better ratings than round ($p=0,086$): Mean values angular (0,715) vs. round (-0,213).

Uncoloured angular windows had significantly better ratings than round ($p=0,008$): Mean values angular (0,561) vs. round (-0,873).

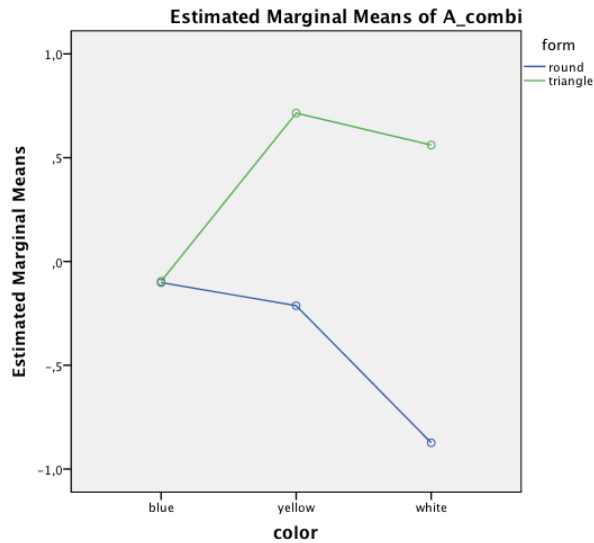


Fig. 32: Effects of Window Shape and Window Colour on Packaging Attractiveness

D. purchase likelihood:

Uncoloured angular windows had significantly better ratings than round (not exactly significant as $p=0,107$): Mean values angular (0,647) vs. round (-0,270).

F. perceived packaging shape:

Blue angular windows had significantly more angular ratings than round ($p=0,000$): Mean values angular (-5,729) vs. round (2,688).

Uncoloured angular windows had significantly more angular ratings than round ($p=0,001$): Mean values angular (-5,634) vs. round (2,533).

After seeing and eating the unpackaged penne

I. actual taste of the penne:

Yellow angular windows had significantly better ratings than round ($p=0,024$): Mean values angular (1,677) vs. round (0,596).

Uncoloured angular windows had significantly better ratings than round ($p=0,067$): Mean values angular (1,287) vs. round (0,418).

J. purchase likelihood:

Yellow angular windows had significantly better ratings than round ($p=0,086$): Mean values angular (1,507) vs. round (0,526).

	Window colour					
	Uncoloured		Yellow		Blue	
Before seeing and eating the unpackaged penne	Angular	Round	Angular	Round	Angular	Round
A. packaging attractiveness	Better	Worse	Better	Worse	---	---
D. purchase likelihood	(Higher)	(Lower)	---	---	---	---
F. perceived packaging shape	Perceived as more angular	Perceived as more round	---	---	Perceived as more angular	Perceived as more round
After seeing and eating the unpackaged penne						
I. actual taste of the penne	Better	Worse	Better	Worse	---	---
J. purchase likelihood	---	---	Better	Worse	---	---

Tab. 19: Concrete significant Effects of Window Shape – Window Colour fixed

Conclusion

Angular uncoloured windows were rated significantly better/stronger in packaging attractiveness, perceived angularity and actual taste than round. Also yellow angular windows and also those which generate a doubled angular impression lead to significantly higher packaging attractiveness, better taste and higher purchase likelihood. This could, beside the fact that angularity was preferred in general, also indicate a crossmodal correspondence between yellow and angular window shape. But as no significant difference in perceived packaging shape occurred for yellow windows be they round or angular this cannot be confirmed. For blue no unexpected effects have been shown in this part of the analysis. It has only been documented that for round windows blue led to a more round perceived packaging shape than for angular windows.

4.4.10 Significant Effects for two specific Factors - fixed Window Shape

Again pairwise comparisons have been conducted which this time are used for fixed window shapes. As before the p-values can be divided by 2.

Before seeing and eating the unpackaged penne

E. Maximum price:

Angular uncoloured windows had better ratings than yellow (not exactly significant as $p=0,112$): Mean values uncoloured (2,442) vs. yellow (1,865).

F. perceived packaging shape:

Round yellow windows had significantly more angular ratings than blue ($p=0,023$): Mean values yellow (-2,652) vs. blue (2,688).

Round yellow windows had significantly more angular ratings than uncoloured ($p=0,030$): Mean values uncoloured (2,533) vs. yellow (-2,652).

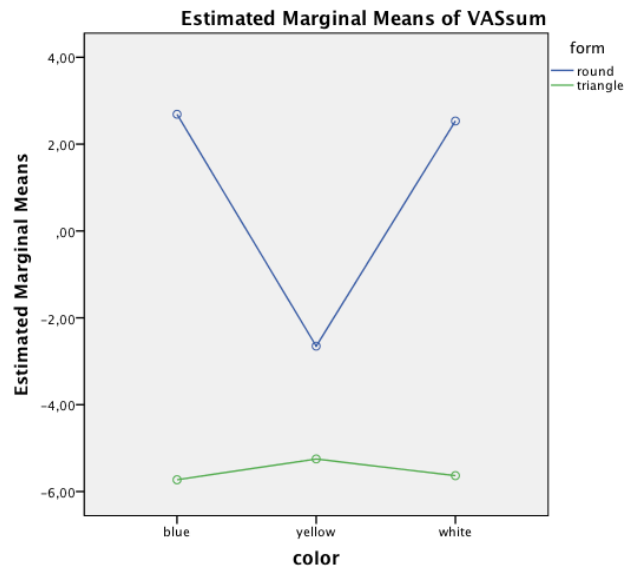


Fig. 33: Effects of Window Shape and Window Colour on perceived Packaging Shape

After seeing and eating the unpackaged penne

G. taste comparison:

Round blue windows had significantly more positive comparison ratings than yellow ($p=0,076$): Mean values yellow (0,213) vs. blue (1,041).

Round blue windows had significantly more positive comparison ratings than uncoloured ($p=0,031$): Mean values uncoloured (0,020) vs. blue (1,041).

I. actual taste of the penne:

Round blue windows had significantly better ratings than yellow ($p=0,053$): Mean values yellow (0,596) vs. blue (1,507).

Round blue windows had significantly better ratings than uncoloured ($p=0,022$): Mean values uncoloured (0,418) vs. blue (1,041).

J. purchase likelihood:

Round blue windows had significantly better ratings than uncoloured ($p=0,079$): Mean values uncoloured (-0,050) vs. blue (0,947).

Angular yellow windows had significantly better ratings than uncoloured ($p=0,099$): Mean values uncoloured (0,572) vs. yellow (1,507).

	Window shape					
	Angular			Round		
Before seeing and eating the unpackaged penne	Un-coloured	Yellow	Blue	Un-coloured	Yellow	Blue
E. Maximum price	(Better than yellow)	(Worse than uncoloured)	---	---	---	---
F. perceived packaging shape	---	---	---	Perceived as more round than yellow	Perceived as more angular than blue and uncoloured	Perceived as more round than yellow
After seeing and eating the unpackaged penne						
G. taste comparison	---	---	---	lower taste increase than blue	lower taste increase than blue	higher taste increase than yellow and uncoloured
I. actual taste of the penne	---	---	---	Worse taste than blue	Worse taste than blue	Better taste than yellow and uncoloured
J. purchase likelihood	Worse than yellow	Better than uncoloured	---	Worse than blue	---	Better than uncoloured

Tab. 20: Concrete significant Effects of Window Colour – Window Shape fixed

Conclusion

For angular windows only two specific effects have been confirmed that arise from different colours. Uncoloured angular windows lead to higher maximum prices prior to tasting the penne than yellow. On the other hand yellow angular windows lead to higher purchase likelihood after eating the penne than uncoloured.

It has also been shown that contrary to that indicated previously, blue had not general effect but only one for round windows. For blue round windows the perception after eating the penne was that the taste expectation was much worse than the actual taste, which was significantly different to uncoloured or yellow windows. The effect is fascinating as this increase is high enough to even lead to better taste impressions than uncoloured or yellow and higher purchase likelihood than the uncoloured comparison window. Thus apparently a halo effect occurred that led to the situation that an unexpected positive impression of the product was extended to other categories but only in case of round windows.

Additionally, colour had a significant effect on the packaging shape perception only in case of round windows so that yellow round windows were perceived as more angular than blue or uncoloured windows. Hence it can be assumed that yellow in context with angular windows is too weak to further increase the impression of angularity that is given by the angular shape already, while for round shapes which do not indicate angularity, yellow has an effect.

4.4.11 Repeated Measures - Analysis of Effect Changes

Repeated measures analyses with the between-subjects factors shape or colour have been conducted for those variables that appeared in the first part (M1 = Before seeing and eating the unpackaged penne) as well as the second part of the questionnaire (M2 = After seeing and eating the unpackaged penne) to test whether their changes have been dependent on colour or shape. Hence first it was analysed by using the tests of within-subjects effects whether the variables have changed significantly from the first towards the second part of the questionnaire. In the next step it was tested whether within the range of shapes or colours there have been significant differences for the examined factor independent from the time of measurement. Finally in a third step it was tested whether the changes between the two different times of measurement are depending on the shape or colour.

From the table below it becomes clear that only for the purchase likelihood independent from colour or shape significant changes between the different times of measurement (M1 and M2) occurred ($p=0,00$). The differences though have only been significantly dependent on colour ($p=0,016$) but not on shape ($p=0,919$). On the other hand on one occasion of measurement the differences between the examined groups could not be explained by colour ($p=0,397$) but by shape ($p=0,015$).

	Within subjects (main effect) p-value	between subjects effects p-value	within subjects (interacting effect) p-value
E.&K. Maximum price			
Shape	0,84	0,596	0,622
Colour	0,82	0,282	0,139
B.&H. product attractiveness			
Shape	0,058	0,143	0,615
Colour	0,055	0,904	0,202
C.&I. Expected and Actual taste of the penne			
Shape	0,73	0,005	0,397
Colour	0,69	0,216	0,09
D.+J. purchase likelihood			
Shape	0	0,015	0,919
Colour	0	0,397	0,016

Tab. 21: Effect changes from M1 to M2

Conclusion

Only in case of purchase likelihood the significant changes from M1 to M2 have been explainable by the window colour.

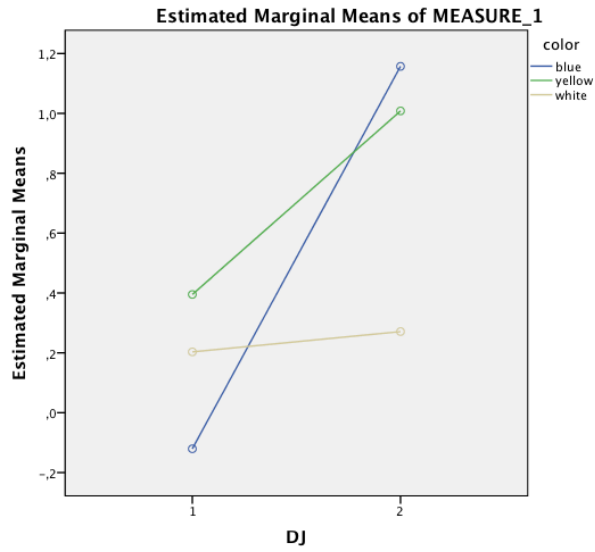


Fig. 34: Effect Changes for Purchase Likelihood from M1 to M2 based on Window Colour

Measure: MEASURE_1

color	D J	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
blue	1	-,121	,282	-,677	,436
	2	1,157	,281	,603	1,711
yellow	1	,395	,287	-,170	,960
	2	1,008	,285	,445	1,571
white	1	,203	,284	-,357	,764
	2	,271	,283	-,288	,830

Tab. 22: Effect Changes for Purchase Likelihood from M1 to M2 based on Window Colour

5 Discussion and Conclusion

Within Chapter 5 all results of the practical studies will be considered to evaluate the hypotheses of Chapter 3 and to formulate Conclusions, Implications and Limitations that arise from this research.

5.1 Analysis of the Hypotheses

General Hypotheses

H1. The window shape will have a significant influence on the product perceptions.

From study 4 it became clear that the window shape had significant effects on packaging attractiveness, expected taste of the penne, purchase likelihood, perceived packaging shape, actual taste of the penne and purchase likelihood after eating the penne. Hence H1. can be confirmed.

H2. The window colour will have a significant influence on the product perceptions.

From study 4 it became clear that the window colour only had significant effects on taste comparison and actual taste of the penne. A close to significant effect was shown for purchase likelihood after eating the penne. Hence H2 can be resumed. Although it has to be noted that only very few significant effects have been shown for the window colour.

Influence of the Window Shape on the Product Perception

H1a. A round as opposed to an angular window shape will lead to different product perceptions for food products with neutral shape.

H1a1. A round as opposed to an angular window shape will lead to better product perceptions for food products with neutral shape.

As shown in study 4 for many factors there have been significant differences between angular and round windows. Furthermore, since actually angular windows lead to perceived more angular packaging shapes while round lead to perceived more round packaging shapes it can be stated that the different shape perceptions that were intended actually have been implemented. Still in all significant cases the results were clearly opposite to what was expected so that round shaped windows never led to more positive results than angular.

In fact angular windows led to significantly more positive product perceptions. This was the case although study 1 showed clearly that both shapes were rated comparably usable and

were estimated to have comparably high usage possibilities. Hence H1a1 can be confirmed while H1a11 must be rejected.

H1b. The window shape will have an effect on the product perception after seeing and eating it unpackaged.

Within study 4 the window shape has been shown to significantly influence the actual taste of the penne and the purchase likelihood after eating the product. Thus H1b can be retained.

No significant effects have been shown for product attractiveness and accepted maximum price.

H1c. The window shape will have an effect on the product perception lasting from prior to after seeing and eating it unpackaged.

From chapter 4.4.11 Repeated Measures - Analysis of Effect Changes it becomes clear that except for purchase likelihood no significant changes have been documented for the effects that have been examined both before and after seeing and eating the unpackaged penne. Further in no case changes between the times of measurement were explainable by the window shape. Thus in line with the overall results of study 4 which showed positive effects for angular windows it can be stated that the effects caused by the window shape are lasting from before until after seeing and eating the unpackaged penne. This is also true for those parameters where no significant effect has been examined for the window shape.

Influence of the Window Colour on the Product Perception

H2a1. If the window colour is contradictory to the expected product colour it will be less accepted than other window colours.

H2a11. A window colour that virtually increases the product colour saturation will be preferred against others.

From Study 3 it became clear that yellow which is close to the natural colour of penne was not rated significantly more often usable in percentage for penne packaging windows than green, red or blue window colours. Also yellow (75 and 86.5) was not rated to have a higher usage possibility for penne packaging windows than Blue75. Additionally, it has been shown for general food packaging that blue was not rated less usable and was not given a lower usage possibility for general food than other colours although barely any food product might actually be blue. In fact blue was even preferred against yellow, red and green for general

food packaging windows. On the other hand yellow was only preferred against green for penne packaging windows and estimated to have a higher usage possibility for penne packaging than red.

On examining Tab. 20: Concrete significant Effects of Window Colour – Window Shape fixed it becomes clear that also within study 4 barely any significant differences for yellow, uncoloured or blue windows have been shown before eating the penne. Further only one significant difference between yellow and uncoloured windows occurred after eating the product. In fact the perceived taste increase (taste comparison) and actual taste rating was significantly higher for blue than for yellow or uncoloured. Thus the impression after eating the penne was that the first idea about the potential taste was much worse for blue windows than actually perceived. Also for blue the purchase likelihood after seeing and eating the unpackaged penne was significantly higher than for uncoloured.

In result H2aI must be rejected since blue, which is different to the expected colour of penne (blue is the complementary colour to yellow) did not lead to significant differences prior to eating the penne and in fact even to some positive differences compared to yellow or uncoloured after eating the penne.

Also H2aII needs to be rejected as yellow did not show significant differences to uncoloured windows except for the connection to angular windows where it once even led to nearly significantly lower maximum prices than uncoloured prior to eating the product.

H2bI. A round as opposed to an angular window colour will lead to different product perceptions for food products with neutral shape.

H2bII. A round as opposed to an angular window colour will lead to better product perceptions for food products with neutral shape.

To only focus on the relevant influences that the perceived shape of blue or yellow had in comparison one has to first examine whether or not these colours actually influenced the perceived packaging shape or not. This actually has only been documented in case of round windows where as expected yellow windows lead to more angular perception of the window than blue or uncoloured and blue lead to more round perception than yellow but not than uncoloured windows.

Significant or nearly significant differences for round window shapes between the colours have further only been examined for taste comparison, actual taste of the penne and purchase likelihood after tasting the penne. To once again only examine the effects of different shape perceptions the category purchase likelihood after tasting the penne is not

relevant anymore since yellow and blue windows did not differ significantly. Hence only two significant differences between yellow and blue have been examined and only in case of round windows.

Thus because the window colour barely had a relevance for the perceived packaging shape and because only in two cases significant differences between an angular (yellow) and a round window colour have been confirmed it seems vague to believe in a relevance of the perceived shape that a window colour for food packaging has.

Following on from this H2bl has to be rejected which thus also results in rejecting H2bII.

H2c. The window colour will have an effect on the product perception after seeing and eating it unpackaged.

From Study 4 it became clear that in fact window colour primarily had an effect after eating the product as taste comparison, actual taste and purchase likelihood after eating the penne have been significantly different for different colours. Just in very few shape specific cases⁶⁸ different colours resulted in different perceptions prior to eating the penne. Thus H2c can be retained.

H2d. The window colour will have an effect on the product perception that changes from prior to after seeing and eating it unpackaged.

Since barely any effects of window colours prior to seeing and eating the unpackaged penne have been documented within study 4 while a few have been shown afterwards one can certainly agree that the impact of window colour has changed between both times of measurement. In fact in case of the purchase likelihood, which is the only documented significant effect change, the window colour significantly explains this outcome⁶⁹.

Thus despite the low general relevance of the window colour that has been documented it is feasible to retain H2d.

⁶⁸ See Tab. 19: Concrete significant Effects of Window Shape – Window Colour fixed, p.106.

⁶⁹ See Tab. 21: Effect changes from M1 to M2, p.111.

Influence of Window Shape and Colour on the Product Perception

H3a. Depending on the impact strength of both factors shape–colour congruency (an angular shape combined with an angular window colour or a round shape combined with a round window colour) will lead to a more positive overall product perception compared to shape–colour incongruence.

Within study 4 no significant interaction effects of window colour and window shape have been documented. However, to at least verify if some effects that concord with the unity theory occurred, it is necessary to find variables that have shown significant differences between the different pairings of yellow and blue window colour with angular and round window shapes.

Yellow angular windows have led to lower maximum prices prior to eating the penne than the uncoloured control group. This is the case although both yellow and the angular shape interact crossmodally. Hence although the perceivable angularity of the window shape has been shown to be of positive influence the theoretical angularity of the yellow window foil did not improve the perceptions but devalued them. Here it needs to be mentioned again that no colour could influence the packaging shape perception for angular windows significantly. The combinations of blue window colour and round window shape also did not lead to an increased perception of roundness compared to the uncoloured control group so that again not even any increase in perceptual roundness has been documented. Just blue rounded windows led to a higher actual taste than both yellow rounded or uncoloured rounded windows. Yellow angular windows only after eating the penne led to higher purchase likelihoods than uncoloured angular windows but again not than blue windows which would have been the case if the unity theory was true for window colour and window shape.

Focusing on these outcomes there are too few cases where a combination of perceived same shaped window frame and window colour was resulting in more positive outcomes than other groupings and further many cases where the opposite was true. Thus H3a needs to be rejected.

H3b. The influence of window colours on the product perception will be stronger than the influence that window shapes have on the product perception.

As shown in Study 4 in all cases except for the taste comparison (G.) shape has had a stronger influence than colour. This is generally true since window colour did not have any effect in most cases where window shape had an effect but also because the window shape

explained 4,2 % of the variance in the actual taste of the penne whereas the window colour only explained 3,5%. Just for the taste comparison it is that window shape as it did not have a significant influence here needs to be valued with 0% while window colour explained 3,8% of the variance. Thus H3b needs to be rejected.

5.2 Theoretical Contribution

The results of this thesis highlight the existence of reliable crossmodal correspondences between window shape or window colour of food packaging and the product perceptions. Nevertheless, they also bear comparison with other research as this apparently is the first research of its kind. Several interesting and surely valuable outcomes for marketing and packaging design have thus been documented. Amongst these are results, which might have been expected but also such which seemed completely unexpected. Of course also some limitations need to be considered that could explain differences between hypotheses and factual results, which will happen in chapter 5.4.

It has been shown that in fact the shape perception of colours at least for transparent foils but most probably in general is depending on the perceived value of the colour tested. This result is apparently unique as former research in all known cases only compared one colour value for different hues but not several colour values of the same hue (Albertazzi et al., 2012; Malfatti et al., 2014; Chen, 2014; Kobbert, 2011; Dumitrescu, 2003,2011). The results thus also explain a wide range of the different outcomes that those studies had referring to the shape colour associations.

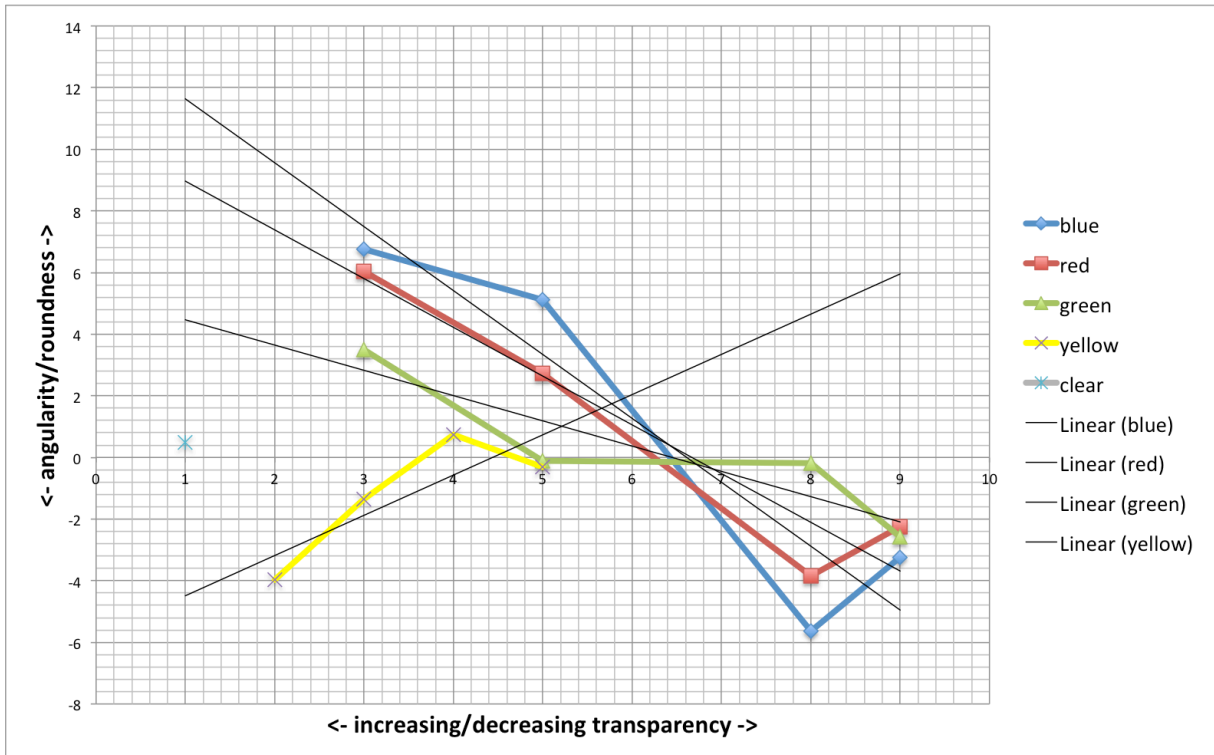


Fig. 35: Descriptive Results of Studies 2 (red and blue) and 3 (green and yellow)

Source: author's illustration

On the other hand highly anticipated outcomes like that unusual colours will not be accepted for food packaging windows have been refuted. Interestingly too, colours that did fit to the product in terms of identical or similar hue were not significantly preferred for food packaging windows. This to some extent is consistent with the steady use of various coloured bottles for beverages, which sometimes are the same as the liquids inside and sometimes not.

Additionally, it has also been shown that for food packaging and penne pasta packaging coloured transparent foils with higher TIV are preferred against those with lower TIVs while uncoloured foils generally are preferred against coloured. Still as the colour was not relevant prior to eating the product because it did barely show significant effects but had significant and often positive effects afterwards this conscious refusal of coloured compared to uncoloured windows is apparently not of high relevance in practice.

The fact that angular window shapes were in all significant cases preferred to rounded window shapes is further in strong contrast to the results by Westerman et al. (2012) or Bar & Neta (2006), who state to have documented an overall preference for rounded shapes.

As it has clearly been documented that the angular shape was perceived as angular and the

round shape was perceived as round in the pretest but also in the main test, one cannot agree that this theory is complete. Within the conducted pretests the only significant difference despite their perceived shape that has been documented for both window shapes was a difference in how often each form was preferred for general food packaging. But in contrast to the results of the main test that included 186 participants the rounded form was preferred against the angular one. Therefore this difference does not explain why the angular shape was rated significantly better than the round one when being used on the factual packaging.

The perceived shape of the window colour was of no relevance also not in connection with the perceived shape of the window frame as no interaction effect has been documented. Thus concerning the perceived shape of a window colour any colour could be used for any window shape while designing a food packaging.

A possible unity perception for the perceived shapes of window colour and window shape, which could have increased specific outcomes also was not documented. Again other factors were more important for the ratings than the shape of the window colour.

The window shape had stronger effects for nearly all variables than the window colour. Hereby it can be assumed that if the window shape is chosen correctly the window colour is barely relevant, which is in line with Jutharath (expert interview II, 2014).

In conclusion even though the window colour did not show as many significant effects as the window shape and barely did so before seeing and eating the penne unpackaged the conceptual model was widely confirmed. Following 'Tab. 16: General significant Effects of Window Colour and Window Shape' the conceptual model has to be restructured as below.

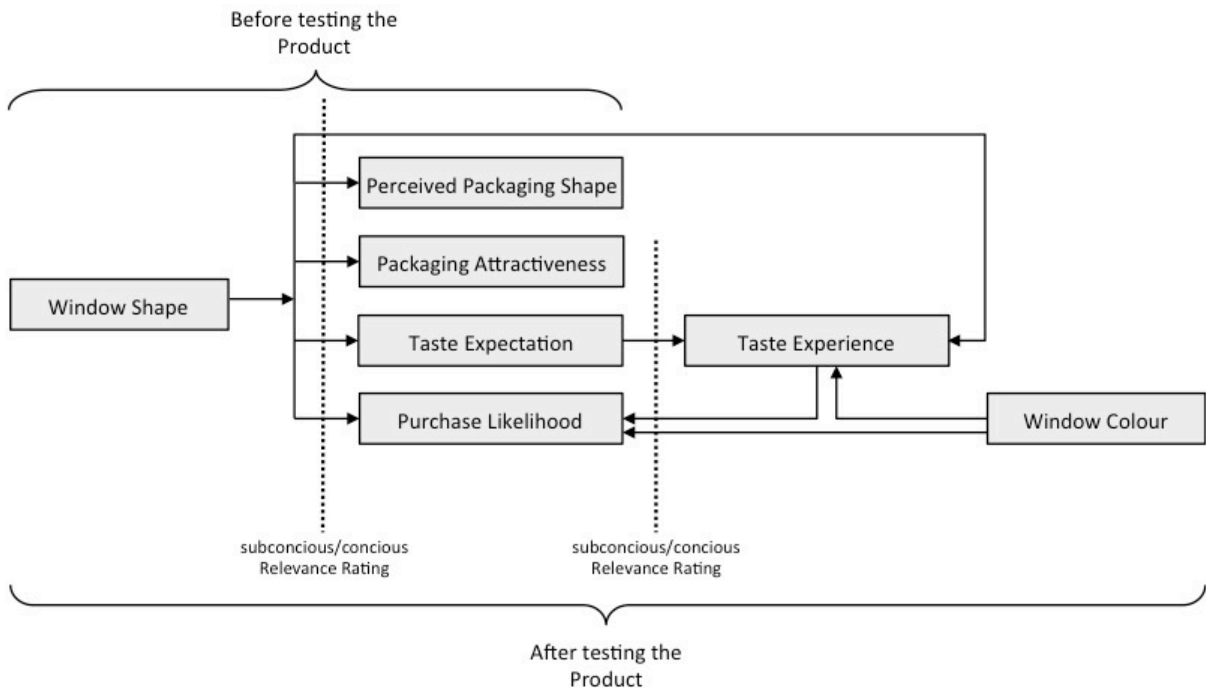


Fig. 36: *Reworked conceptual Model – Influencing the Consumer by Window Shape and Colour*

Source: author's illustration

5.3 Implications for Managers

Packaging design for food is as much variable as its content. Though it seems feasible to state that for managers or project coordinators in packaging design like Mr. Schmitt at Migros Cooperative Alliance (expert interview I, 2014) there is a need to focus on aspects of food packaging windows not only out of a production cost based or creative view but also in a scientific way. Since it has been shown that transparent packaging for many food products can lead to increased consumption (Deng & Srinivasan, 2013) it first of all needs to be evaluated whether the corresponding food product that shall be packaged also is appropriate for a transparent packaging design. If this is the case possible food packaging windows should primarily be tested concerning the effect that their shapes have on consumers while the testing of window colours at first seems of secondary relevance. Hereby the potential cost factor of the corresponding research seems to be in no proportion to the possible costs for recalibrations of machines, redesigns and potentially lost sales like Barilla might have

suffered in the past on the US market⁷⁰. Apparently marketers should in fact prefer angular window shapes against rounded while this preference of customers might also depend on the product and the proportions of the packaging window⁷¹.

By doing so, positive effects on the product perception by up to 4,2 % can be expected while also the overall packaging design might be perceived as 11% more angular.

It has been shown that at least packaging attractiveness, expected taste, purchase likelihood before and after testing the product and actual taste of the product can be increased significantly by using specific window shapes. Thus the proper use of this tool can probably easily be translated into higher returns on investment.

While the window shape has been proved to be of relevance for the product perceptions in a wide range of aspects before the product is tested and hence before purchasing it this has not been documented for window colours.

Still for those it has been shown that the actual taste and the purchase likelihood can be increased after testing the product by making use of a colour that does not correspond to the usual product colour. The problem here is that although there is no significant difference in the product perception before eating the product, the customers believe after eating it that they had a comparably bad first impression. It could thus be that in other scenarios in fact certain colours will lead to negative results before a customer purchases or tests the product. Hence the usage of such colours for transparent windows seems very risky but could be implemented based on the expectation that a window colour might not have significant effects prior to consumption but afterwards. In case marketers decide in favour of coloured transparent materials an aspect, which naturally has not been part of this thesis could help to officially reason their decision. Studies confirm that coloured transparent against uncoloured foils can be an effective tool to protect food, which shall be visible from degeneration (Intawiwat et al., 2010; Myhre et al., 2012). This is in line with some of the reasoning for a use of coloured bottles for beverages.

A by-product of this research has been the outcome that lighter colours are tendentially perceived as more round. For the window colour this is not highly relevant because the perceived shape of the window colour did not have effects on the product perception and because purely highly transparent and thus perceived light foils were accepted. However for other packaging aspects it might be valuable to know that for example a dark green

⁷⁰ See Fig. 1, p.5. Unfortunately within 4 months of constant email and phone inquiries the corresponding packaging designer of Barilla did not reply to any questions.

⁷¹ See 5.4 Limitations and Recommendations for future Research, p.123.

packaging will be perceived as more angular than a light green while the hue in general is not as relevant.

Finally if a marketer opts for a certain window shape or certain window colours a few specific combinations of those will lead to different effects. Hence it is again useful to implement corresponding research in advance of launching a new food packaging with transparent windows.

In summary, marketers should consider designing food packaging windows only after conducting similar to the presented research. In this of course possible corporate colour palettes, packaging colour, packaging shape, logo and graphics will need to be considered in addition to the food packaging window. However, it is surely feasible to state that the design of food packaging windows deserves its share in the overall packaging design process. This underestimated tool could indeed become one of the sensorial manipulation mechanisms that clever marketers are looking for to achieve the best possible product presentation.

5.4 Limitations and Recommendations for future Research

Successful and effective packaging design surely is more complicated and complex than any book or research paper ever can be. However, a few recommendations for future research with specific connection to window design of food packaging shall be given. By doing so, limitations of this research will also be examined.

Starting with the differences between hypotheses and factual outcome possibly the triangle window shape could have been perceived as more usual than the rectangle. But within the pretest no different usability ratings or estimated usage possibilities have been confirmed. Further crossmodal correspondences between the triangle window shape and the angular test packaging seem possible. But this would be in contrast to Westerman et al. (2012) who showed that round graphics were also preferred on angular packaging. Also the proportions of triangle and rectangle could have had an effect so that differently shaped window pairings need to be tested to examine if the proportions have a relevance to the effects that window shapes trigger. But furthermore the size of the window shapes could have had a relevance so that a smaller window might lead to different effects than a big one. Of course the proportions of the packaging, its size and the weight of the penne insight might all have had a certain relevance for the product perception so that elongated packaging as Raghurir & Krishna, (1999) and Silayoi & Speece (2007) stated could have further influenced the effects of different window shapes.

Although contrary to the above, it could simply be that as Becker et al. (2011) and Ngo et al. (2011) have documented before the angular shape triggers a stronger taste perception, which could have influenced the whole rating positively. The results of this thesis seem to confirm this theory. Still future research must test the relevance of the aforementioned aspects.

The small differences between the effects of differently coloured foils could be a result of the high TIV, which was chosen as lower TIVs were rejected by the test persons. Perhaps the colours were thus not strong enough to result in more significant effects. Because of this low presence also no unity effects for window colour and window shape could have occurred. As a result the window shape also had a stronger impact on the product perceptions.

Still, this is in contrast to the fact that some significant effects for the window colours occurred, which indicates that they were strong enough to possibly result in effects.

Most probable seems that all colours were perceived strongly enough but simply the test persons did not merge the colour perceptually with the product attributes except after eating the product. Again this needs to be tested in future research.

A preference for blue windows on general food packaging could be explained by the perception that possibly blue is closer to the uncoloured window which was overall preferred to any other coloured window. Possibly blue led to some better results within the practical test with penne because it is the complementary colour for yellow and thus in line with the simultaneous contrast theory increased the perception of the saturation that the cooked penne had when they were served. Still, this would be in contrast to the result that the yellow window did not generate such results although it directly increased the product saturation of the packaged penne.

Furthermore, bearing in mind the seemingly infinite amount of possible hues certainly some of which could result in different effects than the four tested. It is obviously relevant to test diverse hues also in context to differently coloured food products so that certain window colour - food colour combinations could evoke new and thus far undocumented outcomes. Also the tested packaging has only been offered in white colour, which could have resulted in different outcomes than with other hues.

Another relevant aspect could be that although everything possible was done to avoid participants being aware of the procedure beforehand - including a third test to distract the attention from the actual test - it could not be ensured that participants who already completed the tests did not talk to future participants about the relevant aspects.

Furthermore a possible interactive testing effect resulting from the situation that the

participants knew they were being tested could not be prevented.

Finally regarding the participants, one has to ask to what extent a national or international applicability of the results is given. For example Wessels et al. (1996) showed that even within a short geographical distance and within one country the selection criteria for food products can differ. Still Lennarnäs et al. (1997) and Engelage (2002) agree that although the standard European consumer does not exist, most European consumers and not only them, show a wide range of similarities in their buying behaviour while primarily differing due to sociodemographic criteria like age and gender. Since only students participated in the studies this could indicate different effects than might be shown for other social classes (Solomon, 2013). Additionally, colour effects might still differ between cultures.

To sum up, the area of food packaging windows surely provides an enormous amount of possible future experiments and requires a wide range of methods to further increase the implementable knowledge for marketing. This seems natural, as the present research has been the first to examine window colours and window shapes at all and thus can be completed.

Surely the author of this thesis himself will think about continuing the research as well.

References

- Adams, C., Doucé, L., & Janssens, W. (2014). Congruency of Crossmodal Correspondence between an ambient Scent and a Product Packaging: The Effect on Packaging Preference. In *Conference Material for Consumer Sensory Innovation Lab - Understanding The Customer's Sensory Experience, Philadelphia, VS 5/6/2014 - 6/6/2014*.
- Adams, F. M., & Osgood, C. E. (1973). A Cross-cultural Study of the affective Meanings of Colour. *Journal of Cross-Cultural Psychology, 4*, 135-156.
- Albertazzi, L., Da Pos, O., Canal, L., Micciolo, R., Malfatti, M., & Vescovi, M. (2012). The Hue of Shapes. *Journal of Experimental Psychology: Human Perception and Performance, 39*, 37-47.
- Alvensleben, R. V. (1989): Heiligenscheineffekte bei Nahrungsmitteln. *Marketing-Übersicht, 1*, 58-60.
- Ambrose, G., & Harris, P. (2005). Colour - The Sensation produced by Rays of Light of different Wavelengths, a particular Variety of this. Lausanne: AVA.
- Ambrose, G., & Harris, P. (2011). *Packaging the Brand*. Lausanne: AVA.
- Antick, J. R., & Schandler, S. L. (1993). An Exploration of the Interaction between Variation in Wavelength and Time Perception. *Perceptual and Motor of Skills, 76*, 987-994.
- Argo, J. J., & White, K. (2012). When do Consumers eat more? The Role of Appearance Self-Esteem and Food Packaging Cues. *Journal of Marketing, 76*, 67-80.
- Attneave, F. (1954). Some informational Aspects of visual Perception. *Psychological review 61*, 183-193.
- Ayache, N. J., & Faugeras, O. D. (1986). HYPER - A new Approach for the Recognition and Position of two- dimensional Objects. *IEEE Transactions on Pattern Analysis and Machine Intelligence, 8*, 44-54.
- Bar, M., & Neta, M. (2006). Humans prefer curved visual Objects. *Psychological Science, 17*, 645-648.
- Batra, P., Urvashi, P., & Muhar, I. S. (1998). Hue and Variation in CFF. *Journal of the Indian Academy of Applied Psychology, 24*, 83-86.

- Becker, L., Van Rompay, T. J. L., Schifferstein, H. N. J., & Galetzka, M. (2011). Tough Package, strong Taste: The Influence of Packaging Design on Taste Impressions and Product Evaluations. *Food Quality and Preference*, 22, 17–23.
- Behrens, G. (1982). *Das Wahrnehmungsverhalten der Konsumenten*. Frankfurt am Main: Harri Deutsch Thun.
- Bellizzi, J. A., & Hite, R. E. (1992). Environmental Colour, Consumer Feelings, and Purchase Likelihood. *Psychology and Marketing*, 9, 347-363.
- Bellizzi, J. A., Crowley, A. E., & Hasty, R. W. (1983). The Effects of Colour in Store Design. *Journal of Retailing*, 59, 21-45.
- Belongie, S., Malik, J., & Puzicha, J. (2001). Matching Shapes. In *Proc. Eight Int'l. Conf. Computer Vision*, 454-461.
- Belongie, S., Malik, J., & Puzicha, J. (2002). Shape matching and Object Recognition using Shape Contexts. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 24, 509-522.
- Bodrogi, P., & Khanh, T.Q. (2012). *Illumination, Colour and Imaging*. Weinheim: Wiley-VCH Verlag & Co. KGaA.
- Boesch, M. (1989). *Gesamtsystem Verpackung*. St. Gallen: Verlag Thexis AG.
- Borsuk, K. (1975) *Theory of Shape*. Warsaw: Polish scientific publishers.
- Boyette, M. D., Sanders, D. C., & Rutledge, G. A. (1996). *Packaging Requirements for fresh Fruits and Vegetables*. North Carolina Agricultural Extension Service. (accessed December 29, 2014), [available at: <http://www.bae.ncsu.edu/programs/extension/publicat/postharv/ag-414-8>].
- Bremner, A. J., Caparos, S., Davidoff, J., de Fockert, J., Linnell, K. J., & Spence, C. (2013). “Bouba” and “Kiki” in Namibia? A remote Culture makes similar Shape–Sound Matches, but different Shape–Taste Matches to Westerners. *Cognition*, 126, 165–172.
- Britt, S. H. (1960): *The Spenders*. New York: McGraw-Hill.

- Brucker, V., Majer, I., Wichmann, U., & Ziegler, S. (2005). Der Einfluss von Gestaltungselementen der Verpackung auf die Markenprägnanz. In B. Gaiser, R. Linxweiler, & V. Brucker (eds.), *Praxisorientierte Markenführung: Neue Strategien, innovative Instrumente und aktuelle Fallstudien*. Wiesbaden: Gabler. 291-305.
- Bublitz, M. G., Peracchio, L. A., & Block, L. G. (2010). Why did I eat that? Perspectives on Food Decision making and Dietary restraint. *Journal of Consumer Psychology, 20*, 239–258.
- Calkins, M. W. (1893). A statistical Study of pseudo-Chromesthesia and of mental-Forms. *The American Journal of Psychology, 5*, 439–464.
- Callister, W. D. Jr., & Rethwisch, D.G. (2012). *Fundamentals of Materials Science and Engineering: an integrated Approach*. Hoboken: Wiley.
- Cao, F., Lisani, J.-L., Morel, J.-M., & Musé, P. (2008). *A Theory of Shape Identification*. Berlin: Springer.
- Carbon, C.-C. (2010). The Cycle of Preference: Long-term Dynamics of aesthetic Appreciation. *Acta Psychologica, 134*, 233–244.
- Cardello, A. V. (1993). New Product Trends: Sense or nonsense? *Cereal Foods World, 38*, 870-71.
- Cardello, A. V. (1994). Consumer Expectations and their Role in Food Acceptance. In H. J. H. MacFie, & D. M. H. Thomson (eds.), *Measurement of Food Preferences*, 253–297.
- Cardello, A. V., & Sawyer, F. M. (1992). Effects of disconfirmed Consumer Expectations on Food Acceptability. *Journal of Sensory Studies, 7*, 253–277.
- Charters, S., Lockshin, L., & Unwin, T. (1999). Consumer Responses to Wine Bottle back Labels. *Journal of Wine Research, 10*, 183–195.
- Chattopadhyay, A., Gorn, G. J., & Darke, P. (2010). Differences and Similarities in Hue Preferences between Chinese and Caucasians. In A. Krishna (ed.), *Sensory Marketing*. New York: Routledge. 219-239.
- Chen, N., Tanaka, K., Matsuyoshi, D., & Watanabe, K. (2014). Associations between Colour and Shape in Japanese Observers. *Psychology of Aesthetics, Creativity, and the Arts*, no Pagination specified.

- Cheskin, L. (1957). *How to predict what People will buy*. New York: Liveright.
- Clement, J. (2007). Visual Influence on In-Store buying Decisions: an eyetrack Experiment on the visual Influence of Packaging Design. *Journal of Marketing Management*, 23, 917–928.
- Clydesdale, F. M., Gover, R., Philipsen, D. H., & Fugardi, C. (1992). The Effect of Colour on Thirst quenching, Sweetness, Acceptability and Flavour Intensity in Fruit Punch flavoured Beverages. *Journal of Food Quality*, 15, 19–38.
- Coelho do Vale, R., Pieters, R., & Zeelenberg, M. (2008). Flying Under the Radar: Perverse Package Size Effects on Consumption Self-Regulation, *Journal of Consumer Research*, 35, 380–90.
- Cytowic, R. E. (1989a). Synesthesia and mapping of subjective sensory Dimensions. *Neurology*, 39, 849-50.
- Cytowic, R. E. (1989b). *Synesthesia: A Union of the Senses*. New York: Springer.
- Cytowic, R. E., Wood, F. B. (1982). Synaesthesia II: Psychophysical Relations in the Synaesthesia of geometrically shaped Taste and coloured Hearing. *Brain Cognition*, 1, 36–49.
- Czienskowski, P. (2014). *So schmecken die schwarzen Burger aus Japan*. DIE WELT. (accessed November 10, 2014), [available at: <http://www.welt.de/vermishtes/article132431267/So-schmecken-die-schwarzen-Burger-aus-Japan.html>].
- Deliza, R., & MacFie, H. (2001). Product Packaging and Branding. In L. J. Frewer, E. Risvik, & H. N. J. Schifferstein (eds.), *Food, People and Society: A European Perspective of Consumers' Food Choices*. Berlin: Springer. 55–72.
- Deliza, R., & MacFie, H. J. H. (1996). The Generation of sensory Expectation by external Cues and its Effect on sensory Perception and hedonic Ratings. A review. *Journal of Sensory Studies*, 11, 103–128.

- Deliza, R., Macfie, H. J. H., & Hedderley, D. (2003). Use of Computer-generated Images and conjoint Analysis to investigate sensory Expectations. *Journal of Sensory Studies*, 18, 465–486.
- Delwiche, J. (2004). The Impact of perceptual Interactions on perceived Flavour. *Food Quality and Preference*, 15, 137–146.
- Deng, X., & Srinivasan, R. (2013). When do transparent Packages increase (or decrease) Food Consumption? *Journal of Marketing*, 77, 104-117.
- Deroy, O., & Valentin, D. (2011). Tasting Shapes: Investigating Cross-modal Correspondences. *Chemosensory Perception*, 4, 80–90.
- Desolneux, A., Moisan, L., & Morel, J.M. (2007). *Gestalt Theory and Image Analysis, A probabilistic Approach*. Berlin: Springer.
- Dichter, E. (1971). The Strategy of selling with Packaging. *Package Engineering Magazine*, 7, 16a-16c.
- Döhnert, M., & Engler, E. D. (2003). Das Irlen-Syndrom - gibt es pathophysiologische Korrelate und wissenschaftliche Evidenz für das <Lesen mit Farben>? *Zeitschrift für Kinder- und Jugendpsychiatrie und Psychotherapie*, 31, 305-309.
- Downham, A., & Collins, P. (2000). Colouring our Foods in the last and next Millennium. *International Journal of Food Science and Technology* 35, 5-22.
- DuBose, C. N., Cardello, A. V., & Maller, O. (1980). Effects of Colourants and Flavourants on Identification, perceived Flavour Intensity, and hedonic Quality of fruitflavoured Beverages and Cake. *Journal of Food Science*, 45, 1393–1399.
- Dumitrescu, A. (2003) Study on Relationship between elementary geometric Figures and basic Colours, *Politehnica University Scientific Bulletin - Series D*, 6, 77-90.
- Dumitrescu, A. (2011) New Researches regarding Relationship between elementary geometric Shapes and basic Colours. *Proceedings of the 22nd International DAAAM Symposium*, 22, 1041.
- Eco, U. (1985). How Culture conditions the Colours we see. In M. Blonsky (ed.), *On Signs*. Baltimore: The Johns Hopkins University Press.

Eichenauer, D. (1994). *Verpackungsdesign des 20. Jahrhunderts*. Munich: Klinkhardt & Biermann.

Engel, J. F., Blackwell, R. D., & Miniard, P. W. (1990): *Consumer Behavior*, Orlando.

Engelage, A. (2002). *Qualitätswahrnehmung bei Lebensmitteln: das Verbraucherbild in Rechtsprechung und Wissenschaft*. Berlin: Institut für Lebensmittelhygiene des Fachbereichs Veterinärmedizin der Freien Universität Berlin.

European Parliament (1994). *Article 3 European Parliament and Council Directive 94/62/EC of 20 December 1994 on packaging and packaging waste*. (accessed December 25, 2014), [available at: <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:31994L0062>].

European Parliament (1994b). *Annex II European Parliament and Council Directive 94/62/EC of 20 December 1994 on packaging and packaging waste*. (accessed December 25, 2014), [available at: <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:31994L0062>].

European Parliament (2002). *Regulation (EC) No 178/2002 of the European Parliament and of the Council, CHAPTER I, Article 2*. (accessed December 25, 2014), [available at: <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32002R0178>].

European Parliament (2004). *Regulation (EC) No 1935/2004 of the European Parliament and of the Council*. (accessed December 25, 2014), [available at: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2004:338:0004:0017:en:PDF>].

European Parliament (2011). *Fair packaging and labeling act and the Regulation (EU) No. 1169/2011 of the European Parliament and of the Council of 25 October 2011*. (accessed December 29, 2014), [available at: <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32011R1169>].

Eysenck, H. J. (1981). Aesthetic Preferences and individual Differences. In D. O'Hare (ed.), *Psychology and the Arts*. New Jersey: The Harvester Press. 76-101.

Fang, X., & Mowen, J. C. (2005). Exploring Factors influencing Logo Effectiveness. An experimental Inquiry. *Advances in Consumer Research*, 32, 161.

- FDA (2009). *FDA Food Code 2009 Chapter 1*. (accessed December 29, 2014), [available at: <http://www.fda.gov/Food/GuidanceRegulation/RetailFoodProtection/FoodCode/ucm186464.htm>].
- FDA (2015). *Food Types & Conditions of Use for Food Contact Substances*. (accessed December 24, 2014), [available at: <http://www.fda.gov/Food/IngredientsPackagingLabeling/PackagingFCS/FoodTypesConditionsofUse/default.htm>].
- FDA (n.y.). *FDA's Food Contact Substance Notification*. (accessed December 20, 2014), [available at: <http://www.fda.gov/Food/IngredientsPackagingLabeling/PackagingFCS/ucm2006853.htm>].
- Folkes, V., & Matta, S. (2004). The Effect of Package Shape on Consumers' Judgments of Product Volume: Attention as a mental Contaminant, *Journal of Consumer Research*, 31, 390-401.
- Francis, F. J. (1994). Engineering Properties of Food. In Rao, M.A. (ed.), *Engineering Properties of Food*, New York: Marcel Dekker, 495-523.
- Francis, F. J. (1995). Quality as influenced by Colour. *Food Quality and Preference*, 6, 149-155.
- Frey, U. D. (1994). *Marketing im Aufbruch*. Landsberg: Lech.
- FTC (2014) Fair Packaging and Labeling Act. (accessed December 30, 2014), [available at <http://www.ftc.gov/enforcement/rules/rulemaking-regulatory-reform-proceedings/fair-packaging-labeling-act>].
- Gal, D., Wheeler, S. C., & Shiv, B. (2007). Crossmodal Influences on gustatory Perception. *SSRN Working Paper*, 1-42.
- Gallace, A., Boschini, E., & Spence, C. (2011b). On the Taste of 'Bouba' and 'Kiki': An Exploration of Word-Food Associations in neurologically normal Participants. *Cognitive Neuroscience*, 2, 34-46.
- Garber, L., Hyatt, E., & Starr, R. (2001). Placing Food Colour Experimentation into a valid Consumer Context. *Journal of Food Products Marketing*, 7, 3-24.

- Garber, L., Hyatt, E., & Starr, R. (2000). The Effects of Food Colour on perceived Flavour. *Journal of Marketing Theory and Practice*, 8, 59-72.
- Gavrila, D., & Philomin, V. (1999). Real-time Object Detection for smart Vehicles. In *Proceedings of the seventh IEEE International Conference*, 87–93.
- Gekeler, H. (2000). *Handbuch der Farbe*. Cologne: Dumont.
- Gerbino, W. (1994). Achromatic Transparency. In A. L. Gilchrist (ed.), *Lightness, Brightness and Transparency*. Hillsdale: Lawrence Erlbaum Associates. 215-255.
- Gil, S., & Le Bigot, L. (2014). Seeing Life through positive-tinted Glasses: Colour–Meaning Associations. *PLoS ONE*, 9, 1-13.
- Gilbert, A. N., Martin, R., & Kemp, S. E. (1996). Cross-modal Correspondence between Vision and Olfaction: The colour of smells. *The American Journal of Psychology*, 109, 335-351.
- Goldstein, E. B. (2002). *Wahrnehmungspsychologie*. Heidelberg: Spektrum Akademischer Verlag.
- Gorn, J. G., Chattopadhyay, A., Yi, T., & Dahl, D. W. (1997). Effects of Colour as an Executional Cue in Advertising: They're in the Shade. *Management Science*, 43, 1387-1400.
- Grossman, R. P., & Wisenblit, J. Z. (1999). What we know about Consumers' Colour Choices. *Journal of Marketing Practice: Applied Marketing Science*, 5, 78-88.
- Guéguen, N. (2003). The Effect of Glass Colour on the Evaluation of a Beverage's Thirst-quenching Quality. *Current Psychology Letters Brain Behaviour and Cognition*, 11, 1–6.
- Guilford, J. P., & Smith, P. C. (1959). A System of Colour Preferences. *American Journal of Psychology*, 72, 487–502.
- Guinard, J., & Souchard, A. (1998). Sensory Determinants of the thirst-quenching Character of Beer. *Appetite*, 31, 101–115.
- Hall, R. D. (1958). Flavour Study Approaches at McCormick & Co. In A. D. Little (ed.), *Flavour Research and Food Acceptance*. New York: Reinhold. 224-240.

- Hamstra, A. M. (1993). *Consumer Acceptance of Food Biotechnology - The Relation between Product Evaluation and Acceptance*. Den Haag: Swoka Researchreport Nr. 137.
- Harrison, J. (2001). *Synaesthesia: The strangest Thing*. Oxford: Oxford University Press.
- Harrison, J., & Baron-Cohen, S. (1996). Acquired and inherited Forms of Cross-modal Correspondence. *Neurocase*, 2, 245-249.
- Hassenzahl, M. (2008). Aesthetics in interactive Products: Correlates and Consequences of Beauty. In H.N.J. Schifferstein, & P. Hekkert (eds.), *Product Experience*. Amsterdam: Elsevier. 287–302.
- Heller, E. (1994). *Wie Farben wirken*. Reinbek: Rowohlt Verlag GmbH.
- Helmholtz, H. (1962). *Helmholtz's Treatise on physiological Optics*. New York: Dover.
- Hine, T. (1995). *The total Package: The Secret History and hidden Meanings of Boxes, Bottles, Cans, and other persuasive Containers*. New York: Little Brown.
- Hinton, L., Nichols, J., & Ohala, J. J. (1994). *Sound Symbolism*. Cambridge: Cambridge University Press.
- Hoegg, J., & Alba, J. W. (2007). Taste Perception: More (and less) than meets the Tongue. *Journal of Consumer Research*, 33, 490-498.
- Holt-Hansen, K. (1968). Taste and pitch. *Perceptual and Motor Skills*, 27, 59–68.
- Holt-Hansen, K. (1976). Extraordinary Experiences during Cross-modal Perception. *Perceptual and Motor Skills*, 43, 1023–1027.
- Hunter, R. S. (1967). Development of the Citrus Calorimeter. *Journal of Food Technology*, 21, 906-1005.
- Hunter, R. S. & Yeatman J. N. (1961). Direct reading Tomato Colourimeter. *Journal of the Optical Society of America*, 51, 552-554.
- Hupka, R. B., Zbigniew, Z., Otto, J., Reidl, L., & Tarabrina, N. V. (1997). The Colours of Anger, Envy, Fear, and Jealousy: A Cross-Cultural Study. *Journal of Cross-Cultural Psychology*, 28, 156-171.

Hutchings, J. B. (2003). *Expectations and the Food Industry: The Impact of Colour and Appearance*. New York: Kluwer Academic/Plenum Publishers.

Hüttel, K. (1998). Die Verkaufsförderung in der Produkt- und Programmpolitik. In W. Pepels (ed.), *Verkaufsförderung*. Munich: Oldenburg.

Huttenlocher, D., Lilien, R., & Olson, C. (1999). View-based Recognition using an eigenspace Approximation to the Hausdorff Measure. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 21, 951–955.

Imram, N. (1999). The Role of visual Cues in Consumer Perception and Acceptance of a Food Product. *Nutrition & Food Science*, 5, 224-228.

Intawiwat, N., Myhre, E., Øysæd, H., Jamtvedt, S. H., & Kvalva, M. (2012). Packaging Materials with tailor made Light Transmission Properties for Food Protection. *Polymer engineering and Science*, 52, 2015–2024.

Intawiwat, N., Pettersen, M. K., Rukke, E. O., Meier, M. A., Vogt, G., Dahl, A. V., Skaret, J., Keller, D., & Wold, J.P. (2010). Effect of different coloured Filters on Photooxidation in pasteurized Milk. *Dairy Science*, 93, 1372–1382.

Jacobs, K. W., & Suess, J. F. (1975). Effects of four psychological primary Colours on Anxiety state. *Perceptual and Motor Skills*, 41, 207-210.

Jacobs, L., Keown, C., Worthley, R., & Ghymn, K. (1991). Cross-cultural Colour Comparisons: Global Marketers beware! *International Marketing Review*, 8, 21-30.

Jagadish, H. V. (1991). A retrieval Technique for similar Shapes. In *Proceedings of the 1991 ACM SIGMOD International Conference on Management of Data*, 208-217.

Jantathai, S., Danner, L., Joechl, M., & Dürschmid, K. (2013). Gazing Behavior, Choice and Colour of Food: Does gazing behavior predict Choice? *Food Research International*, 54, 1621–1626.

Johnson, J., & Clydesdale, F. M. (1982). Perceived Sweetness and Redness in coloured sucrose Solutions. *Journal of Food Science*, 47, 747–752.

Jordan, P. W. (2000). *Designing pleasurable Products*. London: Taylor & Francis.

- Kaltenbach, F. (2004) Translucency - Light made Material. In F. Kaltenbach (ed.), *Translucent Materials*. Basel: Birkhäuser Edition Detail. 7-7.
- Kanouse, D. E., & Hanson, L. R. (1971). Negativity in Evaluations. In E.E. Jones (ed.), *Attribution: Perceiving the Causes of Behavior*. Morristown: General Learning Press. 47-62.
- Kareklas, I., Brunel, F., & Coulter, R. A. (2014). Judgment is not Colour blind: The Impact of automatic Colour Preference on Product and Advertising Preferences. *Journal of Consumer Psychology*, 24, 1, 87–95.
- Kaupinnen, H. (2004): *Colours as Non-Verbal Signs on Packages*. Helsinki: Swedish School of Economics and Business Administration.
- Kido, M. (2000), Bio-psychological Effects of Colour. *Journal of International Society of Life Information Science*, 18, 254-62.
- Knoedel, W. (1978). *Marketing-logistische Entscheidungsvariablen für Konsumgüterverpackungen*. Frankfurt am Main: Harri Deutsch.
- Kobbert, M. (2011). *Das Buch der Farbe*. Frankfurt am Main: Primus.
- Kohl, S., Baumann, B., Rosenberg, T., Kellner, U., Lorenz, B., Vadalà, M., Jacobson, S. G, & Wissinger, B. (2002). Mutations in the Cone Photoreceptor G-Protein α -Subunit Gene GNAT2 in Patients with Achromatopsia. *The American Journal of Human Genetics*, 71, 422–425.
- Köhler, W. (1947). *Gestalt Psychology: an Introduction to new Concepts in modern Psychology*. New York: Liveright Publication.
- Koza, B. J., Cilmi, A., Dolese, M., & Zellner, D. A. (2005). Colour enhances orthonasal olfactory Intensity and reduces retronasal olfactory Intensity. *Chemical Senses*, 30, 643–649.
- Küthe, E., & Küthe, F. (2002). *Marketing mit Farben*. Wiesbaden: Gabler.
- Lange, C., Issanchou, S., & Combris, P. (2000): Expected versus experienced Quality Trade-off with Price. *Food Quality and Preference*, 11, 289-297.
- Lange, C., Rousseau, F., & Issanchou, S. (1999). Expectation, liking and Purchase Behavior under economical Constraint. *Food Quality and Preference*, 10, 31-39.

- Lavin, J. G., & Lawless, H. T. (1998). Effects of Colour and Odor on Judgments of Sweetness among Children and Adults. *Food Quality and Preference*, 9, 283–289.
- Lechner, A. (2006). Leverage it – The Story of yellow. *Colour Quarterly - The Colour Business Journal*, 1, 7–11.
- Lechner, A., Simonoff, J. S., & Harrington L. (2008). Colour–Emotion Associations in the pharmaceutical Industry: Understanding universal and local Themes. *COLOUR Research and Application*, 37, 59-71.
- Lee, S.-M., Lee, K.-T., Lee, S.-H., & Song, J.-K. (2013). Origin of human Colour Preference for Food. *Journal of Food Engineering*, 119, 508–515.
- Lennarnäs, M., Fjellström, C., Becker, W., Giachetti, I., Schmidt, A., Remeaut de Winter, A. M., & Kearney, M. (1997). Influences on Food Choice perceived to be important by nationally-representative Samples of Adults in the European Union. *European Journal of clinical Nutrition*, 51, 8-15.
- Lewkowicz, D. J., & Turkewitz, G. (1980). Cross-modal Equivalence in early Infancy: Auditory–visual Intensity matching. *Developmental Psychology*, 16, 597–607.
- Lichtenfeld, S., Elliot, A. J., Maier, M. A., & Pekrun, R. (2012). Fertile Green: Green facilitates creative Performance. *Personality and Social Psychology Bulletin*, 38, 784-79.
- Linxweiler, R. (1998). Verpackung als Objekt künstlerischer Gestaltung. In W. Stabernack (ed.), *Verpackung Medium im Trend der Wünsche*. Munich: Bruckmann. 178-205.
- Liu, Y. (2003). Engineering Aesthetics and aesthetic Ergonomics: Theoretical Foundations and a dual-process Research Methodology. *Ergonomics*, 46, 1273–1292.
- Lord, E. A., & Wilson, C. B. (1986). *The mathematical Description of Shape and Form*. New York: John Wiley & Sons
- Lundahl, D. (2012). *Breakthrough Food Product Innovation through Emotions Research*. Amsterdam: Elsevier.
- Luscher, M., & Scott, I. (1969). *The Luscher Colour Test*. New York: Random House.

- Madden, J. T., Hewett, K., & Roth, S. M. (2002). Managing Images in different Cultures: A cross-national Study of Colour Meanings and Preferences. *Journal of International Marketing*, 8, 90–107.
- Madzharov, A. V., Block, L. G. (2010). Effects of Product Unit Image on Consumption of Snack Foods. *Journal of Consumer Psychology*, 20, 398-409.
- Malfatti, M., Schloss, K. B., Albertazzi, L., & Palmer, S. E. (2014). Shape-to-Colour Associations in Non-synesthetes: Evidence for emotional Mediation. *Journal of Vision* ,14, pages yet undefined.
- Marks, L. (1975). On coloured-hearing Synesthesia: Cross-modal Translations of sensory Dimensions. *Psychological Bulletin*, 82, 303-31.
- Marr, D. (1982). *Vision - A computational Investigation into the human Representation and Processing of visual Information*. New York: W. H. Freeman and Company.
- Martino, G., & Marks, L. E. (2001). Synesthesia: Strong and weak. *Current Directions in Psychological Science*, 10, 61–65.
- Maucher, H. (1998). Tradition und Innovation - Unternehmerische Verantwortung bei der Markenführung. In W. Stabernack (ed.), *Verpackung Medium im Trend der Wünsche*. Munich: Bruckmann. 67-71.
- McDaniel, C., & Baker, R. C. (1977), Convenience Food Packaging and the Perception of Product Quality. *Journal of Marketing*, 41, 57–58.
- Medeyros, M. (1982). *Anmutungshafte Verpackungsgestaltung als Mittel der Produktpolitik*. In U. Koppelman (ed.), *Seminar für Allgemeine Betriebswirtschaftslehre, Beschaffungs- und Produktlehre der Universität Köln - Band 11*. Cologne: Fördergesellschaft Produkt-Marketing e.V.
- Meier, B., & Rothen, N. (2009). Training grapheme-colour Associations produces a synaesthetic Stroop effect, but not a conditioned synaesthetic Response. *Neuropsychologia*, 47, 1208–1211.
- Metzger, W. (1975). *Gesetze des Sehens*. Frankfurt am Main: Waldemar Kramer.

- Middlestadt, S. E. (1989). The Effect of Background and Ambient Colour on Product Attitudes and Beliefs. *Advances in Consumer Research*, 17, 244-249.
- Mininni, T. (2011). Packaging - shelf shouting. In J. Tan (ed.), *Colour Hunting - What we buy, make and feel*. Amsterdam: Frame Publishers. 30-45.
- Mondloch, C. J., & Maurer, D. (2004). Do small white Balls squeak? Pitch-object Correspondences in your Children. *Cognitive, Affective & Behavioral Neuroscience*, 4, 133-136.
- Morrot, G., Brochet, F., & Dubourdieu, D. (2001). The Colour of Odors. *Brain and Language*, 79, 309-320.
- Moser, K. (1990). *Werbepsychologie - Eine Einführung*. Munich: Psychologie Verlags Union.
- Moser, K. (2002). *Markt- und Werbepsychologie - Ein Lehrbuch*. Göttingen: Hogrefe.
- Motluk, A. (1994). The sweet Smell of purple. *New Scientist*, 143, 32-37.
- Murphy, J. (2003). *Additives for Plastics Handbook*. Oxford: Elsevier.
- Nancarrow, C., Wright, T. L., & Brace, I. (1998). Gaining competitive Advantage from Packaging and Labeling in Marketing Communications, *British Food Journal*, 100, 110-118.
- Napolitano, R. (2012). Packaging can be your best Investment. In M. Ståhlberg, & V. Maila (eds.), *Shopper Marketing*. London: KoganPage. 247-253.
- Ngo, M. K., Velasco, C., Salgado, A., Boehm, E., O'Neill, D., & Spence, C. (2013). Assessing Crossmodal Correspondences in exotic Fruit Juices: The Case of Shape and Sound Symbolism. *Food Quality and Preference*, 28, 361-369.
- Ngo, M., Misra, R., & Spence, C. (2011). Assessing the Shapes and Speech Sounds that People associate with Chocolate Samples varying in Cocoa Content. *Food Quality & Preference*, 22, 567-572.
- Ngo, M., Piqueras-Fiszman, B., & Spence, C. (2012). On the Colour and Shape of still and sparkling Water: Insights from online and laboratory-based Testing. *Food Quality and Preference*, 24, 260-268.
- Norman, D. A. (2004). *Emotional Design*. New York: Basic Books.

O'Mahony, M. (1983). Gustatory Responses to nongustatory Stimuli. *Perception*, 12, 627–633.

O'Boyle, M. W., & Tarte, R. D. (1980). Implications for phonetic Symbolism: the Relationship between pure Tones and geometric Figures. *Journal of Psycholinguistic Research*, 9, 535–544.

Otterstätter, G. (1999). *Colouring of Food, Drugs, and Cosmetics*. New York: Marcel Dekker, Inc.

Paasch, U. (2001). *Farbe in Druck und Medien*. Itzehoe: Verlag Beruf+Schule.

Packard, V. (1957). *The hidden Persuaders*. Brooklyn: Pocket Books.

Page, C., & Herr, P. M. (2002). An Investigation of the Processes by which Product Design and Brand Strength interact to determine initial Affect and Quality Judgements. *Journal of Consumer Psychology*, 12, 133–147.

Paine, F. A., & Paine, H.Y. (1992). *A Handbook of Food Packaging*. London: Blackie Academic & Professional.

Palmer, S. E., & Schloss, K. (2010). An ecological Valence Theory of human Colour Preference. *Proceedings of the National Academy of Sciences of the United States of America*, 107, 8877–8882.

Pangborn, R. M. (1960). Influence of Colour on the Discrimination of Sweetness. *American Journal of Psychology*, 73, 229–238.

Pantin-Sohier, G., Decrop, A., & Brée, J. (2005). An empirical Investigation of the Product's Package as an Antecedent of Brand Personality. *Innovative Marketing*, 1, 69-80.

Pepels, W. (1998). *Produktmanagement: Produktinnovation, Markenpolitik, Programmplanung, Prozessorganisation*. Munich: Oldenburg.

Peterson, R. A. (1977): Consumer Perceptions as a Function of Product Colour, Price and Nutrition Labeling. *Advances in Consumer Research*, 4, 61-63.

Peterson, R. A., & Ross, I. (1972). How to name Brands. *Journal of Advertising*, 12, 29–34.

Pilditch, J. (1973). *The silent Salesman*. London: Business Books Limited.

- Pinson, C. (1986). An implicit Product Theory Approach to Consumers' inferential Judgements about Products. *International Journal of Research in Marketing*, 3, 19–38.
- Piqueras-Fiszman, B., & Spence, C. (2011). Crossmodal Correspondences in Product Packaging. Assessing Colour-Flavour Correspondences for Potato Chips (Chrisps). *Appetite*, 57, 753-757.
- Piqueras-Fiszman, B., & Spence, C. (2012a). Sensory Incongruity in the Food and Beverage Sector: Art, Science, and Commercialization. *Petit Propos Culinaire*, 95, 74-118.
- Piqueras-Fiszman, B., Alcaide, J., Roura, R., & Spence, C. (2012b). Is it the Plate or is it the Food? Assessing the Influence of the Colour (black or white) and Shape of the Plate on the Perception of the Food placed on it. *Food Quality and Preference*, 24, 205–208.
- Piqueras-Fiszman, B., Velasco, C., Spence, C. (2012c). *Exploring implicit and explicit Crossmodal Colour–Flavour Correspondences in Product Packaging Food Quality and Preference* 25, 148–155.
- Raghubir, P., & Krishna, A. (1999), Vital Dimensions in Volume Perception: can the Eye fool the Stomach?. *Journal of Marketing Research*, 36, 313-26.
- Rai, S. (2014). *Rivals Burger King and McDonald's in black Burger Face-off in Tokyo*. FORBES. (accessed December 30, 2014), [available at: <http://www.forbes.com/sites/saritharai/2014/10/05/rivals-burger-king-and-mcdonalds-in-black-burger-face-off-in-tokyo/>].
- Ramachandran, V. S., & Hubbard, E. M. (2001). Synaesthesia: a Window into Perception, Thought and Language. *Journal of Consciousness Studies*, 8, 3-34.
- Ramachandran, V. S., & Hubbard, E. M. (2003). Hearing Colours, tasting Shapes. *Scientific American*, 288, 43–49.
- Raymond, M., Sanderson, C., Raymond, M., Klante, R., Ehmann, S., & Moreno, S. (2008). *Create Eating Design and Future Food*. Berlin: Gestalten.

- Rebollar, R., Lidón, I., Serrano, A., Martín, J., & Fernández, M. J. (2012). Influence of chewing Gum Packaging Design on Consumer Expectation and Willingness to buy. An Analysis of functional, sensory and Experience Attributes. *Food Quality and Preference*, 24, 162–170.
- Ricks, D. A. (1984). How to avoid Business Blunders abroad. *Business*, 4, 25-32.
- Riley, M. W., Cochran, D. J., & Ballard, J. L. (1982). An Investigation of preferred Shapes for Warning Labels. *Human Factors*, 24, 737–742.
- Rodríguez-Pulido, F. J., Gordillo, B, González-Miret, M. L., & Heredia, F.J. (2013). Analysis of Food Appearance Properties by Computer Vision applying Ellipsoids to Colour Data. *Computers and Electronics in Agriculture*, 99, 108–115.
- Rohm, H., Strobl, M., & Jaros, D. (1997). Butter Colour affects sensory Perception of Spreadability. *Zeitschrift für Lebensmittel-Untersuchung und Forschung*, 205, 108-110.
- Rolls, B. J., Rolls, E. T., & Rowe, E. A. (1982). The Influence of Variety on human Food Selection and Intake. In L. M. Barker (ed.), *The Psychobiology of Human Food Selection*, Westport: AVI Publ. Co. 101-125.
- Ross, C. F., Bohlscheid, J., & Weller, K. (2008). Influence of visual Masking Technique on the Assessment of 2 red Wines by trained and Consumer Assessors. *Journal of Food Science*, 73, 279-285.
- Roth, H. A., Radle, L. J., Gifford, S. R., & Clydesdale, F. M. (1988). Psychophysical Relationships between perceived Sweetness and Colour in Lemon- and Lime-flavoured Drinks. *Journal of Food Science*, 53, 1116–1119.
- Sacharow, S. (1970). Selling a Package through the Use of Colour. *Colour Engineering*, 9, 25–27.
- Scharf, A., & Volkmer, H.-P. (1997): Geschmackswahrnehmung und Geschmackspräferenzen bei Nahrungs- und Genußmitteln unter besonderer Berücksichtigung von Produkterwartungen. *Marketing - Zeitschrift für Forschung und Praxis*, 17, 5-17.

- Scheier, C., Held, D., Schneider, J., & Bayas-Linke, D. (2012). *Codes - Die geheime Sprache der Produkte*. Freiburg: Haufe-Lexware.
- Schifferstein, H. N. J. (2001). Effects of Product Beliefs on Product Perception and Liking. In L. Frewer, E. Risvik, & H.N.J. Schifferstein (eds.), *Food, People and Society: A European Perspective of Consumers' Food Choices*. Berlin: Springer Verlag. 73–96.
- Schifferstein, H. N. J., & Tanudjaja, I. (2004). Visualising Fragrances through Colours: the mediating Role of Emotions. *Perception*, 33, 1249–1266.
- Schmitt, B. H. (1995). Language and Visual Imagery: Issues in Corporate Identities in East Asia. *Columbia Journal of World Business*, 28-36.
- Schmitz-Maibauer, H. H. (1976). *Der Stoff als Mittel anmutungshafter Produkt-Gestaltung: Grundzüge einer Materialpsychologie*. Köln: Hanstein.
- Schürmann, J. (2008). *Trend towards Transparency*. Cup & Co. (accessed November 10, 2014), [available at <http://www.swissprimepack.com/en/images/stories/pdf/en-01-08.pdf>].
- Scott, M. L., Nowlis, S. M., Mandel, N., & Morales, A. C. (2008). The Effects of reduced Food Size and Package Size on the Consumption Behavior of Restrained and Unrestrained Eaters, *Journal of Consumer Research*, 35, 391–405.
- Seeger, H. (2009). *Praxisbuch Packaging*. Munich: Finanzbuch.
- Shankar, M. U, Levitan, C. A., Prescott, J., & Spence, C. (2009). The Influence of Colour and Label Information on Flavour Perception. *Chemosensory Perception*, 2, 53–58.
- Silayoi, P., & Speece, M. (2004), Packaging and Purchase Decisions: a Focus Group Study on the Impact of Involvement Level and Time Pressure. *British Food Journal*, 106, 607-28.
- Silayoi, P., & Speece, M. (2007). The Importance of Packaging Attributes: a Conjoint Analysis Approach. *European Journal of Marketing*, 41, 1495 - 1517.
- Silayoi, P., Malai, V., Rajatanavin, R., & Speece, M. (2003). The Effects of Packaging on Consumer Satisfaction and Loyalty. In *Proceedings of the eighth international Conference on Marketing and Development, Bangkok, Thailand*.

- Simner, J., Mulvenna, C., Sagiv, N., Tsakanikos, E., Witherby, S. A., Fraser, C., Scott, K., & Ward, J. (2006). Synaesthesia: The Prevalence of atypical cross-modal Experiences. *Perception*, *35*, 1024–1033.
- Singh, J., & Singh, S. P. (2013). Damage Reduction to Food Products during Transportation and Handling. In S. Ebnesajjad (ed.), *Plastic Films in Food Packaging - Materials, Technology, and Applications*. Amsterdam: Elsevier. 181-198.
- Singh, S. (2006). Impact of Colour on Marketing. *Management Decision*, *44*, 783-789.
- Singh, S. P., & Singh, J. (2005). Pictorial Markings and Labels for safe Transport and Handling of Packaged Goods. *Packaging Technology and Science*, *18*, 133-140.
- Small, C. G. (1996). *The statistical Theory of Shape*. New York: Springer.
- Sokolov, D. D. (2001). Curvature. In M. Hazewinkel (ed.), *Encyclopedia of Mathematics*. Berlin: Springer. 200-230.
- Solomon, M. R. (2013). *Consumer Behavior buying, having and being*. Boston: Pearson.
- Sonsino, S. (1990). *Packaging Design*. London: John Calmann and King Ltd.
- Spector, F., & Maurer, D. (2008). The Colour of Os: Naturally biased Associations between Shape and Colour. *Perception*, *37*, 841-847.
- Spector, F., & Maurer, D. (2011). The Colours of the Alphabet: Naturally biased Associations between Shape and Colour. *Journal of Experimental Psychology: Human Perception and Performance*, *37*, 484-495.
- Spence, C. (2007). Audiovisual multisensory Integration. *Acoustical Science & Technology*, *28*, 61–70.
- Spence, C. (2011). Crossmodal Correspondences: A tutorial Review. *Attention, Perception, & Psychophysics*, *73*, 971–995.
- Spence, C. (2011b). Wine and Music. *The World of fine Wine*, *31*, 96–104.

- Spence, C. (2011c). Sound Design: How understanding the Brain of the Consumer Can enhance auditory and multisensory Product/Brand Development. In K. Bronner, R. Hirt, & C. Ringe (eds.), *Audio Branding Congress Proceedings 2010*. Baden-Baden: Nomos Verlag. 37–52.
- Spence, C. (2012). Managing sensory Expectations concerning Products and Brands: Capitalizing on the potential of Sound and Shape Symbolism. *Journal of Consumer Psychology*, 22, 37-54.
- Spence, C. (2013). Why we are not all Synesthetes (not even weakly so). *Psychonomic Bulletin & Review*, 20, 643–664.
- Spence, C., & Gallace, A. (2011). Tasting Shapes and Words. *Food Quality and Preference*, 22, 290–295.
- Spence, C., & Wan, X. (2015). Beverage Perception and Consumption: The Influence of the Container on the Perception of the Contents, *Food Quality and Preference*, 39, 131–140.
- Spence, C., Levitan, C. A., Shankar, M. U., & Zampini, M. (2010). Does Food Colour influence Taste and Flavour Perception in Humans? *Chemical Perception*, 3, 68–84.
- Spence, C.; Ngo, M. K.; Percival, B., & Smith, B. (2013b). Crossmodal Correspondences: Assessing Shape Symbolism for Cheese. *Food Quality and Preference*, 28, 206–212.
- Spiegel, B. (1970). *Werbepsychologische Untersuchungsmethoden*. Berlin: Duncker & Humblot.
- Spillmann, W. (1985). *The Concept of Lightness Ratio of Hues in Colour Combination Theory (1-6) - Proceedings of the 5th ALC Congress*. Monte Carlo: Monaco.
- Stanton, W. J., Etzel, M. J., & Walker, B. J. (1994). *Fundamentals of Marketing*. New York: McGraw-Hill.
- Steenkamp, J.-B. E. M. (1990). Conceptual Model of the Quality Perception Process. *Journal of Business Research*, 21, 309-333.
- Steenkamp, J.-B. E. M., Wierenga, B., & Meulenberg, M. T. G. (1985). *Quality Perception of Food Products*. In Proceedings of the annual Conference 1985 of the European Marketing Academy, Bielefeld, 346-366.

- Stewart, B. (2007). *Packaging Design*. London: Laurence King Publishing Ltd.
- Stewart, I. (2001). *What Shape is a Snowflake? Magical Numbers in Nature*. London: Weidenfeld & Nicolson.
- Swientek, B. (2001). Uncanny Developments. *Beverage Industry*, 92, 38–39.
- Thompson, E., Palacios, A., & Varela, F. J. (1992). Ways of Colouring comparative Colour Vision as a Case Study for Cognitive Science. *Behavioral and Brain Science*, 15, 1-74.
- Trinkaas, J. (1995). Some Perceptions of Shoppers about uncooked Ground Beef: an informal Look. *Perceptual and Motor Skills*, 81, 32-34.
- Tu, Y., Yang, Z., & Mab, C. (2014). Touching Tastes: The haptic Perception Transfer of liquid Food Packaging Materials. *Food Quality and Preference*, 39, 124–130.
- Tuomisto T., Tuomosto, M. T., Hetherington, M., & Lappalainen, R. (1998). Reasons for Initiation and Cessation of Eating in obese Men and Women and the affective Consequences of Eating in everyday Situations. *Appetite*, 30, 211-22.
- Ucherek, M. (2000). The Application of multidimensional Analysis to Assessment of the Quality of Food Products and their Packaging. *Packaging Technology and Science*, 13, 73-82.
- Underwood, R. L. (2003). The communicative Power of Product Packaging: Creating Brand Identity via lived and mediated Experience. *Journal of Marketing Theory and Practice*, 2, 62-76.
- Vaih-Baur, C. (2010). Verpackungen multisensuell stimmig gestalten - Mit Klang und Duft Mehrwert erzielen. In S. Kastner (ed.), *Verpackungsmarketing*. Frankfurt am Main: Edition Horizont. 131-147.
- Valdez, P., & Mehrabian, J. (1994). Effect of Colour on Emotions. *Journal of Experimental Psychology*, 123, 394-409.
- van Campen, C. (2011). Synaesthesia - seeing Sound, smelling Space. In J. Tan (ed.), *Colour Hunting - What we buy, make and feel*. Amsterdam: Frame Publishers. 207-213.

- Vatakis, A., Ghazanfar, A., & Spence, C. (2008). Facilitation of multisensory Integration by the “Unity Assumption”: Is Speech special? *Journal of Vision*, *8*, 1–11.
- Velasco, C., Salgado-Montejo, A., Marmolejo-Ramos, F., & Spence, C. (2014). Predictive Packaging Design: Tasting Shapes, Typefaces, Names, and Sounds. *Food Quality and Preference*, *34*, 88–95.
- Veryzer, R. W., & Hutchinson, J. W. (1998). The Influence of Unity and prototypicality on aesthetic Response to new Product Designs. *Journal of Consumer Research*, *24*, 374–394.
- Walker, P., Bremner, J. G., Mason, U., Spring, J., Mattock, K., Slater, A., & Johnson, S.P. (2010). Preverbal Infants’ Sensitivity to synesthetic Crossmodality Correspondences. *Psychological Science*, *21*, 21–25.
- Wallace, T. P., Wintz, P. A. (1980). An efficient three- dimensional Aircraft Recognition Algorithm using normalized Fourier Descriptors. *Computer Graphics and Image Processing*, *13*, 99-126.
- Wan, X., Woods, A.T., Seoul, K.-H., Butcher, N., & Spence, C. (2015). When the Shape of the Glass influences the Flavour associated with a coloured Beverage: Evidence from Consumers in three Countries. *Food Quality and Preference* *39*, 109–116.
- Wang, G.-J., Volkow, N. D., Telang, F., Jayne, M., Ma, J., Rao, M., Zhu, W., Wong, C. T., Pappas, N.R., Geliebter, A., & Fowler, J.S. (2004). Exposure to appetitive Food Stimuli markedly activates the Human Brain. *Neuroimage*, *4*, 1790-97.
- Wansink, B. (2004). Environmental Factors that increase the Food Intake and Consumption Volume of unknowing Consumers. *Annual Review of Nutrition*, *24*, 455-79.
- Wansink, B., Painter, J. E., & Lee, Y.-K. (2006). The Office Candy Dish: Proximity's Influence on estimated and actual Candy Consumption. *International Journal of Obesity*, *30*, 871-75.
- Ward, J., Moore, S., Thompson-Lake, D., Salih, S., & Beck, B. (2008). The aesthetic Appeal of auditory-visual synaesthetic Perceptions in People without Synaesthesia. *Perception*, *37*, 1285-1296.
- Wauters, B., Brengman, M., & Mahama, F. (2014). The Impact of pleasure-evoking Colours on the Effectiveness of Threat (Fear) Appeals. *Psychology & Marketing*, *31*, 1051–1063.

- Webster, G. D., Urland, G. R., & Correll, J. (2012). Can Uniform Colour colour Aggression? Quasi-experimental Evidence from professional Ice Hockey. *Social Psychological and Personality Science*, 3, 274-281.
- Wei, S. T., Ou, L. C., Luo, M. R., & Hutchings, J. B. (2012b). The Relationship between visual Perceptions and Taste Expectations using Food Colours. In *The 3rd International Conference on Appearance*. Edinburgh: Lulu Press, 157–160.
- Wei, S.-T., Ou, L.-C., Luo, M. R., & Hutchings, J. B. (2012a). Optimization of food Expectations using Product Colour and Appearance. *Food Quality and Preference*, 23, 49–62.
- Wells, L. E., Farley, H., & Armstrong G. A. (2007). *International Journal of Retail & Distribution Management*, 35, 677-690.
- Wells, W., Burnett, I., & Moriarty, S. (1992). *Advertising Principles and Practise*. Englewood Cliffs: Prentice-Hall.
- Welsch, N., & Liebmann, C.C. (2003). *Farben - Natur Technik Kunst*. Heidelberg: Spektrum Akademischer Verlag.
- Wenger, P. (1967). Die Funktionen der Verpackung in der modernen Wirtschaft. In *Band 36 Schriftenreihe der Stiftung „Im Gruenen“*, *Verpackung und Konsument*. Bern: Paul Haupt. 16-24.
- Wertheimer, M. (1923). Untersuchungen zur Lehre der Gestalt, II. *Psychologische Forschung* 4, 301-350.
- Wessels, H.-P., Mathys, P., & Brauchbar, M. (1996). Biotechnologie und Lebensmittel, Teilbericht a: Akteure, Einstellungen und Werte in der Schweiz. In *Technology Assessment 16/1996*. Bern: Schweizerischer Wissenschaftsrat.
- Westerman, S. J., Gardner, P. H., Sutherland, E. J., White, T., Jordan, K., Watts, D., & Wells, S. (2012). Product Design: Preference for rounded versus angular Design Elements. *Psychology and Marketing*, 29, 595-605.
- Wheatley, J. (1973) Putting colour into Marketing. *Marketing*, 67, 24-29.

- Wiegersma, S., & Van der Elst, G. (1988). Blue Phenomenon: Spontaneity or Preference? *Perceptual & Motor Skills*, 66, 308-10.
- Wild, N. (1998). Eigenmarken - Konzepte am Beispiel der Migros. In W. Stabernack (ed.), *Verpackung Medium im Trend der Wünsche*. Munich: Bruckmann. 116-127.
- Wills, F. H. (1960). *Das Auge kauft mit. Werkbuch für werbewirksame Packungsgestaltung*. Essen: Wirtschaft u. Werbung Verlags-Gesellschaft.
- Willson, M. F., & Whelan, C. J. (1990). The Evolution of Fruit Colour in fleshy-fruited Plants. *The American Naturalist*, 136, 790–809.
- Woods, A. T., Lloyd, D. M., Kuenzel, J., Poliakoff, E., Dijksterhuis, G. B., & Thomas, A. (2011). Expected Taste Intensity affects Response to sweet Drinks in primary Taste Cortex. *Neuroreport*, 22, 365–369.
- Yeomans, M., Chambers, L., Blumenthal, H., & Blake, A. (2008). The Role of Expectancy in sensory and hedonic Evaluation: The Case of smoked Salmon Ice-Cream. *Food Quality and Preference*, 19, 565–573.
- Younes, L. (2010). *Shapes and Diffeomorphisms*. Berlin: Springer.
- Young, S. (2012). Packaging can be your best Investment. In M. Ståhlberg & V. Maila (eds.), *Shopper Marketing*. London: KoganPage. 263-268.
- Zampini, M., Sanabria, D., Phillips, N., & Spence, C. (2007). The multisensory Perception of Flavour: assessing the Influence of Colour Cues on Flavour Discrimination Responses. *Food Quality and Preference*, 18, 975–984.
- Zampini, M., Wantling, E., Phillips, N., & Spence, C. (2008). Multisensory Flavour Perception: assessing the Influence of Fruit Acids and Colour Cues on the Perception of Fruit-flavoured Beverages. *Food Quality and Preference*, 19, 335–343.
- Zellner, D. A., & Durlach, P. J. (2003). Effect of Colour on expected and experienced Refreshment, Intensity, and Liking of Beverages. *American Journal of Psychology*, 116, 633–47.

Zhang, Y., Feick, L., & Price, L. J. (2006). The Impact of self-construal on aesthetic Preference for angular versus rounded Shapes. *Personality and social Psychology Bulletin*, 32, 794–805.

Zollinger, H. (2005). *Farbe - Eine multidisziplinäre Betrachtung*. Zurich: Wiley-VCH.

Zwimpfer, M. (2012). *Licht und Farbe*. Zurich: Verlag Niggli.

Appendix

A. Full Transcript of the Interviews

Several expert interviews were carried out and used as an information resource for this thesis. These are presented below.

Expert interview I with Martin Schmitt (protocol)

I. Introduction

The expert interview took place on 19.08.2014 and was conducted by email. The participants were Martin Schmitt and Maximilian W. Engels (Interviewer). Since the interview took place in German, below both the English translation as well as the original German version are given.

II. Expert portrait

Martin Schmitt is Project Coordinator in packaging design at Migros Cooperative Alliance headquartered in Zurich, Switzerland. Migros is Switzerland's largest retail company, its largest supermarket chain and largest employer. In his function Mr. Schmitt is the person who has the final authority to decide on future packaging designs of Migros products. In 2013 Migros made a revenue of 26.726 billion CHF which in August 2014 is approximately 22.071 billion €.

III. Transcript (English translation)

Engels: Concerning the premium line products Sélection Irish Beef Angus Filet; Sélection Olivenöl and Sélection Assam Golden, how can the exceptional window design be explained?

Schmitt: The examples that you have attached to your mail are already older and no longer in our portfolio. The design of the window is unfortunately often coincidental and not intended by the designer. It does happen that the designer can define the window himself, but because mainly we use standard packs the windows are often prescribed. For Switzerland, with its low sales volumes, it is sometimes difficult in the procurement of goods to ask for too many "special requests". Or it is just too expensive, because the implementation of special requests reflects noticeably on the purchase price of the goods.

Where we can determine the window ourselves, we see if it can smartly be combined with the graphics or that it harmonises with these. Especially for meat products it is the case that greater product visibility is desired, which greatly influences the design of the window; in this case, it must simply be "large".



Engels: How does the shape of a transparent window influence customers of food products?

Schmitt: For fresh product as much product insight is offered as possible, so that the customer can evaluate it on 1:1 basis. Especially for fresh meat, chicken, charcuterie and fish, but also for cheese and generally for fresh products where appropriate and/or technically possible this is valid.

I cannot say how the shape influences the customers.

Engels: How does the colour of a transparent window influence customers of food products?

Schmitt: We do not use specific colours for windows. When a window is surrounded by a colour, this is mainly driven by Graphicdesign, meaning that the colour is not there due to the window, but because it is part of the design or the product or respective brand.



Engels: What meaning do packaging windows have in contrast to complete transparent packaging?

Schmitt: In the fresh food sector, primarily in meat, the completely transparent packaging compared to closed packages partially perform above average. Customers can see directly

what they are buying with full transparency. We assume that a nice, fresh product appeals to consumers greatly. Depending on the item this effect can be stronger than if for example a prepared dish is portrayed on the packaging.

To sum up; the window allows a view on the product. What shape the window has for us is mainly relevant from a design or technical production perspective. Basically it will seldom happen that a customer buys or does not the product because of the shape or the colour of the window. It is more likely to happen that a customer buys or does not buy the product because of its appearance.

IV. Transcript (German original version)

Engels: Betreffend die Premium-Produkte Sélection Irish Beef Angus Filet; Sélection Olivenöl und Sélection Assam Golden wie ist das außergewöhnliche Fensterdesign begründet?

Schmitt: Die Beispiele, die Sie Ihrem Mail beigelegt haben, sind bereits älter und leider auch nicht mehr im Sortiment. Das Design des Fensters ist leider oft zufällig und nicht vom Designer bestimmt. Es kommt zwar vor, dass der Designer das Fenster selber definieren kann, da es sich aber vorwiegend um Standardpackungen handelt, sind die Fenster oft schon vorgegeben. Für die Schweiz mit ihren geringen Absatzmengen ist es teilweise schwierig, in der Beschaffung von Waren zu viele „Sonderwünsche“ anzubringen. Oder einfach zu teuer, weil sich die Umsetzung der Sonderwünsche spürbar auf den Einkaufspreis der Waren niederschlägt.

Wo wir das Sichtfenster selber bestimmen können, schauen wir ob es schlau mit der Abbildung kombiniert werden kann bzw., dass es mit dieser harmoniert. Besonders bei Fleischwaren ist es weiter so, dass viel Produkteinsicht gewünscht ist, was die Gestaltung des Fensters stark beeinflusst; in diesem Fall muss es einfach „gross“ sein.



Engels: Wie beeinflusst die Form eines Verpackungsfensters die Kunden von Lebensmittelprodukten?

Schmitt: Bei Frischeprodukten wird soviel Produkteinsicht wie möglich geboten, damit sich der Kunde das Produkt 1:1 anschauen kann, vor allem beim Frischfleisch, Poulet, Charcuterie und Fisch, aber auch bei Käse und eben, generell beim Frischprodukten wo sinnvoll und/oder technisch möglich.

Wie die Form den Kunden beeinflusst kann ich nicht sagen.

Engels: Wie beeinflusst die Farbe eines Verpackungsfensters die Kunden von Lebensmittelprodukten?

Schmitt: Wir verwenden keine spezifischen Farben für Fenster. Wenn ein Fenster von einer Farbe umgeben ist, ist dies vorwiegend vom Grafikdesign getrieben, heisst dass die Farbe nicht wegen dem Fenster dort ist, sondern weil sie zum Design oder zum Produkt bzw. Brand gehört.



Engels: Welche Bedeutung sehen Sie bei der Anbringung von Fenstern auf Lebensmittelverpackungen im Unterschied zu vollständig durchsichtigen Verpackungen?

Schmitt: Im Frischebereich, primär beim Fleisch, performen die vollständig durchsichtigen Verpackungen im Vergleich zu geschlossenen Verpackungen teilweise überdurchschnittlich. Die Kunden können direkt sehen was sie kaufen, volle Transparenz. Wir gehen davon aus dass ein schönes, frisches Produkt die Konsumenten stark anspricht, je nach Artikel stärker als wenn auf der Verpackung bspw. eine Tellersituation mit dem zubereiteten Produkt zu sehen wäre.

Um es zusammen zu fassen; das Fenster gewährt Einblick auf das Produkt. Welche Form das Fenster hat ist für uns vorwiegend aus einer Design- bzw. produktionstechnischen

Perspektive von Belang, grundsätzlich wird es kaum passieren dass ein Kunde aufgrund der Form oder der Farbe des Fenster das Produkt kauft oder nicht kauft. Es wird eher passieren dass ein Kunde das Produkt wegen seines Aussehens kauft. Oder eben nicht.

Expert interview II with Vankaew Jutharath (protocol)

I. Introduction

The expert interview took place on 15.08.2014 and was conducted by email. The participants were Ms. Vankaew Jutharath and Maximilian W. Engels (Interviewer).

II. Expert portrait

Vankaew Jutharath is director of the Thailand based packaging design agency Prompt-Design. The company has worked for clients such as Nestlé, Del Monte Foods, L'Oreal and Gucci. The winner of several prestigious awards has offices in Bangkok and Chiangmai (Thailand) and Boston (USA).

III. Transcript

Engels: Do your package designs for food products include transparent coloured windows and/or notably shaped windows respectively? If yes, why? If no, why not?

Jutharath: Actually, we do both transparent and non-transparent coloured windows. The key factors that determine what kind of design we do are product type and design highlight. Our goal is to understand what kind of product we are designing for and designing it accordingly.

For example, when we do a packaging design for "Grab n' Go" healthy food products such as salad and sandwich, we will focus on showing the real ingredients of the product in order to represent the fresh and clean look along with accentuating the deliciousness of the product. We think this will be attractive and inviting for the customer and make the customer want to try this food product.

It is a very important factor in presenting and packaging fresh food products using a transparent window in packaging design.

As for food products like snacks, we will focus on the appearance of the packaging design such as the brand name and logo, iconic colours, and other design elements.

Engels: How does the shape of a transparent window influence customers of food products?

Jutharath: In my opinion, the shape of a transparent window influences customers of food products greatly in their purchasing decisions.

First of all, the right shape can grab customer attention, which in turn will make customers examine the product more clearly through the transparent window.

Therefore, it's important for the shape of a transparent window to have appropriate design elements such as proper size and shape.

It should be aligned with the design concept for the product and be in harmony with its design elements.

For example, when we do food packing products for kids, we always incorporate cartoon character shapes for the transparent window that's related to character design.

Engels: How does the colour of a transparent window influence customers of food products?

Jutharath: I think it has an influence on customers of food products but not very much. It is up to the designer to determine whether or not certain colours would make the product stand out or not.

But In my opinion, I think mostly consumers of food products would like the product's natural colours rather than artificial or random artistic colours.

Furthermore, they would prefer seeing the real product inside than to see a different one when they open the food packaging.

Engels: What else can you tell me concerning my thesis' topic regarding transparency, colour and shape respectively in context of food packaging?

Jutharath: I think in designing these things, it's important to understand customer needs and the effect of using transparent window design packaging so I would say studying more in this area would be beneficial to you.

The bottom line is that we want to design our packaging in a creative manner in order to attract customers and make them want to purchase the product. If there's a golden rule to make such a design, then everyone would be doing it. But it's not as easy as that but as long as you take the customers' needs into consideration when making your design, then you will be in a good shape.

Expert interview III with Sebastian Beck (protocol)

I. Introduction

The expert interview took place on 12.08.2014 and was conducted by email. The participants were Mrs. Antje Hedenkamp who forwarded the interview questions to Mr. Sebastian Beck, and Maximilian W. Engels (Interviewer).

II. Expert portrait

Mr. Beck is General Manager of Germany-based design agency justblue.design GmbH. It focuses on the areas Graphic Design, Packaging Design, Product Design, Industrial Design and CGI (Computer Generated Images). The company has worked for clients such as Schwartau, Danone, Beck's beer, Schweppes, Nivea, BMW and Yves Rocher and is located in Hamburg.

III. Transcript

Engels: Do your package designs for food products include transparent coloured windows and/or notably shaped windows respectively? If yes, why? If no, why not?

Beck: Yes, our package designs for food products include transparent windows.

This is due to reassurance and quality aspects. We create packaging for cheese in general. The customer wants to be sure what the product inside looks like and if the quantity seems to be best. For cheese the customer wants to see how many holes the sort has and how big they are.

Engels: How does the shape of a transparent window influence customers of food products?

Beck: We use to design window shapes that proper to the package design. It should be nice curved, give a dynamic impression and look appetizing.

Fixed lineal windows are too stiff to attract a customer and give no sufficient view on the content. (depends on the design style, but for cheese it is important)

Engels: How does the colour of a transparent window influence customers of food products?

Beck: For the food products we design packaging with only transparent windows. The customer must be able to see what's in the package.

Food should not have another colour than is naturally has.

Engels: What else can you tell me concerning my thesis' topic regarding respectively transparency, colour and shape in context of food packaging?

Beck: For packaging design of food it is best when the window follows a form and fits to the general design of the packaging. Important is that the window gives the right view on the product that is inside. This also implies for cosmetic and other products.

Expert interview IV with Trina Bentley (protocol)

I. Introduction

The expert interview took place on 12.08.2014 and was conducted by email. The participants were Mrs. Trina Bentley and Maximilian W. Engels (Interviewer).

II. Expert portrait

Mrs. Bentley is founder and owner of the Austin (Texas, USA) based branding and packaging design agency Make & Matter. She is an award-winning designer and her company for more than a decade has focused on simple packaging designs. Clients are primarily US known such as primizie crisps, world peas, plan tea or farmhouse.

III. Transcript

Engels: Do your package designs for food products include transparent coloured windows and/or notably shaped windows respectively? If yes, why? If no, why not?

Bentley: Sometimes yes. Sometimes no. It depends on the product I'm working with and the substrate I'm working on. Some products that are a tad unknown, need to be shown (it makes the consumer feel more comfortable buying & trying out a new product). For other products, the consumer knows exactly what the product is, so showing it in a window is less needed - and focusing on the overall brand, and capturing consumer attention becomes more important.

Also, there are some products where consumers really want to see it. Think about the way we buy meat. You want to see the product. It builds a level of trust and comfort.

Finally, some products simply cannot have a window - due to the nature of their product and its makeup. Sometimes light (from a product window) can make the products less shelf stable.

On the shape of the product windows - I normally explore a range of shapes that seem to make sense for that particular brand and package design. Sometimes the shapes are simple, other times they are not. I think the window shape should accentuate the design and flow with it seamlessly. Different shapes / styles are used to do that.

Engels: How does the shape of a transparent window influence customers of food products?

Bentley: I don't have any research to know definitely here. But I think consumers like seeing the product in the window. As mentioned before, it gives them a level of comfort that they see exactly what they are getting. In regard to a particular shape, and how that plays into their buying decision — I would believe that specific shape probably doesn't influence them too much (e.g. I don't think they are more likely to gravitate toward circles vs. squares, etc.). How that shape plays out with the rest of the brand and the way that package makes a consumer

feel is where the influence comes in. I also think that more unique window cutouts can attract more attention — which of course would also influence the buyer.

Engels: How does the colour of a transparent window influence customers of food products?

Bentley: I think any colour should be used to accentuate the product as best as possible. When designing for the package, we always need to keep in mind the product itself. The colours, the design, etc. should all be used to showcase the product as best as possible .

Engels: What else can you tell me concerning transparency, colour and shape in context of food packaging?

Bentley: the only thing to add is that the placement of window is crucial. The window should show off the product and strategically be placed on the package so that you don't see any empty space (above the product feel line). Or careful not to show any crumbs or less attractive breakdown of the product that may occur at the bottom of the package.

Expert interview V with Jeff Zack (protocol)

I. Introduction

The expert interview took place on 15.08.2014 and was conducted by email. The participants were Mr. Jeff Zack and Maximilian W. Engels (Interviewer).

II. Expert portrait

Mr. Zack is founder and creative director of the New York (USA) based design agency Zackgroup which focuses on package design, brand identity, merchandising and environmental design. Clients are Nestlé, Duncan Hines cake mixes, Brummel&Brown yogurt, Pinnacle frozen foods, Mrs. Paul's frozen foods and several others.

III. Transcript

Engels: Do your package designs for food products include transparent coloured windows and/or notably shaped windows respectively? If yes, why? If no, why not?

Zack: We have only worked with clear transparent windows not coloured. Generally speaking the role of windows is to clearly show the product in its true form. The shape of window often lends itself to working with the design of brand elements and creating a proprietary brand personality. For example, a standard rectangular window on a box would miss the opportunity to shape a window that may follow a specific curve of a logo graphic which would be more custom to the design of that brand. We often like the idea of a special shape window as it can add an additional spark of interest and a more proprietary personality to a brand.

Engels: How does the shape of a transparent window influence customers of food products?

Zack: We do not have data on this, which support these thoughts, however the window size can often be an indicator to freshness of a product, and may even suggest more natural. An example here may be a bread product and less graphic coverage, seeing more product suggests less artificial and more 'real' ingredients. Categories such as branded meat products are careful to maintain about 2/3 window as shoppers tend to shop brand first and then want to choose a particular cut by seeing the actual product very clearly.

Engels: How does the colour of a transparent window influence customers of food products?

Zack: There is one technique I am aware of however which has been around for a long time... I refer to it as "the carrot bag trick". Primarily used in the produce department of grocery for carrots (though I have seen it on celery as well)... a technique of simply creating a pattern or linework on a clear bag in a single colour that is similar to the product, for example, an orange striped pattern on a clear bag of carrots. The effect enhances the natural colour of vegetables to be richer and a more vibrant orange, thus making the product look more appetising.

Engels: What else can you tell me concerning my thesis' topic regarding respectively transparency, colour and shape in context of food packaging?

Zack: A good place to focus attention may be in looking to what we may expect to see more of in the future, the emergence of new trends in our culture, environment and style. I believe the consumers of today have become significantly more sophisticated, brand and style conscious ... Even the graphics used for Mc Donalds today have become more upscale! Trends are also moving towards more natural, simple and honest. In regards to 'clear and windows' , recently the 'Beechnut' branded baby food company had re-designed their entire line of products... not only the packaging graphics but logo, containers, every food recipe reformulated etc... why?, to be more natural and believable brand as 'better for you'. A huge corporate decision, which was addressing the trends of today. You may cite their containers from the old wrap-around label to the now clear bottle with graphics overprinting. The look is more of a natural 'home-prepared' and jarred product. Possible trend towards seeing more product and transparent.

Expert interview VI with Anirudha Mukhedkar (protocol)

I. Introduction

The expert interview took place on 10.09.2014 and was conducted by email. The participants were Mr. Anirudha Mukhedkar and Maximilian W. Engels (Interviewer).

II. Expert portrait

Mr. Mukhedkar is Founder & Chief Executive Officer of India based OWLWORX design. The company has designed packages for Indian food products like MTR foods (Snack Up, Magic Kitchen, Authentic South Indian), Fresh valley, AVT Premium and DALDA.

III. Transcript

Engels: Do your package designs for food products include transparent coloured windows and/or notably shaped windows respectively? If yes, why? If no, why not?

Mukhedkar: The guiding principle in India on including transparency is dependent upon answering some key questions:

- How is the category bought?
- Does visual evaluation dictate the customers' perception of quality?
- Is the product visually unique?
- Can the product get damaged during transit from factory to the retail shelf?

When you have categories where the visual appearance of the product signals quality or uniqueness then a transparent window must be used.

For instance, most commodities like rice, wheat, salt and sugar that are sold in packaged form use almost entirely transparent packs. Here, the transparency allows the buyer to evaluate the colour or purity of the product, thereby signalling the quality that you get inside it. You even have confectionery products like candies that use transparency in the entire back panel of the tiny single unit pack, to show either that the candy is unique - or to show that it hasn't been damaged in transit. This way the buyer knows he or she is not getting a broken hard boiled candy inside.

Of course, the degree of transparency can vary from category to category as exposure to sunlight can sometimes create chemical changes in the product. So milk for instance is never in transparent pouches. But cooking oil is!

Engels: How does the shape of a transparent window influence customers of food products?

Mukhedkar: The shape of the window is not relevant as far as the buyer is concerned. However, the shape, when used innovatively, can add to the design aesthetic and become an integral element of the packaging design.

Engels: How does the colour of a transparent window influence customers of food products?

Mukhedkar: The colour of the window has to be transparent since the job that the window performs is purely a functional one - to help the buyer visually evaluate the product quality, condition or shape.

Engels: What else can you tell me concerning transparency, colour and shape in context of food packaging?

Mukhedkar: These days, products that get damaged during transit - like packaged nachos or potato crisps - do not use window. Nor do many other food categories like packaged tea or coffee. They have started replacing their windows with new technology that reassures customers on the product quality inside the pack thereby eliminating the need for visual inspection. Technologies like nitrogen filled polypacks or vacuum sealed packs give customers the confidence that the product inside is fresh and unbroken or intact. Only categories like confectionery - candies, gum etc use transparency if they have some exciting shape or unique product form/ colour etc.

Expert interview VII with Andreas Kioroglou (protocol)

I. Introduction

The expert interview took place on 20.09.2014 and was conducted by email. The participants were Mr. Andreas Kioroglou and Maximilian W. Engels (Interviewer).

II. Expert portrait

Mr. Kioroglou is Founder & Creative Director of Athens (Greece) based Matadog Design. The company focuses on branding, packaging and product design and has won several awards. It has mainly worked for Greek companies such Aqua Angel bottled water, Enios fruits, Ecosmart, Hauz kitchenware or Bildo toys.

III. Transcript

Engels: Do your package designs for food products include transparent coloured windows and/or notably shaped windows respectively? If yes, why? If no, why not?

Kioroglou: We use transparent window packaging, but it depends on the product and technical and budget limitations. We usually design packages that have shaped windows. We strongly believe that the product must speak for itself. Food is a very sensitive issue. People want to know what they are buying, especially regarding food. Transparency is a powerful tool for selling the product more easily as it visible to consumer, as long as the product is not losing its shape and characteristics due to transportation, stacking, temperature changes etc. Customers/consumers want the package they buy to be in perfect condition and the product should look delicious.

Engels: How does the shape of a transparent window influence customers of food products?

Kioroglou: A shaped window, especially if it's part of the concept and has a meaning or key role (eg. The window will be a mouth) can be powerful and increase sales. Window position is also important as if is placed in a position that can be wrinkled can have a negative effect.

A nice example of negative effect of window packaging is one that I saw on the shelf of one of the most world famous firms. The product was chocolate cookies that were in a window box. The chocolate was melted (probably by bad temperature), making the window chocolate dirty while some of the cookies were cracked. So you have to take in to account the product's nature and its characteristics.

Engels: How does the colour of a transparent window influence customers of food products?

Kioroglou: By using coloured windows, you alter the nature and look of the product so it has to be used only if there is a reason for. The colour can also alter the perceived taste of the product so if colour is used, it must be selected very carefully.

Engels: What else can you tell me concerning transparency, colour and shape in context of food packaging?

Kioroglou: Packaging is not just a great studio photo shot. It's a product for real consumers. There are many products competing on the shelf, consumers will take it on their hands, packaging may fall down, being stacked (so must be able to keep its shape). Packaging might also look different in the case of bad lighting.

Expert interview VIII with Prof. Dr. Charles Spence (protocol)

I. Introduction

The expert interview took place on 19.09.2014 and was conducted by email. The participants were Prof. Dr. Charles Spence and Maximilian W. Engels (Interviewer).

II. Expert portrait

Mr. Spence is Professor of Experimental Psychology at the University of Oxford and head of the Crossmodal Research Laboratory. His work amongst other aspects greatly focuses on an ideal design of multisensory foods. He has published over 500 articles in scientific journals of which many are related to crossmodal correspondence. Additionally, he has won numerous awards such as the Paul Bertelson Award, Friedrich Wilhelm Bessel Research Award and the Cognitive Section Award.

III. Transcript

Engels: How will the shape of a transparent window influence customers of food products/their product perception?

Spence: Thus far, I have been looking mostly at the shapes of labels and logos put on packaging, never the shape of the window.

I guess one could wonder whether shape of window falls into background, and yet there might be some influence.

It would certainly be fun to do a study with a sweet vs bitter/sour product and see whether shape of window rounded vs angular makes a difference. I wouldn't be surprised if there was some small influence there.

Engels: How will the colour of a transparent window influence customers of food products/their product perception?

Spence: Well it depends on the colour contrast/complementarity. Some products - think Heinz beans and Dairy Milk chocolate look good against brand colour, so does Barilla pasta, others don't.

I am currently working with a company who wants to introduce windows, but problem is that the product inside doesn't stand out well.

Engels: Which parameter will have a bigger influence on customers the colour of a window or its shape? Why?

Spence: No idea. My general answer is that one would need to do an experiment to find out.

Engels: What else can you tell me in context to (food) packaging windows and possible crossmodal correspondences?

Spence: Nothing specific to windows.

B. Shape Calculations for Study 1

In the following the mathematical calculations for the window shapes are presented.

Rhombus

Since the rhombus is the figure which compared to its maximum width has the lowest surface area calculation has to start with it for that other figures shall not have a bigger surface area. The angular rhombus will be put together out of two equilateral triangles. The maximum width that is realizable on the packaging boxes for the test is 11,5 cm.

Making use of the Pythagorean theorem the side lengths a are

$$a = \frac{h}{\frac{\sqrt{3}}{2}} \quad \text{with } h = \frac{11,5}{2}$$

This leads to $a = 6,640$ cm

The surface area A is as big as two equilateral triangles:

$$A_{rhombus} = 2 \cdot \frac{\sqrt{3}}{4} \cdot a^2$$
$$\triangleright 2 \cdot \frac{\sqrt{3}}{4} \cdot 6,640^2 = 38,18$$

Square

Since the side lengths of a square are all of the same length and the surface area is the side length squared each side b is: $b = \sqrt{38,18} = 6,18$

Equilateral triangle

Since the surface area shall be $38,18\text{cm}^2$ the calculation for the side lengths will be backwards to the one of the rhombus. The surface area of an equilateral triangle can be

$$A_{equilateral_triangle} = \frac{\sqrt{3}}{4} \cdot a^2 = 38,18$$

described as

As a result a is 9,39.

Rectangle

Since the width-to-height ratio shall be 2:3 the following is true for the side lengths x and y of the rectangle:

$$x \cdot y = 38,18$$

$$1,5x = y$$

$$\triangleright 1,5x \cdot x = 38,18$$

$$\triangleright x = \sqrt{\frac{38,18}{1,5}} = 5,05$$

$$\triangleright y = 1,5 \cdot 5,05 = 7,58$$

Reuleaux

The Reuleaux triangle is constructed by three circles of which each midpoint is crossed by both other circles. As a result the surface area of this polygon consists of one equilateral triangle as well as three circular segments.

Therefore the overall surface area can be described as

$$A_{\text{reuleaux_triangle}} = \frac{\sqrt{3}}{4} \cdot a^2 + 3 \cdot \left(\frac{\pi}{6} - \frac{\sqrt{3}}{4} \right) \cdot a^2$$

Since the formular can be shortened and the surface area shall be 38,18 the formula can be solved with:

$$38,18 = \frac{1}{2} \cdot (\pi - \sqrt{3}) \cdot a^2$$

As a result a is 7,36.

Circle

The surface area of the circle can be described with the radius c:

$$A_{\text{circle}} = c^2 \cdot \pi = 38,18$$

$$\triangleright c = 3,49$$

Ellipse

The surface area of an ellipse is $A_{\text{ellipse}} = \pi \cdot d \cdot e$ with d,e being each one semiaxis (half axis length) and the border of the ellipse consisting only of points that the sum of their distances to two fixed points is constant.

To get an ellipse which is similar to the rhombus d is chosen to be 1,5e:

$$A_{\text{ellipse}} = \pi \cdot 1,5e \cdot e = 38,18$$

$$\triangleright e^2 = \frac{38,18}{1,5\pi} = 8,10$$

$$\triangleright e = 2,85$$

$$\triangleright d = 1,5 \cdot 2,85 = 4,27$$

The diameters are equivalent for the x-axis =2d=8,54 and for the y-axis =2e=5,7.

Superellipse by Piet Hein

This form was described by Piet Hein in 1959 and is different to a usual ellipse as the border of the superellipse does not only consist of points that the sum of their distances to two fixed points is constant. It looks to some extent like a rounded rectangle but has no straight lines.

The border points of the superellipse can be described with

$$x(t) = \frac{\cos(t)}{\text{abs}(\cos(t))} \cdot d \cdot (\text{abs}(\cos(t)))^{0,8}, \quad t \in [-\pi, \pi] \setminus \left\{ -\frac{\pi}{2}, \frac{\pi}{2} \right\}$$

$$y(t) = \frac{\sin(t)}{\text{abs}(\sin(t))} \cdot e \cdot (\text{abs}(\sin(t)))^{0,8}, \quad t \in [-\pi, \pi] \setminus \{-\pi, 0, \pi\}$$

The formular for the surface area of a superellipse is:

$$A_{\text{superellipse}} = 4 \cdot d \cdot e \frac{(\Gamma(1,4))^2}{\Gamma(1,8)} \approx 3,380935356 \cdot d \cdot e$$

The semiaxis d and e shall again be in the same proportion as the rectangle so that d is chosen to be 1,5e.

$$3,380935356 \cdot 1,5e \cdot e = 38,18$$

$$\triangleright e^2 = \frac{38,18}{5,07} = 7,53$$

$$\triangleright e = 2,74$$

$$\triangleright d = 1,5 \cdot 2,74 = 4,11$$

The diameters are equivalent for the x-axis $=2d=8,22$ and for the y-axis $=2e=5,48$.

To draw the superellipse the above formulas for x and y are put into an excel-document and filled with the results for e and d.

C. Penne Pasta Preparation

The penne pasta were prepared as follows:

2 Litres tap water (Hasselt, Belgium) were put into a saucepan. When it started to boil 20gr salt were added. Then 250gr penne pasta was put into the saucepan and the stopwatch was set to 13 minutes and 30 seconds. The penne were stired every 2 minutes. When the stopwatch rang the penne were decanted so that they were not getting completely dry and put into a bowl with the lid mostly covering it. The penne were again stired every 2 minutes. After about 10 minutes the bowl was closed completely. From then on the penne were stired every 10 minutes. This process was repeated up to 4 times a day.

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The use of crossmodal correspondences in the design of food packaging windows**

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Voor akkoord,

Engels, Maximilian Winfried

Datum: **12/01/2015**