

**Exploring the relationship between selected
internal consumer behaviour variables and the
emotional response to the sensory properties of
chocolate**

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ABSTRACT

Sensory properties of food products are assumed to influence emotional product conceptualisations. However, this link requires further research, and consumer behaviour variables are generally not considered in emotional response studies. By showcasing the relationship between emotional response and sensory properties, it could assist in the development of products for target consumers, based on an understanding of the emotional signature of a product or category. Furthermore, by incorporating consumer behaviour, response and product adoption could be anticipated by better understanding consumers' choices. Investigating and describing these relationships for a product such as chocolate, which is highly associated with emotion, can provide insight into the role of sensory properties and consumer behaviour in shaping emotional response.

This study aimed to investigate and describe the relationship between the sensory properties of chocolate and the emotional response of consumers, and the impact of various internal consumer behaviour variables (mood, familiarity, acceptability and attitude) on this response. It will describe the emotional profile of chocolate, identify whether a relationship exists between various sensory properties and various emotions, and indicate how and to what extent these internal consumer behaviour variables influence this emotional response.

A quantitative, descriptive cross-sectional study was conducted, implementing a standardised questionnaire to collect quantifiable data. The questionnaire was compiled by incorporating an existing mood scale, an attitude questionnaire, an acceptability scale, an EsSense25 emotion tool, a consumption frequency questionnaire and a sensory questionnaire which was developed based on a review of 13 chocolate studies. Consumers (n=149) were included in the study through non-probability purposive sampling. Exploratory factor analysis, confirmatory analysis and principal component analysis were conducted to determine whether relationships exist between the variables.

While the intensity of the sensory attributes of chocolates studied varied greatly, emotional profiles were similar, however, the intensity differed. The relationship between the sensory properties and the emotional response indicated that bitter drives emotional response. The investigated consumer behaviour variables, however, also influenced emotional response. A positive mood resulted in a positive emotional response. A negative attitude towards the chocolate category resulted in negative correlations with positive emotions. Positive emotions were reported by respondents who consumed and were familiar with large chocolate formats.

Chocolates with low acceptability are more likely to evoke negative emotions. Emotional response is thus related to both sensory properties of food and consumer behaviour.

This study has described the product variables which were investigated (sensory attributes, emotion attributes, and the consumer behaviour variables namely mood, familiarity, acceptability and attitude), the relative importance of each and the relationship between them in a local context, to showcase that these variables are all interdependent, but that the factors of the variables also have a level of interdependency. The study generated the first data within the field of emo-sensory research in South Africa and has shown that integrated studies are viable and valuable.

KEYWORDS

- Consumer
- Consumer behaviour
- Mood
- Familiarity
- Acceptability
- Attitude
- Emotion
- Emotional response
- Emotion attributes
- Sensory properties/attributes
- Chocolate

LIST OF ABBREVIATIONS

ACQ:	Attitudes to chocolate questionnaire
ANOVA:	Analysis of variance
CASI:	Computer assisted self-completion interviewing
CATA:	Check all that apply
CFI:	Comparative fit index
CMIN:	Chi-square statistics minimum value of discrepancy
C.R.:	Critical ratio
DF:	Degrees of freedom
FACT:	Food Action Rating Scale
HREC:	Health Research Ethics Committee
KMO:	Kaiser-Meyer-Olkin
MAP:	Management Advancement Programme
MBA:	Master of Business Administration
NWU:	North-West University
PAPI:	Pen and paper personal interview
PCA:	Principal component analysis
PDM:	Postgraduate Diploma in Management
QDA:	Quantitative Descriptive Analysis
QFFQ:	Quantitative food frequency questionnaire
RATA:	Rate all that apply
RMSEA:	Root mean squared error of approximation
SD:	Standard deviation
S.E.:	Standard error
SEM:	Structural equation model
SPSS:	Statistical Package for the Social Sciences
WITS:	The University of the Witwatersrand

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“Never regard study as a duty but as an enviable opportunity to learn to know the liberating influence of beauty in the realm of the spirit for your own personal joy and to the profit of the community to which your later works belong.” ~Albert Einstein

TABLE OF CONTENTS

	Page
Abstract	i
Key Words	iii
List of Abbreviations	iv
Acknowledgements	v
List of Tables	xiv
List of Figures	xviii
List of Appendices	xx

CHAPTER 1: INTRODUCTION

1.1 BACKGROUND.....	1
1.2 MOTIVATION FOR THE STUDY.....	4
1.2.1 Value of emotion research for the industry.....	5
1.2.1.1 Value for the chocolate industry.....	5
1.2.1.2 Value for the wider industry	7
1.2.1.3 Value for the consumer.....	8
1.3 PROBLEM STATEMENT	8
1.4 RESEARCH QUESTIONS, AIM AND OBJECTIVES	9
1.4.1 Research questions.....	9
1.4.1.1 Primary research question.....	9
1.4.1.2 Secondary research questions	9
1.4.2 Aim.....	10
1.4.3 Objectives.....	10
1.4.3.1 Literature-related objective	10
1.4.3.2 Empirically related objectives.....	10
1.4.3.3 Implication-related objectives.....	11
1.5. CONCEPTUAL FRAMEWORK.....	12
1.6 OUTLINE OF THE STUDY	13
1.7 AUTHORS CONTRIBUTION AND DECLARATION	15

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION.....	18
2.2 THE CHOCOLATE CATEGORY	18
2.3 EMOTION	20
2.3.1 Classification of emotions.....	23

2.3.1.1 Positive and negative emotion dimensions	24
2.3.1.2 Valence and arousal emotion dimensions.....	26
2.3.2 Emotional response	27
2.3.2.1 Emotional response to food	28
2.3.2.2 Measuring emotional response.....	30
2.3.3 Emotional response and behaviour	33
2.4 THE SENSORY PROPERTIES OF FOOD	34
2.4.1 Sensory evaluation	34
2.4.1.1 Sensory evaluation with consumers.....	36
2.5 EMOTIONAL RESPONSE TO SENSORY PROPERTIES OF FOOD.....	37
2.5.1 The link between sensory properties and emotions	38
2.6 THE RELATIONSHIP BETWEEN SENSORY PROPERTIES, EMOTION AND LIKING	42
2.7 CONSUMER BEHAVIOUR.....	43
2.7.1 Influence of emotion on consumer behaviour	45
2.7.1.1 Mood and emotion.....	45
2.7.1.2 Familiarity and emotion.....	47
2.7.1.3 Acceptability /liking	50
2.7.1.4 Attitude	55
2.8 CONCLUSION	57

CHAPTER 3: RESEARCH METHODOLOGY

3.1 INTRODUCTION	59
3.2 RESEARCH DESIGN	61
3.2.1 Study location.....	61
3.2.2 Sampling	62
3.2.2.1 Inclusion criteria.....	62
3.2.2.2 Sampling technique	64
3.2.2.3 Sampling frame	65
3.2.2.4 Sample size	66
3.2.3 Selection of chocolate as the focus product of the study.....	68
3.3 DATA COLLECTION AND ANALYSIS	71
3.3.1 Preparation of research materials.....	71
3.3.1.1 Preparation of the list of sensory descriptors for chocolate	71
3.3.1.2 Ensuring comprehension of sensory descriptors.....	72
3.3.1.3 Trained panel evaluation of chocolate samples and sensory researchquestionnaire....	73
3.3.1.4 Preparation of the research questionnaire	77
3.3.1.5 Pre-testing and finalising the questionnaire	87

3.3.2 Recruitment of respondents.....	88
3.3.3 Data collection.....	90
3.3.3.1 Preparation and presentation of chocolates.....	90
3.3.3.2 Preparation of sample packs	91
3.3.3.3 Distribution of sample packs.....	92
3.3.3.4 Completion of the research questionnaire.....	92
3.3.4 Data management.....	95
3.3.4.1 Data dissemination	97
3.4 VALIDITY OF THE MEASUREMENT INSTRUMENT	98
3.4.1 Face Validity.....	98
3.4.2 Construct validity	99
3.4.3 Content validity	99
3.4.4 Measures taken to reduce threats to validity.....	99
3.4.4 Reliability.....	101
3.5 ETHICAL CONSIDERATIONS	101
3.5.1 Ethical approval.....	102
3.5.2 Protection of respondents.....	102
3.5.3 Deception of respondents.....	102
3.5.4 Voluntary participation	102
3.5.5 Recruitment of respondents.....	103
3.5.6 Informed consent.....	103
3.5.7 Anonymity, confidentiality and the right to privacy.....	103
3.6 RISK AND BENEFIT ANALYSIS	103
3.6.1 Risks.....	104
3.6.1.1 Physical risks.....	104
3.6.1.2 Psychological risks	104
3.6.1.3 Social risks	104
3.6.1.4 Legal risks	105
3.6.1.5 Economic risks	105
3.6.1.6 Dignitary risks	105
3.6.2 Benefits.....	105
3.6.3 Competence of the researcher	106
3.6.4 Contributions of the study	106
3.7 CONCLUSION	107

CHAPTER 4: THE SENSORY PROFILE OF CHOCOLATE

4.1 INTRODUCTION.....	108

4.2 STATISTICAL ANALYSIS	109
4.3 RESULTS AND DISCUSSION	110
4.3.1 Describing the sensory experience of chocolate	110
4.3.1.1 Appearance	111
4.3.1.2 Aroma.....	112
4.3.1.3 Flavour	112
4.3.1.4 Mouthfeel.....	112
4.3.1.5 Aftertaste	113
4.3.2 Describing the sensory variation between the evaluated chocolates	113
4.3.3 Determining correlations between evaluated chocolates and sensory attributes.....	114
4.3.3.1 Factor analysis for individual chocolates	114
4.3.4 Correlations between individual sensory attributes of evaluated chocolates within factors	116
4.3.4.1 Correlations between sensory attributes from the bitter factor	117
4.3.4.2 Correlations between sensory attributes from the sweet factor	118
4.3.5 The influence of chocolate ingredients on the sensory experience	121
4.3.5.1 Canderel.....	124
4.3.5.2 Lindt.....	124
4.3.5.3 Nestlé.....	125
4.3.6 Chocolate sensory profiles	125
4.3.6.1 The sensory profile of Canderel.....	131
4.3.6.2 The sensory profile of Lindt	131
4.3.6.3 The sensory profile of Nestlé	131
4.4 CONCLUSION	131

CHAPTER 5: THE EMOTIONAL PROFILE OF CHOCOLATE

5.1 INTRODUCTION	133
5.2 STATISTICAL ANALYSIS	133
5.3 RESULTS AND DISCUSSION	134
5.3.1 Emotions experienced during chocolate consumption	134
5.3.1.1 Relevance of emotions included	134
5.3.1.2 Frequency of emotional attribute experienced during chocolate consumption	138
5.3.1.3 Classification of the emotional experience during chocolate consumption	138
5.3.1.4 Variations in the incidence of individual emotion attribute usage	139
5.3.2 Ranking and intensity of weighted mean scores of emotional attributes	140
5.3.3 Describing the emotional experience of chocolate	142
5.3.3.1 Comparison of the emotional experience of the three chocolates	142

5.3.3.2 Emotion discrimination between samples	144
5.4 THE RELATIONSHIP BETWEEN EMOTIONS EXPERIENCED DURING CHOCOLATE CONSUMPTION.....	145
5.4.1 Factor analysis to group emotions	145
5.4.1.1 Factor analysis of Canderel	147
5.4.1.2 Factor analysis of Lindt.....	148
5.4.1.3 Factor analysis of Nestlé	150
5.4.2 Adjustment to the negative emotion factor	152
5.4.3 Classification of unclassified emotions based on factor analysis.....	152
5.4.4 Valence of the chocolate emotion experience.....	153
5.5 THE RELATIONSHIP BETWEEN INDIVIDUAL EMOTIONS	154
5.5.1 Individual emotion correlations of Canderel	154
5.5.2 Individual emotion correlations of Lindt.....	158
5.5.3 Individual emotion correlations of Nestlé	162
5.5.4 Redundancy and interchangeability of emotional attributes	165
5.5.5 Variations in relationships of emotional attributes between chocolates	168
5.6 VISUALISATION OF THE RELATIONSHIPS BETWEEN EMOTIONS	170
5.7 THE EMOTIONAL PROFILE OF CHOCOLATE	173
5.7.1 The emotional profile of Canderel	175
5.7.2 The emotional profile of Lindt	177
5.7.3 The emotional profile of Nestlé	179
5.8 VALIDITY OF THE EMOTION QUESTIONNAIRE.....	181
5.9 CONCLUSION	181

CHAPTER 6: THE RELATIONSHIP BETWEEN THE SENSORY PROPERTIES OF AND THE EMOTIONAL RESPONSE TO CHOCOLATE

6.1 INTRODUCTION	183
6.2 STATISTICAL ANALYSIS	185
6.3 RESULTS AND DISCUSSION	186
6.3.1 The relationship between individual attributes: sensory and emotion correlation analysis	186
6.3.1.1 Canderel.....	193
6.3.1.2 Lindt	193
6.3.1.3 Nestlé	194
6.3.1.4 Positive emotional attributes	194
6.3.1.5 Negative emotional attributes	195
6.3.2 The relationship between factors: sensory and emotion	196

6.3.3 The contribution of the set (collective) of sensory attributes to individual emotions.....	197
6.3.4 The unique contribution of individual sensory attributes to individual emotions.....	202
6.3.4.1 Canderel.....	206
6.3.4.2 Lindt	206
6.3.4.3 Nestlé	207
6.3.4.4 Comparison of the models of the three chocolates	207
6.3.4.5 The contribution of aroma sensory attributes to emotion.....	208
6.3.4.6 The contribution of appearance sensory attributes to emotion	209
6.3.4.7 The contribution of mouthfeel sensory attributes to emotion	210
6.3.4.8 The contribution of flavour sensory attributes to emotion	211
6.3.4.9 The contribution of aftertaste sensory attributes to emotion	215
6.4 PRINCIPAL COMPONENT ANALYSIS OF SENSORY AND EMOTIONAL ATTRIBUTES	216
6.5 CONCLUSION	220

CHAPTER 7: THE RELATIONSHIP BETWEEN VARIOUS INTERNAL CONSUMER BEHAVIOUR VARIABLES AND THE EMOTIONAL RESPONSE TO CHOCOLATE

7.1 INTRODUCTION	222
7.2 STATISTICAL ANALYSIS	223
7.3 RESULTS.....	224
7.3.1 The relationship between mood and emotion	224
7.3.1.1 Mood state of the respondents	224
7.3.1.2 Factor analysis to group moods.....	225
7.3.1.3 The relationship between mood and emotion factors	227
7.3.1.4 The relationship between individual mood and emotion attributes	231
7.3.1.5 Principal component analysis of mood and emotion attributes.....	237
7.3.1.6 Reliability of the mood questionnaire	243
7.3.2 The relationship between familiarity and emotion	243
7.3.2.1 Familiarity of respondents with various chocolate types.....	243
7.3.2.2 Factor analysis to group familiarity with the various chocolate types.....	244
7.3.2.3 Relationship between overall chocolate usage and familiarity attributes	245
7.3.2.4 Relationship between familiarity and emotion factors.....	247
7.3.2.5 The relationship between individual familiarity and emotion attributes	250
7.3.2.6 Principal component analysis of familiarity and emotion attributes.....	255
7.3.2.7 Reliability of the familiarity questionnaire	261
7.3.3 The relationship between acceptability and emotion.....	261
7.3.3.1 Acceptability of the three chocolates.....	261

7.3.3.2 Acceptability and emotion factor correlations: Data of the three individual chocolates	264
7.3.3.3 The relationship between acceptability and individual emotion attributes: Data of the three individual chocolates	266
7.3.3.4 Principal component analysis of acceptability and emotion attributes	272
7.3.4 The relationship between attitude and emotion.....	279
7.3.4.1 Respondents' attitude towards chocolate.....	279
7.3.4.2 Factor analysis to group the attitudes towards chocolate	281
7.3.4.3 The relationship between attitude and emotion factors	285
7.3.4.4 The relationship between attitude and individual emotion attributes: Data of the individual chocolates	287
7.3.4.5 Principal component analysis of attitude and emotion attributes	302
7.3.4.6 Reliability of the attitude questionnaire	308
7.3.5 Summary of Spearman's rank order correlation (r) values between emotion factors and the consumer behaviour variables	308
7.4 CONCLUSION	310

CHAPTER 8: THE RELATIONSHIP BETWEEN THE SENSORY PROPERTIES OF, EMOTIONAL RESPONSE TO AND CONSUMER BEHAVIOUR TOWARDS CHOCOLATE – A STRUCTURAL EQUATION MODEL

1. Introduction	312
2. Materials and methods	318
2.1 Participants	318
2.2 Chocolate samples	319
2.3 Data collection.....	320
2.4 Data analysis.....	323
3. Results	324
3.1 Positive emotion model	324
3.1.1 Positive emotion model fit indices.....	324
3.1.2 Results of SEM analysis of positive emotion model	326
3.1.3 Covariance and correlations of the positive emotion model	327
3.1.4 Squared multiple correlations of measured variables of the positive emotion model	328
3.1.5 Positive emotion model.....	329
3.2 Negative emotion model	331
3.2.1 Negative emotion model fit indices	331
3.2.2 Results of SEM analysis of the negative emotion model.....	331
3.2.3 Covariance and correlations of the negative emotion model	333
3.2.4 Squared multiple correlations of measured variables.....	333

3.2.5 Negative emotion model	334
3.3 Constructed model of positive and negative emotion.....	336
4. Discussion.....	336
4.1 Positive emotion model.....	338
4.2 Negative emotion model	331
4.3 Constructed model of positive and negative emotion.....	339
5. Conclusion	341
6. Literature references	342

CHAPTER 9 – SUMMARY AND CONCLUSION

9.1 INTRODUCTION	351
9.2 LITERATURE-RELATED OBJECTIVE	353
9.3 EMPIRICAL OBJECTIVES	354
9.3.1 Objective 1: Determine whether a relationship exists between consumers' evaluation of the sensory properties of chocolate and their emotional response to it	354
9.3.1.1 Objective 1a: Preparing a sensory profile for chocolate	354
9.3.1.2 Objective 1b: Preparing an emotional profile for chocolate	355
9.3.1.3 Objective 1c: Determine whether specific sensory properties can be linked to specific emotions	355
9.3.1.4. Objective 1c: Determine whether specific sensory properties can be linked to positive or negative emotions categories.....	356
9.3.1.5. Objective 1d: Compiling a model indicating the relationship between the emotional response and the sensory properties of chocolate.....	357
9.3.2 Objective 2: Determine whether a relationship exists between consumers' mood and consumers' emotional response to chocolate	358
9.3.3 Objective 3: Determine whether a relationship exists between consumers' familiarity with chocolate and consumers' emotional response to it.....	359
9.3.4 Objective 4: Determine whether a relationship exists between the acceptability of chocolate and consumers' emotional response to it.....	360
9.3.5 Objective 5: Determine whether a relationship exists between consumer's attitude towards chocolate and consumers' emotional response to it.....	361
9.4 IMPLICATION RELATED OBJECTIVES	363
9.5 CONTRIBUTIONS OF THE STUDY	364
9.6 LIMITATIONS AND RECOMMENDATIONS.....	366
9.7 CONCLUSION	367

CHAPTER 10 – LITERATURE REFERENCES.....	368

LIST OF TABLES

	Page
CHAPTER 1: INTRODUCTION	
Table 1.1: Authors contributions	16
CHAPTER 2: LITERATURE REVIEW	
Table 2.1: Definitions of emotion from 1999 to 2018	21
CHAPTER 3: RESEARCH METHODOLOGY	
Table 3.1: Recruitment results of the study	67
Table 3.2: Comparison between general and Milk chocolate tablet consumption frequencies	68
Table 3.3: Internal consistency of familiarity data	82
Table 3.4: Statistical analysis performed on the collected data	96
Table 3.5: Threats to internal and external validity	100
CHAPTER 4: THE SENSORY PROFILE OF CHOCOLATE	
Table 4.1: Mean sensory values of the sensory attributes of the evaluated chocolates	111
Table 4.2: Pattern matrix with factor extractions for sensory attributes of all three chocolates	115
Table 4.3: Spearman's rank order correlations (r) between sensory attributes of the bitter factor	118
Table 4.4: Spearman's rank order correlations (r) between sensory attributes of the sweet factor	120
Table 4.5: Chocolate ingredients compared with the respondent experience of sensory attributes	122
CHAPTER 5: THE EMOTIONAL PROFILE OF CHOCOLATE	
Table 5.1: Emotions relevant to the chocolate eating experience (% frequency of use)	136
Table 5.2: Ranking (descending order) of weighted mean scores of emotions experienced during chocolate consumption	141
Table 5.3: Variations in mean ratings of emotions experienced during chocolate consumption	143
Table 5.4: Pattern matrix with factor extractions for Canderel to group emotions	147

Table 5.5: Pattern matrix with factor extractions for Lindt to group emotions	149
Table 5.6: Pattern matrix with factor extractions for Nestlé to group emotions	150
Table 5.7: Negative factor Cronbach's Alpha's excluding the guilty attribute	152
Table 5.8: Factor loading of unclassified emotions of three chocolate samples	153
Table 5.9: Spearman's rank order correlations (r) between emotional attributes of Canderel	156
Table 5.10: Spearman's rank order correlations (r) between emotional attributes of Lindt	159
Table 5.11: Spearman's rank order correlations (r) between emotional attributes of Nestlé	163
Table 5.12: Large Spearman's rank order correlation (r) emotion comparison between chocolates	167
Table 5.13: Variations in correlations between the three chocolates	169

CHAPTER 6: THE RELATIONSHIP BETWEEN THE SENSORY PROPERTIES OF AND THE EMOTIONAL RESPONSE TO CHOCOLATE

Table 6.1: Spearman's rank order correlations (r) between individual sensory and positive emotion attributes	187
Table 6.2: Spearman's rank order correlations (r) between individual sensory and negative emotion attributes	191
Table 6.3: Summary statistics from multiple regression analysis between emotion and sensory factors	196
Table 6.4: Summary statistics from multiple regression analysis between individual emotions and the set of sensory attributes	199
Table 6.5: The contribution of variables to the principal components	219

CHAPTER 7: THE RELATIONSHIP BETWEEN VARIOUS INTERNAL CONSUMER BEHAVIOUR VARIABLES AND THE EMOTIONAL RESPONSE TO CHOCOLATE

Table 7.1: Pattern matrix with factor extractions for moods	226
Table 7.2: Spearman's rank order correlations (r) between mood and emotion factors of all three chocolates	227
Table 7.3: Spearman's rank order correlations (r) between mood and emotion factors for the mean of all three chocolates	230
Table 7.4: Spearman's rank order correlations (r) between individual mood and emotion attributes for all chocolates	231
Table 7.5: Spearman's rank order correlations (r) between individual mood and emotion attributes of individual chocolates	234

Table 7.6: Pattern matrix with factor extractions for chocolate familiarity	244
Table 7.7: Spearman's rank order (r) correlations between overall chocolate usage and familiarity with chocolate types	247
Table 7.8: Spearman's rank order (r) correlations between emotions factors and familiarity factors	247
Table 7.9: Spearman's rank order correlations between emotion factors and familiarity factors for individual chocolates	249
Table 7.10: Spearman's rank order (r) correlations between emotion attributes and chocolates from the small factor	250
Table 7.11: Spearman's rank order (r) correlations between emotion attributes and chocolates from the large factor	252
Table 7.12: Mean acceptability scores of the three chocolates	261
Table 7.13: Spearman's rank order correlations (r) between emotion factors and acceptability of individual chocolates	265
Table 7.14: Spearman's rank order correlations (r) between individual emotion attributes and acceptability	267
Table 7.15: Pattern matrix with factor extractions for attitudes	281
Table 7.16: Spearman's rank order correlations between emotion and attitude factors overall	285
Table 7.17: Correlations between emotion and attitude factors for individual chocolates	286
Table 7.18: Spearman's rank order correlations (r) between emotion attributes and attitudes from the negative attitude factor for individual chocolates	288
Table 7.19: Correlations between emotion attributes and attitudes from the emotional attitude factor for individual chocolates	294
Table 7.20: Correlations between emotion attributes and attitudes from the functional attitude factor for individual chocolates	298
Table 7.21: Correlations between emotion attributes and attitudes from the obsession attitude factor for individual chocolates	300
Table 7.22: Summary of correlations between emotion factors and consumer behaviour variable factors	309

CHAPTER 8: THE RELATIONSHIP BETWEEN THE SENSORY PROPERTIES OF, EMOTIONAL RESPONSE TO AND CONSUMER BEHAVIOUR TOWARDS CHOCOLATE – A STRUCTURAL EQUATION MODEL

Table 1: Descriptive demographic profile of respondents included in this study	319
Table 2: Fit indices of SEM of sensory and consumer behaviour variables and	325

positive emotion	
Table 3: Results of the SEM for the positive emotion model	326
Table 4: Covariance and correlations between independent variables of the positive emotion model	328
Table 5: Fit indices of SEM of all variables and negative emotion	331
Table 6: Results of the SEM of the negative emotion model	332
Table 7: Covariance and correlations between independent variables of the negative emotion model	333

LIST OF FIGURES

	Page
CHAPTER 1: INTRODUCTION	
Figure 1.1 Conceptual framework to indicate the relationship between consumer mood, familiarity, acceptability and attitude and the emotional response to the sensory properties of chocolate	12
CHAPTER 3: RESEARCH METHODOLOGY	
Figure 3.1: Data collection and analysis	60
Figure 3.2: Questionnaire sections	78
CHAPTER 4: THE SENSORY PROFILE OF CHOCOLATE	
Figure 4.1: Comparison of sensory profiles of the three commercial chocolates	127
Figure 4.2: Sensory profile of Canderel	128
Figure 4.3: Sensory profile of Lindt	129
Figure 4.4: Sensory profile of Nestlé	130
CHAPTER 5: THE EMOTIONAL PROFILE OF CHOCOLATE	
Figure 5.1: Canderel's large inter-item emotion correlations	158
Figure 5.2: Lindt's large inter-item emotion correlations	161
Figure 5.3: Nestlé's large inter-item emotion correlations	165
Figure 5.4: Map of emotions associated with the three chocolate samples	172
Figure 5.5: Emotional profile of Canderel	176
Figure 5.6: Emotional profile of Lindt	178
Figure 5.7: Emotional profile of Nestlé	180
CHAPTER 6: THE RELATIONSHIP BETWEEN THE SENSORY PROPERTIES OF AND THE EMOTIONAL RESPONSE TO CHOCOLATE	
Figure 6.1: Constructed model of the relationship between sensory attributes and emotional response of Canderel	203
Figure 6.2: Constructed model of the relationship between sensory attributes and emotional response of Lindt	204
Figure 6.3: Constructed model of the relationship between sensory attributes and emotional response of Nestlé	205
Figure 6.4: Principal component analysis of sensory and emotion attributes	217

CHAPTER 7: THE RELATIONSHIP BETWEEN VARIOUS INTERNAL CONSUMER BEHAVIOUR VARIABLES AND THE EMOTIONAL RESPONSE TO CHOCOLATE

Figure 7.1: Mean score of mood of respondents at the start of the questionnaire	225
Figure 7.2: PCA map of mood and emotion attributes of Canderel	238
Figure 7.3: PCA map of mood and emotion attributes of Lindt	240
Figure 7.4: PCA map of mood and emotion attributes of Nestlé	242
Figure 7.5: Frequency of consumption of various chocolate types	243
Figure 7.6: PCA Map of familiarity with chocolate and emotion attributes of Canderel	256
Figure 7.7: PCA Map of familiarity with chocolate and emotion attributes of Lindt	258
Figure 7.8: PCA Map of familiarity with chocolate and emotion attributes of Nestlé	260
Figure 7.9: Acceptability of the three chocolates as % of responses	263
Figure 7.10: PCA map of acceptability and emotion attributes of Canderel	274
Figure 7.11: PCA map of acceptability and emotion attributes of Lindt	276
Figure 7.12: PCA map of acceptability and emotion attributes of Nestlé	278
Figure 7.13: Mean scores of chocolate category attitude attributes	280
Figure 7.14: PCA map of attitude attributes and emotion attributes of Canderel	303
Figure 7.15: PCA map of attitude attributes and emotion attributes of Lindt	305
Figure 7.16: PCA map of attitude attributes and emotion attributes of Nestlé	307

CHAPTER 8: THE RELATIONSHIP BETWEEN THE SENSORY PROPERTIES OF, EMOTIONAL RESPONSE TO AND CONSUMER BEHAVIOUR TOWARDS CHOCOLATE – A STRUCTURAL EQUATION MODEL

Figure 1: Sections of the research questionnaire	322
Figure 2: SEM of positive emotion, sensory properties and consumer behaviour variables	330
Figure 3: SEM of negative emotion, sensory properties and consumer behaviour variables	335
Figure 4: Constructed model of positive emotion, negative emotion, sensory properties and consumer behaviour variables	337

LIST OF APPENDICES

	Page
Appendix A: AUTHeR approval document	404
Appendix B: Ethics approval certificate	405
Appendix C: Permission letter from WITS Business School	406
Appendix D: Permission letter from Firmenich	407
Appendix E: Statistical consultation registration	408
Appendix F: Consent form	409
Appendix G: Poster used to advertise the study	414
Appendix H: Information pamphlet handed out to students	415
Appendix I: E-mail to students regarding consent form	421
Appendix J: E-mail to students regarding screening questionnaire	422
Appendix K: Screening questionnaire	423
Appendix L: Chocolate ingredient list	424
Appendix M: E-mail to students regarding collection of sample packs	425
Appendix N: Steps in the preparation of the sample packs	426
Appendix O: Storage instructions	432
Appendix P: Questionnaire instructions	433
Appendix Q: Survey scales	443
Appendix R: E-mail to students with link to survey	435
Appendix S: Mood questionnaire (Main questionnaire section A)	436
Appendix T: Demographic questionnaire (Main questionnaire section B)	437
Appendix U: Familiarity questionnaire (Main questionnaire section C)	438
Appendix V: Food acceptability questionnaire (Main questionnaire section D)	439
Appendix W: Working article: Applying trained panel data to refine a sensory descriptor list and select products for a consumer-centric study	440
Appendix X: Sensory properties questionnaire – Trained panel	469
Appendix Y: Sensory properties questionnaire (Main questionnaire section E)	471
Appendix Z: Emotional response questionnaire (Main questionnaire section F)	472
Appendix AA: Category attitude questionnaire (Main questionnaire section G)	473
Appendix AB: Descriptive tables	474
Appendix AC: Proof of article submission to Food Quality & Preference	475
Appendix AD: Proof of language editing of thesis	476
Appendix AE: Turnitin report	477

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

Emotion is a subject undergoing intense study in academic and business research (Bagozzi *et al.*, 1999; Johnson & Stewart, 2005; Bakamitsos, 2006). The concept of emotional response has been applied to a very wide range of industries, even extending to the automotive industry (Nakada, 1997; Chang *et al.*, 2006; Tsutsumi & Sasaki, 2008), which suggests that it is a useful commercial tool. The study of emotions within consumer research studies and the outputs achieved has also grown rapidly (Chaya *et al.*, 2015; Meiselman, 2015). However, the application of these findings to food products has been rare (Nakada, 1997; Chang *et al.*, 2006; Tsutsumi & Sasaki, 2008). Meiselman (2015) recently reported that ten years prior, nearly no conference presentations or journal papers examined the emotions associated with food products, and only recently has the connection between food quality and emotions begun to interest food researchers (Jaeger & Hedderley, 2013).

As sensory properties have been indicated to influence emotional product experiences (Thomson *et al.*, 2010b), studies in this field have investigated the possibility of analysing emotions alongside sensory properties of food products (and in certain cases liking or acceptability as well) to better understand consumers' food choices (Edwards *et al.*, 2013). For example, a study conducted by Seo *et al.* (2009) investigated the relationship between sensory properties and adjective sets of emotional response in a study of odours of dairy products, and found significant correlations between specific sensory properties and emotions evoked. Thus, as concluded by Ferrarini *et al.* (2010), the emotional measurement could be used in combination with sensory analysis in order to understand how taste, olfactory and visual aspects of a product arouse subconscious feelings and emotions that could ultimately drive hedonic or pleasure measures and choice behaviour.

It is crucial that consumers can relate brand essence to a product, a link that is of prime importance to marketing efforts. While the brand essence is ultimately based on the sensory

experience which conveys the emotional aspects of a product (King *et al.*, 2010), one cannot ignore the fact that various internal consumer behaviour variables have been found to have emotional connotations or influence the emotional response, including mood, familiarity, acceptability and attitude. Consumers' behavioural response to emotions also varies (Canetti *et al.*, 2002) based on the fact that emotions differ in their foregoing conditions, physiological correlates, frequentness of occurrence and duration (Scherer *et al.*, 1986).

The role of mood (and its dimensions) in impacting consumer behaviour has been acknowledged by various authors and researchers (Hoyer *et al.*, 2012; Solomon *et al.*, 2012). Current mood also impacts the affective (emotional) responses to food (Ferber & Cabanac, 1987; Willner & Healy, 1994). Moods have been found to influence eating responses along the complete process of ingestion: motivation to eat (Macht & Simons, 2000), food choice (Oliver & Wardle, 1999; Gibson, 2006), chewing (Macht, 1998), speed of eating (Krebs *et al.*, 1996), the amount that is ingested (Greeno & Wing, 1994), extending also to metabolic processes and digestion (Wing *et al.*, 1990; Blair *et al.*, 1991).

Familiarity is a consequence of food frequency, as increased usage and thus, product exposure or experience increases the familiarity with a product (Keenan, 2015). It has been noted that memory, attention and product familiarity are closely related (Peter *et al.*, 2010). Repeatedly exposing people to stimuli creates and strengthens stimulus-response associations that are stored in people's memory. With increasing product familiarity, people make associations between the identity of specific objects and other conceptual associations they have developed over time (Thomson *et al.*, 2010b). Some conceptual associations are learned from external sources and some are based on internal experiences (Thomson *et al.*, 2010b). Associations that consumers assign to products are based on experience and learning, and a portion of these associations have emotional connotations (Gutjar *et al.*, 2015).

Product acceptance, appeal, or liking has, over many years, been the means to understand the preference and food choice behaviour (Peryam & Pilgrim, 1957; Pilgrim, 1961; Kamen, 1962; Pilgrim & Kamen, 1963; de Graaf *et al.*, 2005). However, Dalenberg *et al.* (2014) recently found that a model containing product liking alone only moderately fitted the consumer choice behaviour. The relationship between food choice and liking is weak in real-world situations (Dalenberg *et al.*, 2014), and thus liking does not accurately predict food choice. It has recently

been indicated that the emotions which are experienced during food consumption better predict food choice than liking alone (Dalenberg *et al.*, 2014), as emotional profiles provide new information not captured by liking scores (Gutjar *et al.*, 2015).

Studies have also revealed the presence of an “attitude effect” in emotional response, which is when prior attitudes influence emotions experienced (McHugo *et al.*, 1991). As attitude is a propensity to react to stimuli (Mellott, 1983; Oundo *et al.*, 2014), it thus possesses motivation that encourages particular consumer behaviour or limits certain actions (Anilkumar & Joseph, 2012). Consumer behaviour is also not just viewed as a result or outcome of an attitude. It is also seen as a way to measure a consumer’s attitude towards an object (Albarracin *et al.*, 2014).

To date, the link between the specific sensory properties of food products (such as chocolate) and the emotions they evoke has not been adequately measured in an international context. At the time of preparing this document, no published data on South African studies which investigated emotional response to either food products or to their sensory properties could be found either. In addition, emotional response studies generally do not include a view on the impact of internal consumer behaviour variables such as mood, product familiarity, food acceptance or attitude on the emotional response to a food product. Mpinganjira *et al.* (2013) specifically stated that it is of great value to understand the field of consumer behaviour from the outlook of multiple disciplines, as this would provide an opportunity to investigate and describe a particular phenomenon from different viewpoints.

From a commercial point of view, the emotional response can be applied as a product development and differentiation tool, as the emotional linkage between brand and consumer is important in building strong brands (Hultén, 2011), ultimately ensuring a positive product experience. It is crucial that consumers can relate brand essence (what a brand stands for) to the physical product (including its sensory properties), a link that is of primary importance to marketing efforts (King *et al.*, 2010). If emotional response could be related to the sensory properties of foods, the insights would not only aid in the understanding of the emotional signature of a product or product category but would also assist in the development of products for target consumer categories (Ng & Hort, 2014; Schiffman & Kanuk, 2014), alongside a marketing mix which clearly conveys this emotional profile. Furthermore, if the consumer is

incorporated from a behaviour point of view, consumer response and product adoption could be anticipated.

Chocolate was chosen as a product for exploration in the present study because, based on a review of the literature regarding the sensory properties and emotions, moods and attitudes related to chocolate, it can be viewed as a more complex food type in terms of the above concepts, and is thus well-positioned to provide insight into the various areas that will be investigated. Chocolate has been studied by many researchers, and from these, tools to apply in similar studies have also been published by such researchers (Viaene & Januszezowska, 1997; Ziegler *et al.*, 2001; Sune *et al.*, 2002; Golob *et al.*, 2004; Lasekan *et al.*, 2007; de Melo *et al.*, 2009; Kennedy & Heymann, 2009; Nightingale, 2009; Thamke *et al.*, 2009; Thomson *et al.*, 2010b; Leite *et al.*, 2013; Norhayati & Ayob, 2014).

The motivation for the study is outlined in this chapter, including the value for the chocolate and wider industry, as well as value to the consumer. This is followed by a problem statement and the research questions, aims and objectives of the study. The background and motivation are concluded with a conceptual framework and conceptualisation of the definitions within the framework, designed to accentuate the relationship between sensory properties and emotional response, and the impact of the various concepts covered in the literature review (in Chapter 2) on this emotional response. The outline of the study and the content of each chapter are then presented, and lastly, the author's contributions and declarations are summarised.

1.2 MOTIVATION FOR THE STUDY

Although determining sensory acceptability (liking) is widely used in consumer research, the high market failure rates for newly launched products indicate that there is a need for a broad-ranging perspective on consumers' food product experience (Thomson *et al.*, 2010b; Cardello *et al.*, 2012). Therefore, in a competitive environment, pleasantness and performance might not be sufficient (Porcherot *et al.*, 2010). Product innovation is critical for company survival in a competitive global market, to achieve growth in a profitable manner, and increase competitiveness (Stewart-Knox & Mitchell, 2003; Costa & Jongen, 2006; Biazzo *et al.*, 2016). The fact, however, is that the vast majority of newly launched food products fail to achieve sales targets (Stewart-Knox & Mitchell, 2003). It results in increased dependence on emotional profiles of products for a differential advantage in this modern market where many products are

of similar price and quality (Schifferstein *et al.*, 2013), or are similar in technical and performance attributes (Churchill & Behan, 2010). The low rate of innovation and high failure rate of new food and beverage products also suggest that the methodology used for the new food product development process is possibly flawed (Rudolph, 1995; Stewart-Knox & Mitchell, 2003). Many researchers conducting sensory and consumer studies on products thus seek methods which could add new information not yet included in sensory and hedonic measures (Porcherot *et al.*, 2010; King *et al.*, 2013; Jiang *et al.*, 2014).

Recent studies in the field of emotion research have started investigating the possibility of including emotion alongside sensory acceptability (liking) in consumer studies of food products, as it has been indicated that sensory properties influence emotional product conceptualisations and ultimately consumers' food choices. Findings from numerous studies confirm that the measurement of food-evoked emotions provides new information which extends beyond liking and that the emotional profiles of food products can differentiate products more effectively (Thomson & MacFie, 2007; King *et al.*, 2010; Cardello *et al.*, 2012; Jaeger & Hedderley, 2013; Ng *et al.*, 2013).

While various studies (e.g., Macht & Dettmer, 2006; Seo *et al.*, 2009; Thomson *et al.*, 2010b; Agudelo *et al.*, 2015; Chaya *et al.*, 2015; Kostyra *et al.*, 2016) have investigated emotional response to food or beverage products, none have been conducted in a South African setting to the knowledge of the researcher, very few have included a consumer-behaviour component such as mood, familiarity, acceptability or attitude to understand how these emotional responses will translate into action, and no studies have been conducted through the application of this type of research approach. By measuring the emotional response to the sensory properties of chocolate, the sensory properties that most influence a positive or negative emotional response and ultimately acceptance, as well as the different emotions that are evoked, can be identified. Furthermore, the industry can be informed of the drivers of consumer experience with local chocolate products.

1.2.1 Value of emotion research for the industry

1.2.1.1 Value for the chocolate industry

The emotional response has widespread commercial application:

- 1) It can serve as a tool to support product development (King & Meiselman, 2010), because food exposure and how it makes you feel is of importance to the food industry, as foods are often designed and marketed based on their potential emotional influence on the consumer (Cardello *et al.*, 2012). For example, if a relationship between guilt and sweetness were uncovered, a range of chocolates could be developed and branded based on the level of guilt it induces, such as guilt-free low sugar, guilty indulgence high sugar, etc.;
- 2) It can uncover areas of and allow for product differentiation (Dalenberg *et al.*, 2014) and segmentation (King & Meiselman, 2010). For example, if the most significant difference in emotional response stems from bitterness, this can be used as a critical tool for differentiation in a range of products;
- 3) The measurement of emotions can provide a progressive way of describing products internally and externally (King & Meiselman, 2010). Talking about products to consumers or developers based on the way they make you feel could develop a new language for the chocolate category;
- 4) It may help in furthering the connection between sensory science and marketing, as it can provide a common lexicon (a list of all the words used in a particular language or for a particular subject) for sensory science and marketing to apply during product development to meet product and marketing needs, as emotions can be the universal language that brings these together (King & Meiselman, 2010). It can thus serve as a joint platform to communicate both the sensory and emotional needs that the product must fulfil. Furthermore, it can ensure that products are marketed in a manner that is in the best interest of the consumer by ensuring that positive emotions are evoked during consumption and that they do not feel disappointed with products because of aspects such as the communication and packaging which may have a disconnect with the emotion they evoke;
- 5) Products can be labelled by the emotions they evoke, such as calming vs. aggressive products (King & Meiselman, 2010). Sweet products, for example, could be labelled with more joyful, upbeat designs and names, while bitter products with a roasted flavour could display less exciting, more basic packaging and names to match;
- 6) Measurement of emotions could allow for comparison of existing products and quantification of the emotional response to product prototypes (King & Meiselman, 2010). If products appear similar or there is a low level of differentiation, the emotional footprint could explain consumer preference and/or adoption; and

7) For product design processes it is pivotal to understand which product features could evoke negative emotions because this knowledge can help to prevent a negative emotional response to the new design (Desmet & Hekkert, 2009). Specific aromas, for example, could be off-putting to consumers and could cause product failure.

1.2.1.2 Value for the wider industry

While the main interest in commercial research is to characterise and differentiate products (Meiselman, 2015), one of the major challenges for sensory and consumer science is to provide actionable information to make specific changes to product formulations. Another is to guide product reformulation to suit consumer demands and marketing segmentation (Agudelo *et al.*, 2015), not only the generation of product descriptors (Moskowitz & Hartmann, 2008; Ares *et al.*, 2014). From a new product development point of view, choosing a product formulation that is aligned as much as possible with consumer preferences is very important for the food industry (van Kleef *et al.*, 2006), which necessitates a good understanding of consumers product perception, both from a sensory and hedonic point of view (Worch, 2012). One of the most important steps of a new product development process is product optimisation. This aims to identify ideal products, i.e., products that maximise acceptability, usually measured as consumer liking (Ares *et al.*, 2011). Product developers do not only need to know the level of overall liking, but also what people like and dislike about a product, and how these properties might be changed to increase acceptability (Popper *et al.*, 2004). As a result, product development teams need more effective product development techniques (Ares *et al.*, 2011), which could be offered by the emotional field.

An example of a recent approach implemented by some companies to drive this is the development of so-called “sensorial strategies” where a product is marketed from a sensory perspective based on experience and emotion. The primary purpose of sensorial strategies is to promote a multi-sensory brand experience expressed through sensations and sensory experiences in relation to all the human senses. A sensory experience is based on sensory triggers which communicate a brand’s identity and values and leaves an imprint in the mind of the consumer. Sensorial strategies are based more on emotional and psychological elements than functional attributes to clarify and communicate a brand’s identity and values. The rationale for a company to develop sensorial strategies is to set a brand apart from competing ones, especially when functional or rational product properties such as price or quality are the

same, and to be closer to and have a more deeply imprinted image in the mind of the consumer (Hultén, 2011).

1.2.1.3 Value for the consumer

There is also value in emotion-sensory understanding for the consumer. The emotional link between brand and consumer has been suggested as paramount to building strong brands (Hultén, 2011) and ensuring a positive product experience. It is crucial that consumers can relate the brand essence to the product as this conveys an emotional aspect of the product. However, it is ultimately based on the sensory experience, and this link is of primary importance to marketing efforts (King *et al.*, 2010). By clearly conveying to consumers what their emotional experience of a product will be through aspects such as the product name or brand, packaging, key marketing message, price point, etc., it could increase consumer satisfaction when purchasing products, as the product they consume would deliver against the expectations that have been created. Aligning the emotional messages conveyed by the product and its packaging strengthens a brand significantly (Lindstrom, 2005). The sensory challenge, therefore, is to create products that are not only enjoyable and perform well, but also reinforce the emotional benefits alongside the marketing mix (such as claims, advertising message, product positioning and branding) (Porcherot *et al.*, 2010). If emotional response could be connected to the sensory properties of foods, the insights will not only aid in the comprehension of the emotional signature of a product or product category but will also assist in the development of products in target product categories (Ng & Hort, 2014), along with their marketing mix which clearly conveys this emotional profile.

1.3 PROBLEM STATEMENT

One of the main challenges for consumer scientists is to provide actionable information to guide product formulation design which will fit consumer demands or make specific changes to product formulations (Agudelo *et al.*, 2015), and not only to provide product descriptions (Moskowitz & Hartmann, 2008; Ares *et al.*, 2014). From a new product development point of view, choosing a product formulation which is aligned as much as possible with consumer preferences is very important for the food industry (van Kleef *et al.*, 2006), which requires a good comprehension of consumers' perception of products, both from a sensory and hedonic point of view (Worch, 2012). While questions concerning the sensory properties of products have traditionally been included in consumer tests alongside overall liking questions in order to

provide more detail to guide product design (Meilgaard *et al.*, 2006), some researchers have started tapping into the field of emotion measurement in order to uncover and assess these likes and dislikes on mostly a product or category level. The industry is only now moving towards harnessing product-related emotions for competitive advantage (Thomson *et al.*, 2010a). Very few studies have, however, explored the relationship between emotion and the specific sensory properties of food, even though sensory properties have been indicated as one of the sources of food emotion (Desmet & Schifferstein, 2008). Furthermore, a limited number of studies have investigated the relationship between consumer behaviour variables such as mood, familiarity, product acceptability, attitude, and emotional response. It is not currently known if it has been extended to the emotional response to sensory properties. Investigating and describing these relationships for a product such as chocolate which has been proven to be highly associated with emotion, can provide insight into the role of emotion and consumer behaviour in shaping the response of consumers. This study could not only provide a view on the emotions that most influence product acceptance, but also on how certain internal consumer behaviour variables influence emotional response.

1.4 RESEARCH QUESTIONS, AIM AND OBJECTIVES

1.4.1 Research questions

The following research questions which are related to the purpose of the study are applicable:

1.4.1.1 Primary research question:

a) What is the relationship between consumers' evaluation of the sensory properties of chocolate and consumers' emotional response to it?

1.4.1.2 Secondary research questions:

b) What is the relationship between consumers' mood and consumers' emotional response to chocolate?

c) What is the relationship between consumers' familiarity with chocolate and consumers' emotional response to it?

d) What is the relationship between the acceptability of chocolate and consumers' emotional response to it?

e) What is the relationship between consumer's' attitude towards chocolate and consumers' emotional response to it?

1.4.2 Aim

This study aims to investigate and describe the relationship between the sensory properties of chocolate and the emotional response of consumers, and the impact of various internal consumer behaviour variables (mood, familiarity, acceptability and attitude) on this response. This will describe the sensory and emotional profile of chocolate, identify whether a relationship exists between various sensory properties and various emotions, and indicate how and to what extent internal consumer behaviour variables (mood, familiarity, acceptability and attitude) influence this emotional response. The study will be guided by various specific objectives, including literature-related objectives, empirical objectives, as well as implication-related objectives.

1.4.3 Objectives

1.4.3.1 Literature-related objective

The literature-related objective for this study is to conduct a literature review regarding emotion, emotional response to food products and specifically chocolate, emotion measurement, sensory science, consumer mood, familiarity, food acceptability as well as attitude. In the literature review, operationalisation of concepts will serve to define concepts within the subject field. In order to formulate this objective, various scientific databases (for example Ebscohost, Science Direct, One Search and Google Scholar) were consulted to obtain the relevant background knowledge regarding these areas. Considering this background knowledge, the empirical objectives for this study are stated.

1.4.3.2 Empirically related objectives

The specific primary objectives of this study are to determine whether a relationship exists between:

- 1) Consumers' evaluation of the sensory properties of chocolate and consumers' emotional response to it (via correlation analysis of data collected in a consumer survey). (This objective will be addressed with the research question a); in order to:
 - a) Prepare a sensory profile for chocolate;
 - b) Prepare an emotional profile for chocolate;
 - c) Determine whether specific sensory properties can be linked to positive or negative emotions categories and to specific emotions and

d) Construct a model indicating the relationship between the emotional response and the sensory properties of chocolate.

The specific secondary objectives of this study are to determine whether a relationship exists between:

2) Consumers' mood and consumers' emotional response to chocolate (via correlation analysis of data collected in a consumer survey). (This objective will be addressed within the research question b).

3) Consumers' familiarity with chocolate and consumers' emotional response to it (via correlation analysis of data collected in a consumer survey.) (This objective will be addressed within the research question c).

4) The acceptability of chocolate and consumers' emotional response to it (via correlation analysis of data collected in a consumer survey). (This objective will be addressed within the research question d).

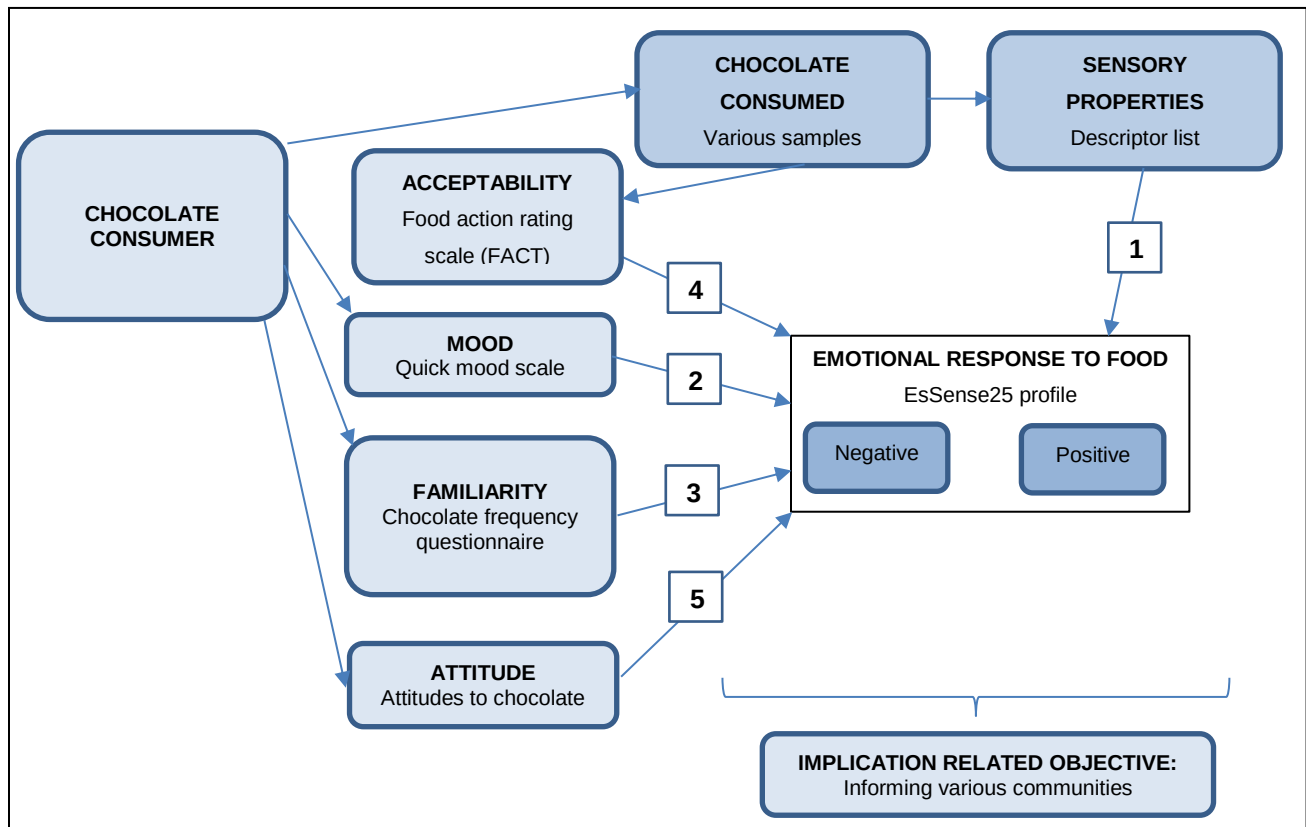
5) Consumers' attitude towards chocolate and consumers' emotional response to it (via a correlation analysis of data collected in a consumer survey). (This objective will be addressed within the research question e).

1.4.3.3 Implication-related objectives

The implication-related objectives of this study are: a) Inform the emotion, sensory and consumer research community as to whether sensory properties can evoke specific emotions and thus whether products in the chocolate segment could be differentiated based not only on their sensory, but also on their emotional profile; b) Whether a consumer's mood impacts a consumer's emotional response to a product or product category and thus whether emotional response is not an isolated incident but is related to or impacted by other affective feelings; c) Whether usage frequency and thus familiarity impacts emotional response to chocolate; d) Whether acceptability of chocolate impacts the emotions experienced when consuming it and thus which types of emotions (positive or negative) or which specific emotions are most influenced by acceptability; e) Whether a pre-existing attitude impacts a consumer's emotional response to a product or product category and thus whether emotional response is not an isolated incident but is related to or impacted by other affective feelings, and f) To inform the commercial community how internal consumer behavioural variables influence emotional response and how these could be incorporated in product development research methodologies in order to design products and marketing mixes that deliver against consumer expectations.

1.5. CONCEPTUAL FRAMEWORK

The following conceptual framework (Figure 1.1) serves to provide an overview of this study, according to the literature.



Note: Numbering indicates empirical objectives

Figure 1.1: Conceptual framework to indicate the relationship between consumer mood, familiarity, acceptability and attitude and the emotional response to the sensory properties of chocolate

Concept clarification:

- Consumer: It is an individual who purchases and uses goods or services according to his or her needs (Solomon *et al.*, 2012), and for this study, a consumer of chocolate.
- Mood: Is a conscious state of mind or predominant emotion, and is enduring, builds up gradually, is diffuse and not focused on a referent (King & Meiselman, 2010; Ferdenzi *et al.*, 2013).

- Familiarity: It is a concept that is directly related to the amount of time which a consumer has spent processing information about a product, regardless of the type of or extent of the processing (Baker *et al.*, 1986).
- Acceptability: It is the perception that something is “agreeable, palatable, or satisfactory” (Proctor *et al.*, 2011).
- Sensory properties: It is the interpretation of what the five senses (sight, olfaction, taste, touch, and audition) inform about a product (Giboreau *et al.*, 2007).
- Emotional response: It is the reaction to meaning, brought about by a product, an automated response to thoughts associated with a situation or object (Demirbilek & Sener, 2003).
- Attitude: It is a learned tendency to respond consistently towards a given object, either favourable or unfavourable (Schiffman & Kanuk, 1987).

1.6 OUTLINE OF THE STUDY

The research study will consist of ten Chapters, and the content of the chapters is summarised as follows:

Chapter 2 – Literature review

a) A literature review on emotion, emotional response to food products and specifically chocolate, emotion measurement, sensory science, mood, familiarity, food acceptability as well as consumer attitudes.

It serves to support the literature-related objective: To conduct a literature review regarding emotion, emotional response to food products and specifically chocolate, emotion measurement, sensory science, mood, familiarity, food acceptability, as well as consumer attitudes.

Chapter 3 – Research methodology

This chapter will deal with the population and sample selection, as well as a complete discussion of the research methodology and data collection method. The statistical analysis techniques will also be provided in this Chapter.

Chapter 4 – The sensory profile of chocolate

A chapter regarding the sensory profile of chocolate developed through the application of the designed sensory questionnaire in a South African context.

It serves to obtain evidence to support empirical objective one sub-segment a: Prepare a sensory profile for chocolate. It also serves to achieve the dissemination objective.

Chapter 5 – The emotional profile of chocolate

A chapter on the emotional profile of chocolate developed through the application of the EsSense25 profile in a South African context.

It serves to obtain evidence to support empirical objective one sub-segment b: Prepare an emotional profile for chocolate. It also serves to achieve the dissemination objective.

Chapter 6 – The relationship between the sensory properties of and the emotional response to chocolate

A chapter regarding the relationship between the sensory properties of chocolate and the emotions evoked.

It serves to obtain evidence to support empirical objective one: Determine whether a relationship exists between the sensory properties of and the emotional responses to chocolate. It also serves to obtain evidence to support empirical objective one sub-segment c: Determine whether specific sensory properties can be linked to positive or negative emotion categories and to specific emotions, and d: Compile a model indicating the relationship between the emotional response and the sensory properties of chocolate. It also serves to achieve the dissemination objective, and implication objective a: to inform the emotion, sensory and consumer research community whether sensory properties can evoke specific emotions and thus whether products in the chocolate segment could be differentiated based not only on their sensory but also on their emotional profile.

Chapter 7 – The relationship between various consumer behaviour variables and the emotional response to the sensory properties of chocolate

A chapter regarding the relationship between consumer mood, familiarity with chocolate, acceptability of chocolate and attitude towards chocolate, and the emotional response to the sensory properties of chocolate.

It serves to obtain evidence to support empirical objective two: Determine whether a relationship exists between mood and the emotional response to chocolate; three: determine whether a relationship exists between the familiarity with chocolate and the emotional response to it; four: determine whether a relationship exists between the emotional response to chocolate and

acceptability, and five: determine whether a relationship exists between consumer attitude and the emotional response to chocolate. It also serves to achieve the dissemination objective, and implication objective b: Determine whether a consumer's mood impacts a consumer's emotional response to a product or product category and thus whether emotional response is not an isolated incident but is related to or impacted by other affective feelings; c: how usage frequency and thus familiarity impacts emotional response to chocolate; d: how acceptability of chocolate impacts the emotions experienced when consuming it, and thus which types of emotions (positive or negative) or which specific emotions are most influenced by acceptability; and e: whether a pre-existing attitude impacts a consumer's emotional response to a product or product category and thus whether emotional response is not an isolated incident but is related to or impacted by other affective feelings.

Chapter 8 – The relationship between the sensory properties of, emotional response to and consumer behaviour towards chocolate – a structural equation model

A chapter regarding the relationship between consumer mood, familiarity with chocolate, acceptability of chocolate and attitude towards chocolate, and the emotional response to the sensory properties of chocolate, determined by structural equation modelling.

This chapter was prepared as a summary of the relationships between all the variables investigated in this study. Although it was not one of the empirical objectives of this study, it serves to achieve the dissemination objective as it was prepared in article format and was submitted to the journal Food Quality and Preference.

Chapter 9 – Summary and conclusion

This chapter will present the summary of the study, conclusions, recommendations, limitations and study implications.

Chapter 10 – References

This chapter contains the literature references mentioned in all chapters.

1.7 AUTHOR'S CONTRIBUTION AND DECLARATION

The role of the researcher in this study is to collaborate with respondents and the statistics team in order to gather and analyse data needed to meet the objectives of the study (Maree & Van

der Westhuizen, 2007). Other responsibilities of the researcher include the planning of the research project in terms of:

- Performing a thorough and comprehensive literature review regarding the mentioned topics under investigation;
- Generating a research question and study-specific objectives;
- Writing the research methodology and developing the questionnaire with assistance from study leaders, a statistician, and experts in the field, and creating an electronic version;
- Preparing materials for data collection and presenting information sessions;
- Data collection;
- Assisting with data analysis;
- Preparing the research report, academic articles, presentations for academic conferences as well as participating students; and
- Conducting research in an ethical manner.

It is the researcher's responsibility to fulfil these tasks effectively to ensure a meaningful thesis.

This study, as reported in this thesis, was planned and executed by a selected team of researchers. Each researcher's role and contributions are reported in Table 1.1.

Table 1.1: Authors contributions

Author	Contribution
Ms. I. Taljaard	Main investigator
Dr. A. Mielmann	Promoter and general project advisor
Dr. N. Le Roux	Co-promoter and project advisor
Prof. S.M. Ellis	Statistical analysis

The following contains statements from the co-authors confirming their individual roles in this study and giving permission that the article may form part of this thesis:

I declare that I have approved the chapters and article included in this thesis, that my role in the study, as indicated above, is representative of my actual contribution, and that I hereby give my consent that it may be published as part of the Philosophiae Doctor in Consumer Sciences of Ms. Innike Taljaard.

Ms. I. Taljaard

Researcher

Dr. A. Mielmann

Promoter and general project advisor

Dr. N. Le Roux

Co-promoter and project advisor

Prof. S.M. Ellis

Statistical analysis

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

In this chapter, a literature review provides an in-depth look at chocolate, the focus product of the study. This is followed by a review of the critical concepts of the study, including emotion, emotional response and the measurement thereof, sensory properties of food and sensory evaluation of these, as well as the link between food and sensory properties and emotion. Furthermore, the concept of consumer behaviour is addressed, as well as the various internal consumer behaviour elements which have been reported to influence the emotional response, including mood, familiarity, acceptability and attitude. This review includes more recent as well as various older references. The theoretical constructs from older references are still highly applicable and provide the foundation for the empirical findings of recent research on the study variables under investigation as well as the relationship between these. In certain instances, the older references also serve as empirical findings as certain constructs were already investigated and reported on many years ago.

2.2 THE CHOCOLATE CATEGORY

The word "chocolate" comes from the Classical Nahuatl word *chocolātl* (the language of the Aztecs), from the combined words *chikolli* meaning "hook," possibly in reference to the beater which was used to mix chocolate with water, and *ātl*, meaning "water" or "liquid". Its original form was that of a drink, a bitter liquid mixed with spices such as cinnamon, cloves and pepper, and with ground corn (Off, 2016). In the sixteenth century, this drink arrived in Europe and at this point, sugar was added to it (Cadbury, n.d.), which started increasing its popularity, first amongst the ruling classes and later on amongst the general population. The first edible chocolate bar appeared during the industrial revolution, and was produced in Britain around 1847 by mixing cocoa powder with cocoa butter in a mould to create the kind of chocolate bars which we are familiar with today (Kim *et al.*, 2017b). Today, two-thirds of the world's cocoa is produced in Western Africa. Ivory Coast is the largest source, with other West African countries

Ghana, Nigeria, and Cameroon among the top five cocoa-producing countries in the world (Exchange, 2017).

Chocolate is the most consumed snack worldwide, as globally on average 64% of consumers reported consumption during the past 30 days (Nielsen, 2014), while for Middle Eastern and African consumers, this number reduces to 51% (which follows fresh fruit at 52% as the most consumed snack). It is a product traditionally high in sugar and fat content and appeals to consumers based on this composition and resulting sensory attributes (such as texture and aroma) (Bruinsma & Taren, 1999). It is also the most frequently craved food type (Hill & Heaton-Brown, 1994). Craving for chocolate is particularly intense, as the desire for chocolate tends to be stronger and disappear much more slowly than cravings for other foods (March, 2018). Chocolate has been found to increase activation, reduce fatigue, elevate mood and evoke joy (Macht & Mueller, 2007), and might even be good for health (Serafini *et al.*, 2003). It has the potential to arouse sensory pleasure as well as positive emotions due to its good taste (Macht & Dettmer, 2006), and as a result, is often consumed when people are feeling depressed (Macdiarmid & Hetherington, 1995; Willner *et al.*, 1998; Wansink *et al.*, 2003). However, there have been studies which also found that it is associated with negative emotions, particularly that of guilt (Macdiarmid & Hetherington, 1995), which may be induced by cognitions based on cultural and societal determined attitudes to health and body weight (Macht *et al.*, 2003). Chocolate has as a result been classified as an emotional product, as affective states appear to be closely connected to chocolate consumption, both as precursors and consequences (Macht & Mueller, 2007), and based on this, it has been the subject of various sensory and emotion studies (Macht & Dettmer, 2006; Macht & Mueller, 2007). From these studies, various findings have been reported and multiple research tools have been published to apply in similar studies (Viaene & Januszewska, 1997; Ziegler *et al.*, 2001; Sune *et al.*, 2002; Golob *et al.*, 2004; Lasekan *et al.*, 2007; de Melo *et al.*, 2009; Kennedy & Heymann, 2009; Nightingale, 2009; Thamke *et al.*, 2009; Thomson *et al.*, 2010b; Leite *et al.*, 2013; Norhayati & Ayob, 2014; Schouteten *et al.*, 2018).

The South African retail chocolate market is sizeable and was recently (in 2015) valued at R5.03bn (InsightSurvey, 2016). Despite economic pressures, the market continued to grow (Sanchez, 2015), along with total “confectionery” consumption which has grown by 13.0% to 2.6 kg/capita/year since 1999 (Ronquest-Ross *et al.*, 2015). This growth was as a result of

increasing consumption of “chocolate confectionery” (+12.5%), mainly from “tablets” or “slabs” which were the most popular chocolate confectionery format in South Africa and held over 50.0% market share (Research, 2011). Milk chocolate is still preferred to dark chocolate, but the ratio is, however, changing based on the health benefits associated with dark chocolate (Euromonitor International, 2018). South Africans consume on average 1.3 kilograms per capita (Nieburg, 2017), compared to Switzerland which was reported as the highest consumer of chocolate per capita in 2017, with an average of 8.8 kilograms consumed per resident per year (Bureau, 2018). In 2014, major South African manufacturers expected that the country’s chocolate market would grow by more than ten percent per year over the next five years, which would have exceeded the global average of six percent (Nielsen, 2014). However, due to the recent introduction of sugar-tax and based on the growth of the health-conscious consumer base in South Africa, consumers are looking for healthier alternatives which contain less sugar. As a result, confectioners are exploring lowered sugar and sugar-free products, to appeal to health-conscious consumers who still want to eat and enjoy chocolate. Hence, one of the biggest trends expected in the confectionery industry is a growing demand for high-cocoa, low-sugar products, such as dark chocolate (Report, 2018). Increased pressure in the current economic climate is also impacting the ability of consumers to “*exercise confectionary indulgence*” (Reporter, 2016). It thus appears that the South African chocolate market could currently be in a stage of evolution or revolution based on these various forces, and this study could provide a perspective on how consumers may emotionally react to these changes. As chocolate was the food type applied in this study to investigate the concepts of emotion, sensory properties, mood, familiarity, acceptability and attitude; these variables are reviewed in the coming sections and the connection to food products and in certain instances chocolate is also discussed.

2.3 EMOTION

Emotion is a component of a larger group of reactions known as affective feelings (Meiselman, 2015), as a consensus has emerged over time regarding the distinction between emotion and the other affective feelings namely mood and attitude (Meiselman, 2015). King and Meiselman (2010), as well as Ferdenzi *et al.* (2013), reported that one could distinguish between at least three different affective feelings of which emotion is one:

- 1) Mood, which is more enduring, builds up gradually, is more diffuse and not focused on a referent (e.g. “I am happy”);

2) Emotion, which is brief, intense and focused on a referent (e.g. “this makes me feel angry”); and

3) Attitude, which includes an evaluation component (e.g. “I like” or “I love”).

Scherer (2009) included a fourth dimension to affective feelings, that of personality traits, such as being an anxious person. To date, various definitions of emotions have been suggested, rooted in different academics (such as behaviour and psychology), and are thus varied in perspective and complexity (Table 2.1).

Table 2.1: Definitions of emotion from 1999 to 2018

Year	Definition	Author
1994	<i>“conscious subjective experiences that accompany the affective states created by bodily sensations”</i>	Frijda (1999)
2001	<i>“an episode of interrelated, synchronized changes in the states of all or most of the five organismic subsystems in response to the evaluation of an external or internal stimulus event”</i>	Scherer (2001)
2006	<i>“constructions made by individuals to give meaning to the sensations that they experience”</i>	Barrett (2006)
2007	<i>“a set of neural, bodily/expressive and feeling/motivational components generated rapidly, automatically and non-consciously when ongoing affective-cognitive processes interact with the sensing of perception of an ecologically valid stimulus to activate evolutionarily adapted neurobiological and mental processes”</i>	Izard (2007)
2010	<i>“the responses to a specific thing that are rapid, intense and shorter lasting”</i>	Ferrarini et al. (2010)
2010	<i>“Emotion consists of neural circuits (that are at least partially dedicated), response systems, and a feeling/ state/process that motivates and organizes cognition and action. Emotion also provides information to the person experiencing it, and may include antecedent cognitive appraisals and ongoing cognition including an interpretation of its feeling state, expressions or social-communicative signals, and may motivate approach or avoidant behaviour, exercise control/regulation of responses, and</i>	Izard (2010)

Table 2.1 continued

Year	Definition	Author
2010	<i>be social or relational in nature</i>	Izard (2010)
2018	<i>“emotions are evaluative states”</i>	Netzer <i>et al.</i> (2018)

Many definitions of emotion exist as the most fundamental issue facing emotion research within a product context is identifying one accepted definition of emotion (Meiselman, 2015). Currently, there is no agreeable definition of emotion (Beck, 2015), and there are as many emotion theories as there are emotion theorists (LeDoux & Brown, 2017). A single defined and agreed-upon definition of emotion would result in scientific objectivity when it is approached from different perspectives, as in emotion research the author might be categorising emotions based on behaviours, physiological responses, feelings, thoughts, or any combination thereof (Beck, 2015). The emotional process is complex and can, as per above, be interpreted from many different viewpoints. Therefore it is challenging to achieve a comprehensive and exact definition of emotion (Jiang *et al.*, 2014). Izard (2010), for example, reviewed 34 definitions of emotion and created a new definition of what emotion does – and not what it is (also indicated in Table 2.1).

What further increases the complexity of emotion as a subject and further hinders the creation of an objective definition, is that emotions have also been found to have an unconscious component in addition to conscious subjective experiences, which is the existence of affective reactions of which the person is merely unaware, even when they are explicitly asked to report on their mental state (Winkielman *et al.*, 2011). For an emotion to be viewed as unconscious, people must not be able to report their emotional reaction at the moment it is caused, yet there must be proof of the emotional reaction in their behaviour, either through a physiological response or a subsequent impression of an effect-laden event (Berridge & Winkielman, 2003). Furthermore, emotion has an intuitive component (Zajonc, 1980; Kahneman, 2003; Slovic *et al.*, 2007), as people are often not aware of their emotional responses, they may also not be aware of the conditions that may have evoked these emotions (Barrett *et al.*, 2007). People form an impression rapidly and easily about whether or not they like something and to what extent they like or dislike it, without necessarily needing to pause and think about what the object is or what the meaning is it as to them (Zajonc, 1980). Slovic *et al.* (2007) reported that the reliance on this intuitive system is more efficient for survival than reasoning. Whether intuitive or

unconscious, only when a consumer knows what caused an effect (when the consumer knows what caused how you feel), it signals an emotion, thus indicating that there is also a component of awareness of cause within the definition of emotion (Beedie *et al.*, 2011). Thus, it is not through the presence of a reaction but through the awareness of what caused the reaction that emotion is defined (Beedie *et al.* (2011).

Emotional and generally affective processes are also viewed as an adaptive process which allows the individual to adjust to environmental conditions or events by exhibiting adapted, suited behaviours (Scherer, 1994; Keltner & Gross, 1999). Ferdenzi *et al.* (2013) indicated a potential connection between emotion and adaptive universal functions of olfaction, such as danger avoidance, ingestion and social communication. However, unlike other biologically based response tendencies such as reflexes, emotions only suggest that someone acts; they do not compel people to do so, which means that persons may deny the expression of some impulses, while expressing others freely (Strachey, 1961).

2.3.1 Classification of emotions

As the first or the most basic level of emotion classification, emotions are usually viewed in two dimensions, i.e. positive or negative, or pleasure vs. displeasure (Shaver *et al.*, 1987; Storm & Storm, 1987; King & Meiselman, 2010). Researchers have tried to uncover further underlying dimensions of emotional experience and have found at least one additional dimension (Gladstones, 1962; Averill, 1975; Russell & Mehrabian, 1977; Watson & Tellegen, 1985), that of an activation (positive or negative experience of the emotion) and an arousal (intensity) dimension, considered by Shaver *et al.* (1987) and Storm and Storm (1987) as a basic emotional level but by the other abovementioned researchers as the second level of emotion classifications. Every emotion can be described according to its location on these activation and arousal dimensions (Russell & Mehrabian, 1977). Activation-arousal dimensions are reported to play an essential role in describing and categorising different emotions (Schifferstein & Desmet, 2010), not only as positive and negative. The third level, which is the lowest subordinate level that has been defined, consists of groups of individual emotions that form category names after the most typical emotion of that category (Shaver *et al.*, 1987; Storm & Storm, 1987), such as anger, fear, love and pride. Despite the development of this three-level classification, emotions are still conceptualised in some studies as general emotions such as positive and negative affect, whereas others use a comprehensive set of specific emotions. As

with the definition of emotion, agreeing on what is viewed as basic emotions has also been problematic.

A recently conducted study which employed pattern analysis to define what basic emotions are, however, found that this analysis did not provide evidence to support the existence of basic emotions (Clark-Polner *et al.*, 2017). Even more recent investigation by other emotion researchers have indicated that emotions have a multi-level or hierarchical structure from basic or single-dimensional to complex or multi-dimensional (Kurth, 2019). Dimensional theorists (dimension theory is a branch of general topology dealing with dimensional invariants of topological spaces) also disagree about the number and nature of the dimensions that provide an ideal framework for studying emotions (Fontaine *et al.*, 2007). As a result, these theorists have made very few attempts to present an explanatory framework to predict the occurrence of responses in a consistent manner. These disagreements have resulted in an ongoing debate about both the hierarchical structure and content of emotions, and the use of general emotions vs. a distinct set of specific emotions in research studies (Richins, 1997; Ruth *et al.*, 2002; King & Meiselman, 2010). Furthermore, it has been found that not only the classification, but also the analysis of emotions can yield different results, and that emotions could, for example, be grouped into clusters, yielding a hierarchical structure (Storm & Storm, 1987), which also capture the different levels of abstractness (Shaver *et al.*, 1987; Storm & Storm, 1987). Thus, as the objective, scope, approach to, analysis of results and presentation of the findings of various emotion studies have yielded such varied results, it has not yet been possible to design a common framework of emotion classification for emotion studies.

2.3.1.1 Positive and negative emotion dimensions

Despite the various definitions and classifications of emotion, the most common emotion categorisation that has been applied in research studies is that of positive-negative (Laros & Steenkamp, 2005; King & Meiselman, 2010). This is due to the general agreement that emotions play a central role in human rationality, and that the true nature of emotion based on this view is either a good or bad feeling which then guides or biases behaviour and decision-making (Schifferstein & Desmet, 2010). While positive emotions (such as good and happy) pull people towards beneficial stimuli, negative emotions (such as bored or disgusted) push people away from stimuli that are harmful or threatening (Schifferstein & Desmet, 2010). There is, however, a group of emotions such as daring and eager that cannot be classified and are

labelled as 'uncategorised' or 'unclassified' in emotion lists. Products, however, often elicit different types of emotions, or mixed emotions, which occur simultaneously in regard to a given product, rather than being a single reaction (Kostyra *et al.*, 2016), and it is therefore not unexpected to see both positive and negative feelings describing a single product (Edell & Burke, 1987; Mano & Oliver, 1993; Desmet, 2012).

General emotion research literature has, however, focused more on unpleasant than on pleasant emotions, and most clinical or psychological emotion lists contain more negative than positive emotions (Plutchik, 1980; Ekman *et al.*, 1987; Schrauf & Sanchez, 2004). This may be based on the theory of flourishing vs. languishing, where Boniwell (2008) stated that it appears that the ratio of 3:1 or above of positivity to negativity results in the experience of flourishing, while anything below this ratio results in the experience of languishing. King and Meiselman (2010) reported that the number of basic emotions that have been identified and described which are negative, far exceeds the number of positive ones, which may be due to the negativity bias, which is a natural human propensity to pay more attention to negative emotions than positive ones (Gavin, 2018). Even in the Handbook of Emotions only two chapters out of 49 deal with positive emotions (Gross *et al.*, 2008). The birth and growth of Positive Psychology have more recently led to the consideration of positive emotions such as happiness (Stewart *et al.*, 2010; Bongers *et al.*, 2013). An *et al.* (2017), however, provides an interesting perspective in that, in an attempt to classify emotions on a single continuum from positive to negative, that each emotion contains some degree of negativity as well as positivity, and that concurrent experience of positive and negative emotions could also have both positive and negative consequences.

In the general food and nutrition domain, the majority of emotion research still focuses on the negative emotions associated with unhealthy eating patterns (Schifferstein & Desmet, 2010), despite the fact that the food experience is positive in nature (Gibson, 2006). While there was a bias in the past towards the early commercial emotion methods that drove these results and created this perception, this has started to change and researchers are looking for more balance (Meiselman, 2015). Tools are being created that better reflect the nature of the food consumption experience. In this study, positive (16), negative (three) and uncategorised (six) emotions were included, based on the classification of the EsSense25 profile (King & Meiselman, 2010), and thus different emotion classifications were considered.

2.3.1.2 Valence and arousal emotion dimensions

In addition to viewing emotions as either positive or negative, it has been agreed by many researchers that emotions contain at least two additional qualities: valence and arousal (Dalenberg *et al.*, 2014), or more specifically hedonic valence or physiological arousal as indicated in Section 2.3.1. Valence can be mapped from unpleasant to pleasant, while arousal can be mapped from calm to excitement, also expressed by some as intensity (Russell, 1980; Watson & Tellegen, 1985; Larsen & Diener, 1992; LaBar & Cabeza, 2006). However, while many studies have viewed this as the second level of the emotion hierarchy, it has been recommended that valence and arousal be included in emotion studies in addition to other emotion views, such as positive and negative, as the use of a simple valence by arousal representation has been found to be insufficient (Porcherot *et al.*, 2010). Classical models of emotion thus combine these two variables in a valence-arousal dimension, and some include basic emotions as well (Ferdenzi *et al.*, 2013). Dimensional theories also extend beyond valence-arousal and while they reduce emotions to positions in a two-dimensional space of valence by arousal, dimensional theorists propose a three-dimensional space in addition to the two-dimensional view by including potency (Russell, 1980; Lang *et al.*, 1993). Many emotion theorists now employ emotion sets that are balanced for valence and represent a broader range of emotions, including emotions such as admiration, hope and relief (Ortony *et al.*, 1988; Roseman, 2001).

While emotion measurement has provided information on both valence and arousal for food products (Ng *et al.*, 2013; Bhumiratana *et al.*, 2014), it has been found that there is no significant relation between arousal and food choice on a group level (Dalenberg *et al.*, 2014). Arousal is by nature also more difficult to define, measure and link to behaviour and the Optimal Arousal Theory assumes that a stimuli's arousal levels are evaluated in respect of the optimal arousal level of the individual at the moment of consumption (Lévy *et al.*, 2006). Furthermore, the association between perceived arousal and choice is subject to large individual differences (Dalenberg *et al.*, 2014). To fully assess arousal, one must measure the appropriate personal characteristics, and thus more information would be needed on personal characteristics such as attitudes to food and optimal evoked arousal levels to apply the arousal view to improving food choice estimation (Dalenberg *et al.*, 2014).

Model comparisons have, however, shown that product valence is a strong predictor of food choice (Dalenberg *et al.*, 2014) and valence furthermore positively correlates with liking (Lévy *et al.*, 2006; Gutjar *et al.*, 2015b). Measuring valence in addition to product liking significantly improved model fit for choice estimation, and it has even been reported that valence and liking are mutually exclusive (Dalenberg *et al.*, 2014). Desmet (2008), however, stated that distinct emotions instead of general valence responses are of specific interest to those who aim to study the experience of food emotion in the context of everyday life. Responses to the EsSense Profile are expected to provide discrimination among samples through the emotion words contained which are related to both valence and arousal, in agreement with previous studies (King & Meiselman, 2010; Jaeger & Hedderley, 2013; Ng *et al.*, 2013; Dorado *et al.*, 2016; Danner *et al.*, 2017).

2.3.2 Emotional response

An emotional response is a reaction to a particular intra-psychic feeling (an emotion), accompanied by physiological changes that may not be outwardly displayed, but motivate or bring about some action or behavioural response (Mosby, 2006). As emotions differ, as stated earlier, in their antecedent conditions, physiological correlates, frequency of occurrence and duration (Scherer *et al.*, 1986), the response to these emotions also varies (Canetti *et al.*, 2002). Emotional response to a stimulus takes place in two stages, a primary sensory-motor response which takes place beneath conscious awareness, and a secondary process of awareness of the emotional experience (Churchill & Behan, 2010). Emotional expressive behaviour reflects the combined influence of the inner emotional impulse and factors governing the expression of certain emotions (Gross & John, 1995).

An emotional response does have not only a psychological basis, but also a physiological component. The physiological basis of affective reactions to food is demonstrated in homology (the existence of shared ancestry) across various species of primates (Steiner *et al.*, 2001). It has been found that eating activates neural substrates in a comparable manner to drugs which are abused (Grigson, 2002). The ingestion of sweet and fatty foods in animals and humans has been found to alleviate crying and other behavioural signs of distress in infants (Blass *et al.*, 1989; Upadhyay *et al.*, 2004). From a psychological perspective, the feeling component of an emotion integrates and may regulate the other components (cognitive, behavioural, expressive and physiological) to create a response that fits the requirements of the physical and social

environment (Grandjean *et al.*, 2008; Scherer, 2009), and affective responses such as disgust, desire or well-being certainly play a crucial role in driving such subsequent behaviours (Ferdenzi *et al.*, 2013).

2.3.2.1 Emotional response to food

Food or beverage evoked emotions can be defined as “a brief but intense physiological and/or mental reaction to a food or beverage item” (Bagozzi *et al.*, 1999; King & Meiselman, 2010; Kenney & Adhikari, 2016). To date, the field of sensory evaluation has predominantly focused on the way consumers perceive an evaluated sample based on our five senses. However, consumers are also predisposed to purchase certain products based on emotional responses triggered by other aspects of the products (Holak & Havlena, 1998; Dubé *et al.*, 2003). Only recently has this relationship between food and emotions begun to intrigue food researchers (Jaeger & Hedderley, 2013). Meiselman (2015) reported that ten years prior, almost no conference presentations or journal papers examined the emotions associated with food products, and the application of these findings to food products and development was also then still rare (Chang *et al.*, 2006; Tsutsumi & Sasaki, 2008).

In the field of sensory and consumer science, interest in the measurement of food product related emotion is, however, growing (Jaeger & Hedderley, 2013), as food-induced emotions have been found to be powerful determinants of food choice (Rozin & Schulkin, 1990; Galef, 1996; Martins & Pliner, 2005). As emotions have been indicated to provide an internal stimulus or state that elicits a beneficial, and sometimes corrective food choice (Mojet *et al.*, 2015), food-evoked emotions as motivators for food choice have recently received considerable attention (Moskowitz *et al.*, 2005; Dalenberg *et al.*, 2014). Emotional reactions to the consumption of foods or the experience of fragrances play an important role in the acceptance of products in the market (Danziger, 2004; Pawle & Cooper, 2006; Beckley *et al.*, 2008), and thus product-focused emotion research could provide a deeper understanding of these product experiences by consumers that leads to acceptance (Spinelli & Niedziela, 2016; Spinelli & Monteleone, 2018). Consumers experience various emotions in their relationships with products and these emotions can be evoked by a variety of product aspects or properties (Schifferstein & Desmet, 2010) such as sensory properties, functionality, usability, the social implications of using or owning the product, memories or associations attached to the product -or experience and learning- (Jaeger *et al.*, 2018), or the anticipated impact of product usage or ownership (Jordan, 2000; Desmet,

2002; Norman, 2004). Desmet and Schifferstein (2008) reported that there are five distinct sources of food emotion, namely: 1) The sensory properties (e.g. bored by low levels of salt); 2) Experienced consequences (e.g. relieved after drinking); 3) Associated consequences (e.g. hope to be healthy by eating fruit); 4) Personal or social meanings (e.g. strawberries make me think of our summer holiday); and 5) Behaviour or agents involved (e.g. angry because I received a meal that I don't like).

Food intake is immersed in daily personal routines as well as social rituals and is connected to various behaviours such as acquiring, conserving, preparing, consuming and sharing food, and it is thus expected that more than only the basic emotions will be relevant when food is studied (Bourdieu, 1984). People eat the foods that they like, and thus, it is presumed that foods elicit mainly positive emotions (King & Meiselman, 2010; Cardello *et al.*, 2012), also as healthy individuals have a predominantly positive disposition toward eating food (Schifferstein & Desmet, 2010; Meiselman, 2015). Desmet and Schifferstein (2008) also described food experiences as primarily positive. This indicates that choice may in part, be guided by positive food-evoked emotions that go beyond liking (Gutjar *et al.*, 2015b). Gibson (2006) and King *et al.* (2010) extend this to include neutral emotions by stating that food or beverage-evoked emotions are generally positive or neutral (neither positive nor negative) in nature, which is consistent with the general purpose of consuming food or beverages.

When reviewing the emotional responses recorded for different foods and food names, it is also clear that some foods have a higher emotional motivated connection than others (Cardello *et al.*, 2012). Pizza, vanilla ice cream and fried chicken, for example, are classified as emotion-laden products, while other foods such as oatmeal and carrots can be described as less emotional (Cardello *et al.*, 2012). Emotional products are not necessarily consumed for their nutritional value, but often as an emotional eating strategy or to satisfy cravings (Parker *et al.*, 2006). The reality is also that, thus far, direct emotion measurement of food items was mainly applied to pleasant snack items and favourite foods, and this has fortified the idea of the predominance of positive emotional effects associated with foods (Köster & Mojet, 2015).

Food and emotion are also connected in several different ways. While, on the one hand, there is the influence of emotion on food choice and consumption, on the other hand, consuming food can influence people's moods and feelings (Köster & Mojet, 2015), and thus the emotional

response to food is not a stand-alone, one staged process but rather a continuous loop. It has often been viewed as a one-directional event (i.e. emotion influencing food consumption), and food consumption influencing emotion was only recently noticed in consumer and sensory research (Desmet & Schifferstein, 2008; King *et al.*, 2010; Cardello *et al.*, 2012; Ng *et al.*, 2013; Bhumiratana *et al.*, 2014; Dalenberg *et al.*, 2014).

A study by Dalenberg *et al.* (2014) discovered that food-evoked emotions can successfully differentiate products and is thus increasingly becoming critical for product differentiation as many food products have similar characteristics, packaging and price (Jiang *et al.*, 2014), and thus a lot of commercial emotion research is not linked to acceptance, liking, food choice or purchase, but is rather aimed at differentiating between products, sometimes even of the same acceptance (Meiselman, 2017). Some studies do, however, link emotion to liking as it can be informative to assess consumers' emotional responses to foods in addition to liking (King *et al.*, 2010; Thomson *et al.*, 2010b; Cardello *et al.*, 2012), and evidence has shown that consumers' emotional associations with food or beverage products can add additional information beyond overall acceptance (King & Meiselman, 2010; Thomson *et al.*, 2010b; Cardello *et al.*, 2012; Ng *et al.*, 2013; Spinelli *et al.*, 2014; Gutjar *et al.*, 2015a; Schouteten *et al.*, 2015).

2.3.2.2 Measuring emotional response

The field of emotion research has to date been dominated by a clinical orientation (Meiselman, 2015), and such traditional studies of emotions have focussed mainly on the negative emotions associated with mental health and mental illness (Meiselman, 2015). Although many attempts have been made to measure emotions in the psychology and sociology fields (Block *et al.*, 2009; Habhab *et al.*, 2009), the measurement of food-elicited emotions is recent and not well established. Many researchers have been frustrated by the lack of precise methods in emotion measurement of products (Meiselman, 2015), as many methods fail to probe beyond the obvious. In most cases, traditional methods of clinical and academic research do not fit the product situation (Meiselman, 2015) and thus unique study designs are required in many instances. Emotion assessment or measurement, in general, is a very complex task and even more so for the food segment as its methodology has only recently been applied to food (Manzocco *et al.*, 2013).

It has been stated that in emotion-sensory research the challenge is to develop methods that show what may be intuitive, to access the deeper conceptualisations that influence choice, and to do so without creating distortions or deviations (Thomson *et al.*, 2010b). Furthermore, emotions are dynamic (Weiss & Cropanzano, 1996; van Kleef *et al.*, 2006; Hareli & Rafaeli, 2008); however, most emotion measurements are static (Donaldson & Grant-Vallone, 2002). Some who are involved in consumer research and product design processes are inclined to regard the concept of product emotion as intangible and therefore unsuitable for measurement through a structured approach (Schifferstein & Desmet, 2010). Regardless, many researchers are currently focussing on this area and attempting to design tools and methodologies to capture consumers' emotions elicited by food (Dalenberg *et al.*, 2014) and that can link emotions to product usage and experience. There is a growing list of methods that are being used for emotion measurement in product development contexts, although some of these methods were initially developed for other applications, such as in a clinical field (Cardello *et al.*, 2012). Thus, during the last few years, an increasing number of studies have been carried out to investigate the associations consumers make with food products, with a key focus on emotional conceptualisations (Jiang *et al.*, 2014; Köster & Mojet, 2015; Thomson & Crocker, 2015). This increase in the area of emotion research also caused a growing need for effective emotion measurement methodologies (Chaya *et al.*, 2015). While there is rapid growth in the outputs achieved from emotion measurement in consumer research studies (Chaya *et al.*, 2015; Meiselman, 2015), the application of emotion assessments is still very recent (Manzocco *et al.*, 2013). There is additionally keen interest in the development of new rapid methods which seek to increase the efficiency and efficacy of the data collection process while maintaining the robustness of the data obtained (Fleming *et al.*, 2015), and emotion research could play a role here. Despite the development of all these methodologies and tools and the increased focus on this area, there is, however, still no standard method for emotion measurement (Meiselman, 2015).

Instruments to measure emotion can be divided into explicit (self-reports) and implicit (observational techniques or by autonomic responses and brain imaging) methods (de Wijk & Zijlstra, 2012; Köster & Mojet, 2015; Mojet *et al.*, 2015; Lagast *et al.*, 2017). Implicit measurement methods register data continuously while explicit methods obtain data at certain points in time (Lagast *et al.*, 2017). Explicit methods include verbal or visual self-reported measurements that ask participants to report their feeling, emotions upon consumption, smelling

or seeing food products (Lagast *et al.*, 2017). Lagast *et al.* (2017) concluded that an explicit method for measurement of emotion was the most commonly used method historically, as it is quick and user-friendly and does not require more involvement of the participant. Self-reports are currently considered by many researchers as the only method to determine whether a person is experiencing an emotion and to measure the content of subjective experiences of emotion (Barrett, 2006), but some believe that explicit measurements can be cognitively biased (Dalenberg *et al.*, 2014; Danner *et al.*, 2014), which is why implicit measurement of emotions has been included in many studies (Lagast *et al.*, 2017).

Questionnaires are most commonly used to record data and to measure explicit food-related emotions (Cardello & Jaeger, 2016). It is usually used with an emotional lexicon or list of emotional terms or sentences that can be checked or rated (Lagast *et al.*, 2017). Cardello *et al.* (2012) and Gmuer *et al.* (2015) have recommended the inclusion of large numbers of emotions in product testing as it is beneficial to fully characterise the complex emotional response to eating and drinking (Spinelli & Monteleone, 2018). Products could be differentiated with a large number of emotions as consumers use a large number of emotion-related words to evaluate products (Jaeger *et al.*, 2018). A higher number of emotional terms in standard questionnaires are also included to ensure that no important terms are missed (Jaeger *et al.*, 2013; Spinelli *et al.*, 2014), as Laros and Steenkamp (2005) have counselled against shortening emotion lists by collapsing words, as important nuances can be lost.

A common approach for the measurement of food-related emotion is the application of self-reported ratings of emotion terms in questionnaires such as the EsSense Profile (King & Meiselman, 2010) or its reduced version known as EsSense25 (Nestrud *et al.*, 2016). Several food-specific questionnaires have been developed, of which the EsSense Profile appears to be the best validated and has gained influence in the field of sensory science (Jaeger *et al.*, 2018). It is considered as 'the' illustrative example of explicit measurement method (Lagast *et al.*, 2017). The EsSense profile contains a relatively large number of emotion terms based on the finding that people tend to describe food products using a large number of terms (King *et al.*, 2010; Meiselman, 2013), and this broad and detailed list of emotional terms delivers a more detailed emotional profile of a product which could have added value for marketing purposes (Jaeger *et al.*, 2018). Other than popularity, it has proven relevance across many product categories (Jaeger *et al.*, 2018), including chocolate (Cardello *et al.*, 2012; Jaeger & Hedderley,

2013; Schouteten *et al.*, 2014; Dorado *et al.*, 2016). The EsSense Profile has, however, been criticised for containing too many emotion words associated with pleasure and too few words associated with displeasure (Jaeger *et al.*, 2018), however, the general idea that food elicits mainly positive emotions might explain the dominance of positive emotional terms in emotion lists (Lagast *et al.*, 2017). Some emotion measurement methodologies and tools have, however, been stress-tested for various food products including chocolate, and the standardised tool such as the EsSense profile has also been applied to chocolate research studies with great success. In a study conducted by Cardello *et al.* (2012) which included chocolate as one of the products assessed, the emotion ratings obtained in repeated tests without evoked contexts were highly correlated and therefore the EsSense tool was deemed stable to measure emotional response to chocolate.

2.3.3 Emotional response and behaviour

Based on the definition of emotional response, emotion thus does not only have a psychological basis, but also a physiological component, and as outlined in the introduction, consumers' behavioural response to emotions varies. This combination of psychology and physiology was described by James in 1884 (Cornelius, 2000). According to him, there are three distinct emotional aspects, namely internal feelings, variations in autonomic nervous system arousal and facial expressions. Lindquist *et al.* (2015) included a learning component in emotion elements by stating that the basic elements that contribute to emotions are portrayals of sensations from inside the body (known as affect – the psychological component) or from outside the body (known as exteroceptive sensations – the physiological component), and concept knowledge used to make those sensations meaningful in context. Churchill and Behan (2010) also pointed to the existence of this autonomic nervous system arousal by stating that emotional response to a stimulus takes place in two stages, a primary sensory-motor response which is beneath conscious awareness, and a secondary process of awareness of an emotional experience. This is referred to as the feeling component of emotion which integrates and may regulate the other components (cognitive, behavioural, expressive and physiological) to create a response that fits the demands of the physical and social environment (Grandjean *et al.*, 2008; Scherer, 2009).

There is also evidence of non-perceptual behavioural changes (behaviour changes that are not even recognised by the consumer undergoing it) as a consequence of emotional conditioning in

humans (Herz *et al.*, 2004). It was illustrated that if a specific emotional state (unconditioned stimulus) is combined with a neutral ambient odour (conditioned stimulus), the odour conditioned stimulus becomes able to elicit a specific emotion and mood, (thus a conditioned response, an automatic response to an ordinarily neutral stimulus), and congruent behavioural changes (Herz *et al.*, 2004). Conditioning is usually unconscious to humans (Greenwald & De Houwer, 2017).

2.4 THE SENSORY PROPERTIES OF FOOD

The sensory and hedonic experience and perceptions of products are regarded as crucial factors for consumer food choice (Tuorila, 2007), and thus describing the sensory characteristics of products is a common procedure in the food and beverage industry. Sensory research has broad application. It allows the making of informed business decisions (Stone & Sidel, 2004), guides product development to match a consumer's ideal or to get closer to a benchmark (Brody & Lord, 2007) and measures the impact of ingredient or process changes (Sharif *et al.*, 2017). It is also implemented for quality control purposes, to track product change over time, and to correlate findings with other instrumental measurements (Varela & Ares, 2012). In many sensory analysis studies, one of the main reasons to request subjects to assess products has been to conceive the sensory dimensions that discriminate amongst these products (Lê *et al.*, 2016).

2.4.1 Sensory evaluation

In order to design food products which consumers will accept as they meet sensory expectations and will thus create a positive sensory experience, food companies require information about how consumers perceive sensory characteristics of products (Guinard *et al.*, 2001; ten Kleij & Musters, 2003). Sensory attributes or intrinsic attributes are considered to be experience attributes (Marreiros & Ness, 2009) because consumers have to experience (taste) the sensory properties of foods directly to assess or evaluate the product, which plays a crucial role in consumers' product evaluation (Tuorila & Pangborn, 1988; De Pelsmaeker *et al.*, 2013; Piqueras-Fiszman & Jaeger, 2014). This experience of evaluation, in turn, influences a consumer's preferences and choice (Juodeikiene *et al.*, 2018).

Sensory evaluation has been considered as a means to define the quality and competitiveness of products (Tuorila & Monteleone, 2009). However, from a consumer perspective, considering

the competitiveness in the market today, it is no longer adequate to evaluate product performance by only measuring overall liking of a product (Bhumiratana *et al.*, 2014). In response, sensory research and thus sensory marketing has undergone major developments (Daucé & Rieunier, 2002). This need to understand exactly what drives preferences and the resulting growing interest in consumer-based methodologies has motivated the need to directly include consumer input in new product development processes (Valentin *et al.*, 2012; Varela & Ares, 2012). Consumer-based sensory characterisation has thus increased in popularity in the last decade (Varela & Ares, 2012), as it has been said that the best way to understand consumer preferences is through consumer data (Risvik *et al.*, 1997).

The sensory response of consumers is assumed to be largely associated with rational decisions based on food properties (Manzocco *et al.*, 2013), and thus sensory analyses methods have gradually expanded in areas such as food product development and consumer preferences, causing a shift in scientific focus. The shift took place from studying the food product to studying both the food product and the consumer (Köster, 1981; McBride, 1990; Meiselman, 1993; Trijpp, 1995), which has further necessitated the direct inclusion of consumers in sensory studies. Many studies have found that measuring only the sensory appeal of food products is insufficient to apply the findings during product development successfully (Thomson & MacFie, 2007; Desmet & Schifferstein, 2008; King *et al.*, 2010; Dalenberg *et al.*, 2014; Köster & Mojet, 2015).

Descriptive sensory analysis can be conducted to visualise sensory dimensions or sensory product profiles. This is of importance to the food industry as it can identify sensory properties essential for consumer acceptance (Reinbach *et al.*, 2014). Although such traditional product characterisation techniques do provide accurate and reliable information, new methods for sensory product characterisation with consumers continue to be developed (Varela & Ares, 2012) to respond to the changing needs in the commercial sector. For example, descriptive sensory analysis or profiling is increasingly conducted with consumer panels, as it identifies the sensory drivers which are essential for consumer acceptance and marketing of products (Reinbach *et al.*, 2014). In both industrial and academic fields, descriptive sensory analysis or profiling is used to serve as the link between product properties and consumer reaction (King & Meiselman, 2010), but this analysis or product characterisation was traditionally performed by trained panels using this methodology (Stone & Sidel, 2004; Meilgaard *et al.*, 2006). Despite

continuous research, descriptive sensory analysis has remained one of the most powerful and most extensively used tools in sensory science (Varela & Ares, 2012). Including consumers in such sensory analysis studies allows for quantitative characterisation of perceivable product properties, as consumers will directly assess stimuli for researchers to comprehend the sensory dimensions that differentiate between the stimuli (Lê *et al.*, 2016).

2.4.1.1 Sensory evaluation with consumers

As the interest in consumer-based methodologies has increased, it has motivated the need to directly incorporate consumer input into the new product development process (Valentin *et al.*, 2012; Varela & Ares, 2012). Consumers have mainly been considered as being unable to provide reliable information about the sensory properties of products (Worch *et al.*, 2010). Usually, they have been called upon to only indicate liking or disliking of products (Stone & Sidel, 2004). Many warnings are given in literature concerning the use of consumers for profiling, such as that with an untrained panel the reliability and validity of responses are uncertain unless they are asked to indicate overall acceptance (Stone & Sidel, 2004) or degree of likeness of products (Lawless & Heymann, 2010). According to traditional views on sensory evaluation, hedonic tests (where consumers are asked to quantify their degree of liking of a product) are the only types of tests where untrained individuals should be involved (Schutz, 1999; Stone & Sidel, 2004; Meilgaard *et al.*, 2006; Lawless & Heymann, 2010; Tuorila, 2015), whereas only trained assessors who are familiar with attribute recognition and scaling are suitable for analytical sensory tests and sensory characterisation (Stone & Sidel, 2004; Meilgaard *et al.*, 2006; Lawless & Heymann, 2010).

Historic thinking was therefore that trained panels were required for sensory profiles and to perform analytical tests - discriminative and descriptive (Stone & Sidel, 2004), and consumers were required only for affective tests and hedonic profiles (Worch *et al.*, 2010). This view has been challenged in recent years through evidence that consumers are able to provide accurate information about the sensory properties of products, which in many cases is similar to the information provided by trained assessors (Moskowitz, 1996; Husson *et al.*, 2001; Dooley *et al.*, 2010; Moussaoui & Varela, 2010; Worch *et al.*, 2010; Ares *et al.*, 2011). As sensory profiles obtained with consumers using intensity scales have in some past studies met discrimination and reproducibility requirements, it is now viewed as an exciting alternative when companies are unable to use trained assessors' panels (Husson *et al.*, 2001; Worch *et al.*, 2010).

There is also commercial pressure to develop alternative methods to trained assessors that eliminate the need to train a sensory panel, as well as to gather information directly from and for consumers (Faye *et al.*, 2004). As a result, consumers are increasingly used in the sensory profiling of food products (Moussaoui & Varela, 2010; Varela & Ares, 2012; Meiselman, 2013). Research showing that consumers can in fact provide accurate information regarding the sensory properties of products has also led to the development of various new consumer-based methodologies, such as projective mapping, rapid profiling, sorting and napping (Moskowitz, 1996; Husson *et al.*, 2001; Worch *et al.*, 2010; Ares *et al.*, 2011; Ares & Varela, 2014). In addition to new methodologies, many new tools (e.g. check-all-that-apply (CATA) or rate-all-that-apply (RATA), and descriptive sensory analysis) have also emerged as complementary tools to sensory and consumer science that can be applied to gather product descriptions directly from consumers (Valentin *et al.*, 2012; Varela & Ares, 2012) with the added benefit of receiving feedback directly from them, and sometimes even based on their own vocabulary (Moussaoui & Varela, 2010).

Sensory characterisation with consumers is useful not only for uncovering perceptions and opinions regarding food products (which is valuable information during new food product development), but also to generate results which can be applied during the commercialisation phase when designing marketing or communication campaigns (Varela & Ares, 2012). In addition, consumers' sensory description of products can be correlated to other measures, such as hedonic judgements to identify the sensory properties of the ideal product, i.e. the product that maximises liking (Lagrange, 1987; Moskowitz & Hartmann, 2008). Many studies have thus been conducted to explore the sensory properties of chocolate with both trained and untrained or consumer panels, have applied various methodologies, tools and scales, and have focussed on different chocolate products (e.g. Thomson *et al.*, 2010b; Leite *et al.*, 2013; Norhayati & Ayob, 2014).

2.5 EMOTIONAL RESPONSE TO SENSORY PROPERTIES OF FOOD

Consumers are sensitive (in terms of emotional response) to the sensory qualities of a single taste (Gibson, 2006). A large amount of literature is available on emotions and senses or sensory perceptions in isolation (Rouby *et al.*, 2016), however, limited research has been conducted or results published to date on their relationships. While emotional response to food is a recent field, researchers have even more recently become aware of this connection

between the sensory impression and the emotional experiences elicited during product consumption (Bhumiratana *et al.*, 2014).

Sensory characteristics are one of the primary sources of food-related emotion (Desmet & Schifferstein, 2008), and are thus considered an emotional feature. Sensory perception and consumer emotion play significant roles in building an emotional connection between consumers and products or brands (Lindstrom, 2005; Chen & Lin, 2018). The provision of the sensory experience identity and the resultant emotions allow consumers to perceive, interpret and give meaning to individual experiences to an object or concept on a cognitive level (Pishghadam & Shayesteh, 2017). When sensory characteristics, emotional experiences and such cognitive responses are integrated, this provides consumers with a view of what is happening around them (Dunn, 2000).

Researchers (Pishghadam *et al.*, 2016) have examined how the inputs humans receive from different senses can relativise cognition. They have found that hearing about something, or seeing, or touching it could generate various different emotions in people that mould their understanding of the world (Pishghadam *et al.*, 2016). However, through giving prominence to the emotional aspect of senses rather than their cognitive ones, a hypothesis of sense-induced emotions was built, which they called emotioncy (Pishghadam *et al.*, 2016). What this means, in essence, is that sensory experiences or characteristics which are intrinsic to the products, and therefore are considered part of its identity, become conceptualisations; and these conceptualisations and the evoked emotions merge into a single idea (Thomson *et al.*, 2010b). As a result, an implicit view on emotion is being questioned as it ignores the impact of an explicit understanding of sense-induced emotions on cognition (Pishghadam *et al.*, 2016).

2.5.1 The link between sensory properties and emotions

Some studies have included and attempted to identify linkages between sensory properties and consumers' emotional associations to products and have been successful in doing this. However, research that was directly aimed at uncovering relationships for specific products between consumers' sensory experience and emotional reactions or associations, remains rare (Lagast *et al.*, 2017). Some studies have, however, been successful in proving that these links exist. Desmet and Schifferstein (2008), Thomson *et al.* (2010b), Gutjar *et al.* (2015b) and Seo *et al.* (2009) are all authors who, to date, have published results in detail on the role of sensory

properties in the elicitation of food-related emotions. Desmet and Schifferstein (2008) stated that sensory properties such as visual, olfactory and tactile qualities of foods could have a direct emotional impact. Gutjar *et al.* (2015b) specifically reported that the emotional profile of a food product was based on the intrinsic sensory properties of a product. Thomson *et al.* (2010b), who studied chocolate as a subject, stated that sensory properties acted as a driver for emotional response and found a link between specific sensory properties and emotional conceptualisations. The conceptualisations included that cocoa flavour was associated with powerful and energetic; smoky/burnt flavour with arrogant, serious, traditional and pretentious; creamy texture and sweet taste with fun, comforting and easy-going; bitter with confident, adventurous and masculine; and vanilla flavour, brown colour and initial bite with sensual, fun and luxurious. Seo *et al.* (2009) also investigated the relationship between specific sensory properties and adjective pairs of emotional response in a study of odours of dairy products and found significant correlations between specific sensory properties and emotions evoked.

Other studies have implicated the sensory properties of foods in driving emotional response for a range of product categories (Thomson *et al.*, 2010b; Ng *et al.*, 2012; Ng *et al.*, 2013; Sester *et al.*, 2013; Bhumiratana *et al.*, 2014; Spinelli *et al.*, 2014). For example, by representing the conceptual profiles of products using a bi-plot and overlaying sensory data on the key dimensions of the conceptual bi-plot, it is possible to make associations between emotional conceptualisations and the sensory properties that may drive them (Thomson *et al.*, 2010b). It was also, for example, reported many years ago that tasting energy-dense food such as high sugar or high-fat foods evoke positive affective responses that promote acceptance and ingestion, whereas tasting bitter compounds which cue toxins, evokes negative affective responses that promote rejection and non-consumption (Steiner, 1979; Rosenstein & Oster, 1988). Desmet and Schifferstein (2008) used solutions that represented the primary taste qualities of sweet, salty, sour and bitter, and found a significant effect of the stimulus on the associations with the emotions happiness, surprise, sadness, fear, disgust and anger. The sweet solution was mainly associated with the emotions happiness and surprise, whereas the bitter solution was mainly associated with the emotions anger and disgust. Salty and sour solutions were however associated with all emotions, reflecting more variable taste associations (Desmet & Schifferstein, 2008). The sensation of sweetness is inherently pleasant, while other sensations derived from tasting food are inherently aversive such as bitterness and sourness.

Sweetness together with fatty acids has an ability to influence mood and might be a major determinant of affective influences in food choice (Gibson, 2006).

The fragrance industry has managed to successfully measure and illustrate the connection between sensory properties (mainly odours) and emotional response. A citrus fragrance obtained high scores of energetic, invigorated and clean emotions, and thus affective changes produced by the fragrance seemed to be related to the chemical properties or intrinsic quality of the perfume (Chrea *et al.*, 2009; Porcherot *et al.*, 2010). Another study indicated that exposure to ambient citrus and vanilla aromas showed that the fragrances had differential behavioural, psychological and physiological effects. Exposure to citrus elevated the consumer's mood, increased physical activity in young adults and affected food choice. In contrast, exposure to vanilla only impacted emotions (de Wijk & Zijlstra, 2012). Warrenburg (2005) also demonstrated that vanilla and clementine (citrus) were evaluated as equally pleasant fragrances however differed in that clementine was found to be stimulating, whereas vanilla was relaxing.

Therefore, various studies have indicated that a clear link exists between emotions and sensory properties and that emotional profiling thus provides additional information alongside the sensory profile of products. Many researchers are thus attempting to obtain joint sensory and emotion profiles for products (Thomson *et al.*, 2010b; Spinelli *et al.*, 2014; Schouteten *et al.*, 2015) in order to have a "holistic" view of the product. In addition, emotions which are firmly linked to sensory experience could determine preference for a product (Ferrarini *et al.*, 2010) and can be considered alongside liking to understand the acceptability of food products (King *et al.*, 2010; Jiang *et al.*, 2014). As vast as the diversity of foods/beverages available to consumers is, so is their different sensory characteristics and emotional profiles. Collecting data across and within various food categories will over time allow researchers to conclude on whether similar relationships exist between sensory properties and emotions irrespective of a food category, and thus whether the emotional response can be predicted for food consumption. Some studies have reported that the relationship between sensory properties and emotions experienced indicate that in similar sensory products, the same emotions are experienced (Silva *et al.*, 2017).

The scientific need to better conceptualise consumers' experience with food has led to the increased interest in the integration of emotions into consumer and sensory research (King *et*

al., 2013; Gutjar *et al.*, 2015a; Meiselman, 2015; Mojet *et al.*, 2015; Walsh *et al.*, 2017). Although areas such as emotional conceptualisations and sensory affect are increasingly included in sensory testing by the food, beverage and fragrance industry, and has increased in importance during product development, the theoretical and methodological supports are only in the early stages of development (Meiselman, 2015). Only a few studies examining the relationship between a food product's emotional profile and its sensory properties have been published (Thomson *et al.*, 2010b; Spinelli *et al.*, 2014). Thus, while the interest in the application of consumer-based methodologies during new food product development has dramatically increased over the last decade (Varela & Ares, 2012), the development of suited instruments to simultaneously measure both sensory properties and affective feelings to products are also still in early developmental stages (Meiselman, 2015).

One of the possible reasons why the development of agreed-upon methodologies to measure this link has been slow, is that although sensations and emotions are linked (Heller, 2003), how they are linked is a matter of debate amongst researchers (Pishghadam *et al.*, 2016). One view is that today's consumers seek emotional experiences and they receive these from products via sensory perception (Thomson *et al.*, 2010b). Another view is that all objects have emotional features and these features are recognised by our sensory channels (Pishghadam & Shayesteh, 2017) which then become a sensory experience which is crucial in affecting these emotions (Tsaor *et al.*, 2007). Therefore sensory experience is crucial in affecting emotions, and sensory stimulus is a critical precursor of consumer emotions and is closely intertwined, affecting one another in both directions (Pishghadam & Shayesteh, 2017). Another reason could be that individuals are not necessarily aware of sensory-induced emotions and may not be able to verbalise them (Pishghadam & Shayesteh, 2017), and therefore measuring explicit views is still generally the approach (Lagast *et al.*, 2017) which may not fully capture all the relevant results.

Despite the sensory-emotion research area being in its infancy, some of the findings of studies which have been conducted in this area to date can be applied to consumer studies where an emotional response to sensory properties is measured:

- 1) It has been recommended that, ideally, emotions and sensory properties should be presented in the same question format, allowing consumers to evaluate the product in an integrated

survey, as this would provide researchers with an overall sensory and emotional evaluation of the product (Schouteten *et al.*, 2015);

2) It has, however, been found that it is crucial to deal with emotionality and functionality separately within a single research exercise as functional conceptualisations are often more readily apparent and accessible to people than emotional conceptualisations, and therefore the former tend to dominate (Thomson *et al.*, 2010b);

3) It is also recommended that the same or similar scales are used to measure emotion and sensory properties (Thomson *et al.*, 2010b); and

4) When such a study is designed, the order of presentation of each section needs to be carefully considered as one measure or section impacts another (King *et al.*, 2010).

2.6 THE RELATIONSHIP BETWEEN SENSORY PROPERTIES, EMOTION AND LIKING

Some studies have also considered the cognitive component of consumer behaviour in emotion studies, for example, Ferrarini *et al.* (2010) found that if emotional aspects are strongly linked to sensory experience, those emotions could determine product preference. Measuring only sensory appeal (or liking) of food products is currently considered insufficient due to this link between sensory properties and emotions which has been uncovered (Thomson & MacFie, 2007; King *et al.*, 2010; Schifferstein & Desmet, 2010). Thus recent studies have investigated the possibility of analysing emotions alongside acceptability (liking) for food products to better understand consumers' food choices (Dalenberg *et al.*, 2014; Köster & Mojet, 2015; Spinelli *et al.*, 2015). However, characterising products by making associations between sensory and emotional profiles can be a means to improve the products' market positioning in addition to its liking (Juodeikiene *et al.*, 2018), which is already considered to be a broader view on how consumers really experience food products (Thomson & MacFie, 2007; Thomson *et al.*, 2010b; Ng *et al.*, 2013; Stolzenbach *et al.*, 2013; Gutjar *et al.*, 2015b).

The understanding of this relationship has been taken to a level of including olfactory and visual aspects, to gauging which sensory components of a product evoke subconscious emotions that will drive hedonic measures and ultimately choice behaviour (Ferrarini *et al.*, 2010). In a competitive marketplace where product homogeneity is a reality, the sensory-emotion profiles of food products have become an important tool for building holistic product understanding (King *et al.*, 2010; Jiang *et al.*, 2014; Poonnakasem *et al.*, 2016; Wardy *et al.*, 2017). The responses to the specific sensory characteristics of a particular product which is a major determinant of

consumers' emotional product reactions and associations, may differentiate it from other similar products in the same category (Thomson *et al.*, 2010b). Furthermore, it is crucial for the product design process to understand which product features could elicit negative emotions, as this knowledge could help prevent a negative emotional impact of a newly designed product (Desmet & Hekkert, 2009). Based on these new varying opportunities and needs which have been identified for the application of the findings of such research, several new studies will be required to broaden the methodology and understanding that currently exists of how emotional associations and responses are shaped by the sensory properties of foods and beverages.

2.7 CONSUMER BEHAVIOUR

Consumer behaviour is a psychological (Furaji *et al.*, 2012), social and physical (Peter *et al.*, 2010) process of decision-making as well as physical activity (Solomon, 2007; Schiffman & Wisenblit, 2015) which involves identifying a need (Furaji *et al.*, 2012) or want (Solomon, 2007; Schiffman & Wisenblit, 2015). Consumers then seek to acquire, appraise, use and dispose of the product and service options available to satisfy the identified need, followed by making the purchase decision, deducing information, making plans and then applying these plans (Furaji *et al.*, 2012; Schiffman & Wisenblit, 2015).

Solomon *et al.* (2012) also highlight that consumer behaviour is interdisciplinary, as it is composed of different fields that assist the understanding of how people interact in the marketplace, and thus should be considered from an economic, psychological, sociological and cultural point of view (Mpinganjira *et al.*, 2013). From an economic perspective, consumer behaviour focusses on behaviour from a rational standpoint, assuming that consumers formulate needs based on concrete and rational criteria (Mpinganjira *et al.*, 2013). Solomon *et al.* (2012) add that the economic perspective takes the approach of the Consumer-Sovereignty model, where the consumer is always right, as they make rational and informed choices. Individual differences in consumer behaviour are accounted for through the consideration of the psychological perspective which acknowledges individual traits such as motivation, attitude and personality (Mpinganjira *et al.*, 2013). What is generally agreed upon is that consumer behaviour is complex, dynamic and multi-dimensional and is thus often reflected and expressed in consumer decision-making models (Sharma & Lal, 2012), which are useful to understand and predict individual consumers in a marketplace (Ladipo, 2014). As consumers are usually influenced by several external and internal variables (Ladipo, 2014), such models incorporate

many elements which have been found to form part of the decision-making process and many or all of the elements could be in play during the process.

Consumer behaviour towards food is regarded as highly complex with many external and internal influences (Hartwell *et al.*, 2016), and thus the influence of emotions on food choice and food intake (Canetti *et al.*, 2002; Gibson, 2006; Macht, 2008), motivation to eat and amount of food consumed (Jiang *et al.*, 2014), food acceptability, intention to purchase, attitudes and behaviour has been examined in various ways (Wardy *et al.*, 2015; Walsh *et al.*, 2017). Many studies focused on the relationship between food and emotion, with only some incorporating or somewhat considering selected consumer behaviour variables, failing to take into account a third variable, which was already identified years ago by Russell and Mehrabian (1977), that of behaviour and behavioural response. Food-related behaviour has been demonstrated to be the result of intuitive reasoning that occurs at an unconscious level (Köster, 2009; Manzocco *et al.*, 2013) and, thus, emotion must play a role. Kim *et al.* (2017a) stated that by measuring emotion we may indirectly tap into the underlying motivations for food intake, which may not be related to only sensory properties. While the current argument is that emotions are an intuitive reaction towards sensory properties of food based on associated learning, consumers have developed complicated feelings or attitudes towards food products (Jiang *et al.*, 2014) which must influence these reactions.

Another factor which should also be considered in relation to emotional response is anticipation. Consumers' anticipated emotions which they may experience before consuming a product can contribute to the comprehension of behavioural intention and behaviour towards products (Juodeikiene *et al.*, 2018). Based on the theory of planned behaviour (Fishbein & Ajzen, 1975), it is presumed that individual behaviour is determined by behavioural intentions. While behavioural intention has been predicted in many studies, e.g. purchase intention, (Rosas-Nexticapa *et al.*, 2005), few have attempted to investigate the prediction of actual behaviour, e.g. purchases (Park & Kim, 2003), especially in the food research field. Stronger behavioural intentions imply a higher probability of individual behaviour. Therefore, behavioural intention can be considered the potential behavioural tendencies of a person. Accordingly, it can predict behaviour (Ajzen & Driver, 1991).

2.7.1 Influence of emotion on consumer behaviour

As early as 1987, researchers have stated that emotions contribute far more than cognition to brand or product interest, purchasing attitudes and product acceptance (Westbrook, 1987; Mano & Oliver, 1993; Oliver, 1993; Moskowitz & Hartmann, 2008). More importantly, as foods are an omnipresent element of daily life, the influence that they have on emotional states may have very broad significance to consumer behaviour in general (Cardello *et al.*, 2012). It is generally acknowledged that human eating behaviour, which is influenced by external cues from foods, the body, and the social and the physical environment, is affected by and associated with emotion (Desmet & Schifferstein, 2008). Emotions serve distinct motivational functions and contribute to the control of basic behavioural systems in animals and humans (Tomkins, 1963; Plutchik, 1984; Frijda, 1986; Izard, 1993; Fredrickson, 1998) and different emotions can have different behavioural consequences (Macht & Dettmer, 2006). Different positive emotions can have different effects on consumer and user behaviour (Schifferstein & Desmet, 2010). While activating positive associations may induce action and thus generally facilitate product orientation (Ferdenzi *et al.*, 2013), it has been proposed that negative emotions might be of more importance as indicators of acceptability and predictors of future consumer behaviour than positive emotions, as it is well known that feelings of discontent grow over time and positive feelings wear off with repeated exposure. It is only in the short term that product exposure and familiarity will lead to acceptability and consumption (Gibson, 2006). However, an article by Peighambari *et al.* (2016) - who reviewed consumer behaviour research articles published over 12 years - did not report that emotion was a major topic of consumer behaviour in any of the surveyed articles. This indicates that emotion is not yet considered a significant role player in consumer behaviour while it is acknowledged that motivation to consume food, in general, is related to emotion (Ershadi *et al.*, 2017), and while it has been reported by Pishghadam *et al.* (2016), it has not yet been widely researched.

2.7.1.1 Mood and emotion

Mood is a physiological arousal state lasting at least a few minutes and usually more prolonged (Gibson, 2006) and it builds up more gradually and lasts longer than emotions (Meiselman, 2015). It is one of the factors that can impact a person's food choice (Kanjanakorn & Lee, 2017). Moods are not in response to a specific thing either (Meiselman, 2015); they appear and persist in the absence of obvious stimuli and might be more covert to observers (Rolls, 2000; Matthews *et al.*, 2003). There are specific emotions such as anger, fear, sadness and joy which

do, however, present themselves as moods, and these, as well as other emotional states which can be defined as moods, are thought to last longer and be more diffuse than emotions (Ekman, 1992; Frijda, 1993).

It has been reported that emotions are subject to the mood and psychological state of consumers, and that consumers in positive and negative emotional states have provided varying evaluations of food (Jiang *et al.*, 2014). There is also published evidence that sweetness, perhaps together with fatty tastes, in particular, may be able to influence mood (at least in some individuals some of the time), and might be a key determinant of affective food choice (Gibson, 2006). Induced negative mood has also been found to improve immediately and selectively after eating palatable food (Macht & Mueller, 2007). Despite all the evidence gathered to date that food affects mood, relatively little has been published on mood research within the scope of food product development (King & Meiselman, 2010).

Food can affect a behaviour change as food affects the way we feel and can change a person's state of arousal and mood during consumption; mood and emotion can thus be a significant behavioural outcome of food exposures (Lieberman, 2005). Motivation to eat, the quantity consumed, the frequency of consumption and the choice of foods could all be affected by a person's moods and may not necessarily be related to physiological needs of the consumer or the nutritional composition of the food (Schifferstein & Desmet, 2010). Mood impacts emotional response as the emotions evoked by a stimulus such as food may depend on the internal state of the individual, not only on the nutritional state or the overall physical state but also on the current mood of the consumer (Desmet & Schifferstein, 2008). When consumers experience negative emotions, they can become eager to participate in consumption behaviours that lighten their mood (Cohen *et al.*, 2008).

Observers have noticed across the years that emotion, mood and food choice can interact with one another, varying from strong and overt to subtle and subconscious (Gibson, 2006), and thus some researchers have included mood as a key variable determining food choice (King & Meiselman, 2010). The Food Choice Questionnaire developed by Steptoe *et al.* (1995) identified nine factors that were determinants of food choice, including mood as a main variable. Consumers' mood or psychological state may have a significant impact on how a product is evaluated and what consumers decide to purchase and consume (Askegaard *et al.*, 2013).

2.7.1.2 Familiarity and emotion

Conceptual associations, e.g. the association between chocolate and happiness, are based on experience and learning from either internal sources, e.g. that when chocolate is consumed one's mood is improved, or external experiences, e.g. that chocolate is linked to various happy holidays such as Easter and Christmas (Thomson *et al.*, 2010b); and part of these associations are emotional connotations (Gutjar *et al.*, 2015b). Product familiarity is one of the factors most frequently studied for its influence on food-elicited emotion (Jiang *et al.*, 2014). Familiarity has been found to have an important bearing on the experience of consumers (Sester *et al.*, 2013) as it creates knowledge of and attitudes towards products and brands which could influence products' emotional and sensory profiles (Schiffman & Kanuk, 2010; Stolzenbach *et al.*, 2013; Crocker & Thomson, 2014; Spinelli *et al.*, 2015; Thomson & Crocker, 2015). Familiarity was, for example, found to be one of the main characteristics influencing hedonic ratings of odours in the field of chemosensory perception (Royet *et al.*, 1999; Bensafi *et al.*, 2002; Seo *et al.*, 2008).

2.7.1.2.1 Consumption frequency and emotion

With increasing product familiarity, people make associations or mental connections between the identity of a particular object and other conceived associations (Thomson *et al.*, 2010b), such as concepts, events or mental states that originated from specific past experiences. The mechanism by which this association between a property and concurrent emotion is formed may be described by the classical conditioning theory (Herz *et al.*, 2004), which is that behaviour is learnt by a repetitive association between the response and the stimulus. These conceptualisations are formed from external sources, including hearsay and advertising, and is also formed internally, based on beliefs and inner experience (Thomson *et al.*, 2010b).

This can also be viewed as cognitive associative learning, the process by which an event or object becomes connected to another through experience, and is critically involved in human cognition and behaviour (Wasserman & Miller, 1997). Associative learning principles have been applied to explain human perceptual responses to odours (Engen, 1988; Herz, 2001). It has been proposed that odour hedonic perception (i.e. liking or pleasantness) is derived from a learned association with the emotional context in which the odorant was first encountered (Worch *et al.*, 2010) and thus the identity consumers assign to objects is based largely on learning (Thomson *et al.*, 2010b).

While product users in general have stronger positive emotions, non-product users have a different emotional profile altogether, usually focused on negative emotions, while food products often hardly elicit emotions in non-users (King & Meiselman, 2010). It has thus been recommended that the emotions evoked by innovative new product concepts that are not yet launched should be investigated before they are introduced. Studying non-users could identify characteristics that could either promote or inhibit product adoption as one might find unpleasant emotions to be evoked more frequently (Desmet & Schifferstein, 2008), as non-users are ultimately potential users and their non-use should be modified (Meiselman, 2015). Frequency furthermore influences emotion ratings, as the rating of emotion intensities has been found to increase alongside an increased frequency of product use for positive emotion terms, while the intensity of negatively charged emotion terms increased inversely with increased frequency of use (King & Meiselman, 2010; King *et al.*, 2010).

2.7.1.2.2 Emotional conceptualisations or associations

The way in which consumers conceptualise a product category is highly responsible for the emotion profile of a product when it is evaluated. This may be even more important than the impact of sensory properties alone, because the purchase decision of a food is usually not dependent on tasting memories alone, but on the whole consumption experience (Jiang *et al.*, 2014). This happens because part of these associations has emotional connotations (Gutjar *et al.*, 2015b), which then deliver object-related emotions that create positive or negative emotions towards different objects. The intrinsic nature of an object merges with these emotions to create an individual's understanding of the object (Thomson *et al.*, 2010a; Pishghadam & Shayesteh, 2017). Ultimately, the identity of an object or concept depends mainly on these resultant emotions which in the end allow consumers to perceive, interpret and give meaning to individual experiences (Pishghadam & Shayesteh, 2017) and is mostly based on learning (Thomson *et al.*, 2010b). Most emotion scientists, however, do not make the clear distinction between causes and associations, because associations also play an important role in the conditions which evoke an emotion (Desmet & Schifferstein, 2008). Nevertheless not all objects and experiences have the same level of emotion connected to them, and everyday life experiences show that events or items which are associated with emotions are recalled better and in greater detail than those lacking emotional significance (Conway, 1990; Ochsner, 2000).

2.7.1.2.3 The role of memory in familiarity

Familiarity also relates to memory, but the role of memory is almost always overlooked in food-related consumer research, although it is probably much more important than first impression experiences which are more commonly investigated (Köster & Mojet, 2015). The emotions evoked by remembering products are essential in the creation of expectations that guide repurchase decisions. The neglect of memory in combination with the superficiality of first impression measurements is one of the main reasons for the high volatility of the market and the high failure rate of newly launched food products (Köster *et al.*, 2007). Memory could also be viewed as associative learning, as early learned odour preferences have also been found to influence food and flavour preferences in later life. It has been reported that infants whose mothers consumed foods with distinctive scents (such as garlic or alcohol) during pregnancy or lactation are more likely to prefer those odours than infants whose mothers did not have such habits, due to emotional bonding (Mennella *et al.*, 2001). Even more studies have emphasised the role of associative learning in regulating the hedonic response to odours based on the emotional setting the person was in when they first smelled the odour (Herz *et al.*, 2004). That is because emotions in humans are thought to be formed upon experience and the resulting memory created by these experiences (Hamann, 2001). It has been reported that people are able to recall multiple facts about the foods they have recently consumed and that this encoding is done effortlessly without conscious awareness (Mojet & Köster, 2002; Köster *et al.*, 2004). Tasted foods can also evoke associated memories based on previous eating occasions and are thus also linked to emotions experienced on such occasions (Köster & Mojet, 2015). Pleasant ambient odours have, for example, been found to have a favourable impact on mood and emotion by activating positive associations stored in memory (Ferdenzi *et al.*, 2013).

Köster and Mojet (2015) found that the memory of chocolate evokes stronger emotions than actual consumption. This seems to be especially true for strong person- or situation-related memories (such as active, adventurous, affectionate, eager, energetic, enthusiastic, good, guilty, happy, loving, merry, pleased and satisfied) with perhaps a few exceptions (calm, friendly, good-natured and nostalgic), and not at all for emotions that might be more product-related (bored, mild, pleasant, secure, steady, whole and tender). Eating related pleasures go beyond sensory stimulation; they are anticipated and remembered (Rozin, 1999; Macht *et al.*, 2005) and this remembered enjoyment has been found to be an important predictor of consumer behaviour (Robinson *et al.*, 2011; Robinson *et al.*, 2012).

Another school of thought is that the recognition for food is based on change detection rather than on memory recollection (Morin-Audebrand *et al.*, 2012). Consumers do not necessarily remember the products they have eaten before by recollecting a detailed internal representation, but their food memory is directed at novelty and change detection (Morin-Audebrand *et al.*, 2012). The emotions evoked by remembering a product are essential in creating the expectations that guide repurchase decisions (Köster & Mojet, 2015) and the neglect of memory in combination with the superficiality of first-impression measurements is probably the main reason for the high failure rate of new food products (Köster *et al.*, 2007; Koster, 2012; Koster & Mojet, 2012a).

2.7.1.3 Acceptability /liking

Liking is defined as the immediate enjoyment experienced when consuming or otherwise interacting with a product (Thomson *et al.*, 2010b) and is most commonly viewed as an explicit measure (Garbinsky *et al.*, 2014). Liking, as it relates to food or beverages, has also been referred to as palatability which relates to one's hedonic responses to food, and is a triggered affective state that requires no motivation for further reward (Berridge, 2009).

In sensory science acceptability or liking has, over many years, been the measure used to understand the preference and food choice behaviour (Peryam & Pilgrim, 1957; Pilgrim, 1961; Kamen, 1962; Pilgrim & Kamen, 1963; de Graaf *et al.*, 2005). A product that is liked a great deal will often be scored as a probably or definitely purchase (Beckley *et al.*, 2008) and thus, for many applications, overall liking and purchase intent are often used interchangeably to assess general performance (Beckley *et al.*, 2008). As both purchase intent and overall liking belong to the world of overall evaluations, this is typically the world into which the researcher taps when doing an experiment and it is usually either overall liking or purchase intent that is the main focus of many researchers (Meiselman, 1978).

It has been stated that it is crucial for sensory studies to move beyond measuring liking only by assessing a broader range of insights into consumers' food product experience (Thomson *et al.*, 2010a; Cardello *et al.*, 2012). There is more to food choice than liking (Gutjar *et al.*, 2015b) and choice behaviour is known to be differentially influenced by many elements, including sensory and extrinsic product properties such as packaging or labelling (Torres-Moreno *et al.*, 2012). Liking may also have a detrimental impact on the ability of researchers to access the deeper

and less accessible yet highly influential conceptualisations triggered by an object (Thomson *et al.*, 2010b). Various different groups of scientists have also highlighted the need for more reliable and discriminative measures of feeling than liking or acceptability ratings (Rétiveau & Milliken, 2004; Warrenburg, 2005; Desmet & Schifferstein, 2008; King & Meiselman, 2010). Additional research is required to understand the relationship between emotion and acceptability and why this relationship varies (King *et al.*, 2010), as King and Meiselman (2010) reported various examples of highly acceptable products with different emotional intensities. Various studies have found that measuring only the appeal of food products is insufficient to successfully apply the findings during product development (Thomson & MacFie, 2007; Desmet & Schifferstein, 2008; King *et al.*, 2010; Dalenberg *et al.*, 2014; Köster & Mojet, 2015). Concepts such as satisfaction are more appropriate than simple acceptance scores for commercial products (Thomson & MacFie, 2007).

2.7.1.3.1 Liking and food choice

Product liking can be associated with product choice (Chaya *et al.*, 2015) but measuring liking alone is insufficient as a predictor of food choice (Dalenberg *et al.*, 2014). Dalenberg *et al.* (2014) found that a model containing product liking alone only moderately fitted consumer choice behaviour. The relationship between food choice and liking is weak in real-world situations (Dalenberg *et al.*, 2014), and thus liking does not accurately predict food choice. Thus, while liking is an integral part of food choice, it may make only a modest contribution to explaining the overall variation in food. Other elements have thus been investigated which could explain and predict choice behaviour.

2.7.1.3.2 Emotion and liking

Emotion research and emotional response understanding concerning acceptance and liking are also of importance, as a lot of commercial emotion research is not linked to acceptance but is instead aimed at differentiating between products, sometimes of the same acceptance (Meiselman, 2017), which an understanding of emotions a product is associated with, can provide. The expectation of liking and emotions also plays an essential role in the ultimate food perception by consumers (Kostyra *et al.*, 2016).

There are, however, exceptions in when overall liking scores are not necessarily predicted by positive emotions (Jiang *et al.*, 2014), as not all emotions are related to product acceptability,

and their relationship is furthermore subject to a specific product, product category, or the demographic and psychographic characteristics of the consumer (King & Meiselman, 2010). While certain emotions contribute to purchase behaviour, it is unclear what role they play in the full product experience, especially in predicting purchases. Liking at the end of the consumption of food has been found to determine the delay until the food is consumed again (Garbinsky *et al.*, 2014). There is also a hypothesis that hedonic experience may strongly influence liking expectations when consumers are yet to develop detailed semantic knowledge of that food (Robinson *et al.*, 2013).

2.7.1.3.3 Emotion provides information beyond liking

Findings from several studies confirm that measurement of evoked emotions provides new information beyond liking, but it is still unclear today which part of the emotional responses provide the new or additional information and also how to determine or measure this (Jaeger *et al.*, 2018). It could be as Oliver (1993) stated that emotional responses mediate the impact of product attributes on satisfaction, and thus as product attributes have a strong capacity to evoke emotions, satisfaction itself can be referred to as “an evaluation of emotion” (Hunt, 1991). For this reason, it is generally acknowledged that human eating choices are impacted by and associated with emotions (Hanoch *et al.*, 2007; Moskowitz *et al.*, 2009; Schifferstein & Desmet, 2010). The connection between emotion and liking is further implied, as food-related emotions such as pleasantness and satisfaction partly tap into the same dimensions as liking (Gutjar *et al.*, 2015b; Jaeger *et al.*, 2018). It has therefore been found that the greatest predictive strength was achieved by the combination of evoked emotions and liking (Dalenberg *et al.*, 2014) and that combining these ratings resulted in the best prediction of choice of tasted products (Gutjar *et al.*, 2015b). While Dalenberg *et al.* (2014) showed that pleasantness and emotions together can predict food choice better than pleasantness alone, King *et al.* (2010) stated that pleasantness does not always predict the product success in the market, and therefore emotions can help to explain it. Based on the strong relationship between nutrition and survival, it is not surprising that emotional valence (measured as liking) (Gutjar *et al.*, 2015b) is strongly related to experimentally controlled food choice behaviour (Dalenberg *et al.*, 2014), as high arousal emotions such as anger and joy have been shown to increase desire to eat (Macht, 1996; Macht *et al.*, 2002), whereas low arousal negative emotions such as sadness have been shown to decrease appetite and consumption (Macht *et al.*, 2002).

2.7.1.3.4 Food choice

Food-evoked emotions as motivators for food choice have received considerable attention (Moskowitz *et al.*, 2005; Dalenberg *et al.*, 2014). Emotion could also influence food choice by inducing physiological changes which could alter appetite, or by changing other behaviours that constrains or alters food utilisation (Mojet *et al.*, 2015). A recent finding indicated that actual food choice is related to mainly positive emotions (Gutjar *et al.*, 2015b). Studies on emotional responses to foods have to date included preference ratings as an index of the consumer's satisfaction with the product, and as an estimate of the consumer's future choice behaviour towards the product (Gutjar *et al.*, 2015b). However, the ultimate behaviour of interest is the actual choice and consumption (Gutjar *et al.*, 2015b). Furthermore, the human physiological system may mediate hedonic evaluation of food sensory stimuli or liking (Berridge & Robinson, 1998) and one could thus expect a link between opioid action, (a compound resembling opium in addictive properties or physiological effects) and food choice (Blass *et al.*, 1989; Upadhyay *et al.*, 2004). Thus, as stated by Ferrarini *et al.* (2010), emotional measurement could be used in conjunction with sensory analysis in order to understand how taste, olfactory and visual aspects of a product evoke subconscious emotions that ultimately drive hedonic reaction and choice behaviour.

2.7.1.3.5 Food choice and consumption

It is clear that the emotional reactions to the consumption of foods or the perception of fragrances play an important role in the acceptance of products and as it has been proven to ultimately affect food choice (Danziger, 2004; Pawle & Cooper, 2006; Beckley *et al.*, 2008); it has become critical to researchers who attempt to uncover the drivers of food choice. This is exemplified by chocolate consumption: although chocolate is highly liked, actual consumption of chocolate varies among consumers and depends on many more factors than merely liking or acceptability (Dalenberg *et al.*, 2014).

Despite the complexity of this behaviour, choosing what to consume is often governed by a fast, intuitive process that involves reasoning (Dalenberg *et al.*, 2014), and one characteristic of intuition is its emotional basis. Berridge and Winkielman (2003) even suggested that liking is an “unconscious emotion” and illustrated this by describing the facial expressions of infants and chimps when tasting a sweet solution. The idea of unconscious emotion is also supported by evidence from neuroscience indicating that subcortical brain systems underlie basic “liking”

reactions (Winkielman & Berridge, 2004). Consumers show high variability in food choice behaviour because the elements influencing choice behaviour are complex and include psychological, physiological, situational, socio-cultural, intrinsic and extrinsic product characteristics (Dalenberg *et al.*, 2014), as well as hedonics, experience, attitudes, personal beliefs and habits (Gedrich, 2003; Van Kleef *et al.*, 2005; Koster & Mojet, 2012b). More consumers today tend to choose foods they can emotionally resonate with (Porcherot *et al.*, 2010), as food choice may in part be guided by positive or neutral food-evoked emotions that go beyond liking (Gutjar *et al.*, 2015a), because when people experience a high degree of positive emotion, they may change their behaviour more (Patel & Schlundt, 2001; Cyders & Smith, 2008).

Various recent studies have suggested that emotional measurements could be linked to food choice (Rozin & Schulkin, 1990; Galef, 1996; Martins & Pliner, 2005; Dalenberg *et al.*, 2014; Gutjar *et al.*, 2015a; Köster & Mojet, 2015). Numerous studies have also shown that emotions could influence product choice (Ackert *et al.*, 2003), even via physiological effect that changes appetite (Gibson, 2006) and eating behaviour (Macht, 2008; Wallis & Hetherington, 2009). Food choice leading to food consumption which then influences mood and emotion, deliberate or otherwise (Gibson, 2006) has, however, only recently gained attention in consumer and sensory research (Cardello *et al.*, 2012; Bhumiratana *et al.*, 2014; Dalenberg *et al.*, 2014).

The effects of emotions on food choice and consumption have been classified into five basic classes (Macht, 2008):

- (1) Emotions induced by food stimuli which affect food choice;
- (2) Emotions high in arousal or intensity which suppress eating due to incompatible emotional responses;
- (3) Emotions moderate in arousal or intensity which can impact eating depending on the motivations to eat, such as:
 - (a) In restrained eating, negative and positive emotions enhance food intake due to impairment of cognitive control;
 - (b) In emotional eating, negative emotions elicit the tendency to be regulated by eating and consequently, enhance the intake of sweet and high-fat foods; and
 - (c) In normal eating, emotions affect eating in congruence with their cognitive and motivational features.

Food choice could also at times be driven by the physiological need to replenish a specific essential nutrient (Gibson, 2006). This has been illustrated in the choice of so-called “comfort food” which is high in fat and sugar, but where individuals food choice is varied (Jiang *et al.*, 2014). As a result, emotion connotation has become an essential tool to understand what drives choices and to differentiate food, and the number of studies considering product-elicited emotions and the role of emotions in food choice have grown tremendously over the last decade (Meiselman, 2015; Mojet *et al.*, 2015), underpinned by this recognition that emotions are linked to decision-making and exert a considerable influence on consumption behaviour (Bechara & Damasio, 2005; Rick & Loewenstein, 2008; Padoa-Schioppa, 2011; Ledoux *et al.*, 2013; Jiang *et al.*, 2014). Most studies have, however, focused on distinguishing between products based on group averaged emotions scores and not on predicting individualised food choice and consumption behaviour (Dalenberg *et al.*, 2014). Individual differences in consumers have also been observed in emotion studies (Macht & Simons, 2000; Gibson, 2006) and the link between emotions and food choice may be mediated by these variations (Macht, 2008).

2.7.1.4 Attitude

As with emotion, social psychologists do not agree on the precise definition of an attitude and as a result multiple definitions have been developed (Yuan *et al.*, 2008). Coney *et al.* (2001) defined attitude as *"an enduring organization of motivational, emotional, perceptual, and cognitive processes with respect to some aspect of our environment"*. Schiffman (1997) in an early edition of this well-known book on consumer behaviour, provided a more consumer-centric definition by defining attitudes as *"a learned predisposition to behave in a consistently favourable or unfavourable way with respect to a given object"*, and in a later edition provided a more emotional base and defined attitude as someone's inner feeling that show whether he/she likes or dislikes something (Schiffman & Wisenblit, 2015). Eagly and Chaiken (1993) combined these definitions and stated that attitudes are thus a tendency to evaluate a target object with some degree of favour or disfavour, and are based on emotional reactions, behaviours toward and cognitive evaluations of the object. It has, therefore, been broadly agreed that attitude reflects the relationship between a consumer and an object based on the evaluation of the object by the consumer (Kassarjian & Robertson, 1973) and exists simply because it performs a particular function to a person (Hogg *et al.*, 2006), which means that it is determined by the motives of an individual (Anilkumar & Joseph, 2012).

Attitude formation, from having no attitude towards an object to having some form of attitude is a result of learning (Schiffman & Kanuk, 2014). Three possible learning theories relate to attitude formation, namely classical conditioning, instrumental conditioning and cognitive learning theory (Schiffman *et al.*, 2008; Mpinganjira *et al.*, 2013; Botha *et al.*, 2019). Classical conditioning is a general feeling of satisfaction created by the historic purchase of a brand which can be evoked by marketers for a new product under the same brand, attempting to create the same positive attitude for the new product. Instrumental conditioning is, if the consumer is satisfied with the performance of an unknown newly purchased brand, product or category, a favourable attitude is likely to be developed for it. Cognitive learning theory is when consumers form attitudes (either positive or negative) when solving a problem or satisfying a need based on exposure and their own knowledge and beliefs. All three could be present and at play at different points in time. Furthermore, the formation of consumer attitudes is strongly influenced by personal experiences, the influence of family and friends, direct marketing, and mass media (Schiffman & Kanuk, 2010).

Many experts believe that attitudes are a significant tool to understanding consumer behaviour as behaviours are determined (Frymier & Nadler, 2007) to a large extent by people's states of mind or feelings towards an object, i.e. their attitudes towards it (DeFleur & Westie, 1958; Walters & Paul, 1970; Wilkie, 1994) and as a result attitudes predict behaviour (Frymier & Nadler, 2007). Attitudes' important role in consumer behaviour and decision-making is based on the fact that an attitude basically refers to how much we like or dislike something (Edunote, 2017) and approaching the object is typically associated with liking or a positive attitude toward it, whereas avoiding the object is typically associated with disliking or a more negative attitude (Netzer *et al.*, 2018). Attitudes can thus predict consumer behaviour as they provide clues as to the type of decisions a consumer will make and the courses of action he or she will adopt (Yuan *et al.*, 2008). Attitude is also seen as relatively permanent and reflects behaviour coherently (Anilkumar & Joseph, 2012), although attitude could only be regarded as permanent if consumer behaviour consistently matches up with consumer attitude (Anilkumar & Joseph, 2012). Coney *et al.* (2001) noted, though, that since products are evaluated in the context of a specific situation, attitude is not fixed, and that affective reaction to a product (as well as the beliefs about a product) may change as the situation does.

There are three components of attitudes, namely cognitive component (brand beliefs), affective component (brand evaluations) and behavioural component (intention to purchase), but this can be extended to category or product (Assael, 1995; Coney *et al.*, 2001; Botha *et al.*, 2019). Behavioural scientists have attempted to construct attitude models to highlight underlying dimensions in order to understand the attitude-behaviour relationship (Jain, 2014). A popular attitude model proposed in the literature, the tri-component attitude model, proposes that attitudes consist of affective, cognitive and conative components (Alexandris *et al.*, 2008; Schiffman & Wisenblit, 2015). Consumers' emotions or feelings towards an object make up the affective component of attitude (Wilkie, 1994) and these emotions and feelings are primarily evaluative in nature. They summarise an individual's overall assessment of the object, viz., the extent to which the individual rates the object as favourable or unfavourable. Since this component assesses overall feelings about the object, it is often considered the essential aspect of an attitude. Affect also plays a crucial role in linking beliefs with behaviour (Reibstein *et al.*, 1980). Consumer choice and consumption behaviour thus has a significant emotional dimension (Bechara & Damasio, 2005; Rick & Loewenstein, 2007; Padoa-Schioppa, 2011). People's attitude towards food furthermore exists or changes correspondingly based on conditioning, but it is also influenced by different emotional states (Jiang *et al.*, 2014). Some studies on emotional responses to foods have included attitudinal measures as an indication of the consumer's satisfaction with the product and as a predictor of the consumer's future behaviour towards the product (Gutjar *et al.*, 2015a). For example, a study conducted by Koren (2015) with chocolate as the subject, found that consumers who have a positive attitude towards sustainability issues are more willing to buy sustainability-labelled chocolate products.

To improve the knowledge of the causes and consequences of chocolate consumption, Benton *et al.* (1998) developed the Attitudes to Chocolate Questionnaire (ACQ). This measurement tool was proposed as a functional approach to measuring chocolate eating (Müller *et al.*, 2008). This questionnaire was recently applied and assessed by Van Gucht *et al.* (2014) and was found to yield valid results, and was thus employed in this study.

2.8 CONCLUSION

Based on a review of the literature, it has become clear that a relationship exists between sensory properties of foods (and chocolate) and emotion, and that various consumer behaviour elements have an emotional component. The extent and strength of these relationships and the

relative importance of the various behaviour attributes and emotion have, however, not been measured and quantified for chocolate in order to conclude on whether emotional response is most influenced by consumer behaviour or by the unique sensory properties of food. The methodology applied to gather consumer data on each of the attributes of the study and the data analysis conducted to determine the relationship between these is reported in Chapter 3.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 INTRODUCTION

From the aforementioned review and discussion, it is evident that there is a relationship between the sensory properties of food and emotional response experienced, and that consumer behaviour variables could influence this response.

Knowledge gained about these relationships will serve various purposes:

- 1) Identifying the main emotions associated with the consumption of chocolate will create an understanding of the perception of the product amongst South African consumers;
- 2) Identifying the sensory attributes (sensory properties) which will most likely influence positive and negative emotional response, an insight which can be applied for product and marketing mix development;
- 3) Concluding whether various internal consumer behaviour variables (mood, familiarity, acceptability and attitude) influence emotional response to chocolate, and if so to what extent, in order to identify whether these emotions may be present despite the specific sensory properties of the product;
- 4) Constructing a model that showcases the relationship between sensory properties and emotional response.

This chapter will outline the methodology applied to collect data that was used to identify and describe these relationships. It will first describe the research design of and sampling for the study. It will further outline the reasons behind the selection of chocolate as the focus product of the study. This will be followed by the operationalisation of the study, which includes three steps, namely the preparation of research materials, data collection, and data analysis and dissemination, as indicated in Figure 3.1.

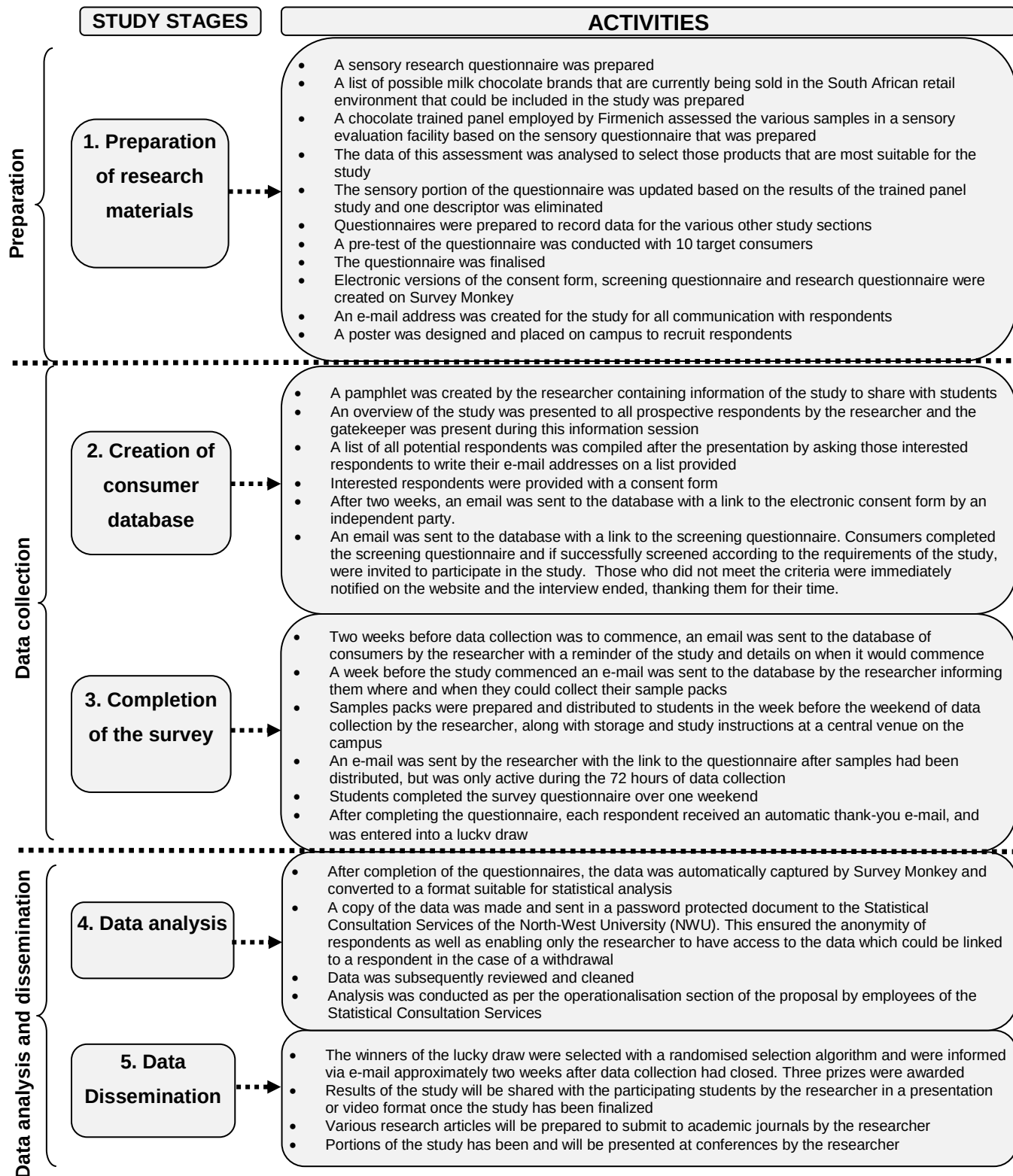


Figure 3.1: Data collection and analysis

Preparation of research materials included the construction of the screening and research questionnaire, the identification of the potential chocolate samples to be included in the study, evaluation of these chocolates along with the research questionnaire by a trained panel, pre-testing the questionnaire with selected successfully screened respondents and updating the questionnaire based on their feedback, creating an electronic version of the research questionnaire, as well as advertising the study to potential respondents.

Data collection commenced with information sessions, from which a database was compiled of prospective respondents. Consent was then obtained from these respondents, and they were subsequently screened. The chocolate samples which the respondents evaluated were then prepared, as well as the sample packs which were distributed to all those participating. The respondents then completed the survey. The last stage, that of data analysis and dissemination, commenced when data was downloaded, reviewed and cleaned. The analysis was then conducted on all the collected data. Data has and will continue to be disseminated in various manners. Lastly, validity and reliability, ethical considerations, risks, benefits and contributions of the study will be discussed.

3.2 RESEARCH DESIGN

This study was a quantitative, descriptive cross-sectional study (De Vos *et al.*, 2011), implemented employing an electronic questionnaire to collect quantifiable data (Pietersen & Maree, 2007; Delport *et al.*, 2011). As this study concerns affective feelings and behaviour of consumers, it is necessary to obtain objective explanations of the collected data in order to answer the research questions (see Chapter 1, section 1.4). This study is consequently grounded in a positivistic research paradigm, as real-life events were observed empirically and explained with logical analysis (Creswell, 2013). The aims and objectives of a study (see Chapter 1, sections 1.4.2 and 1.4.3) determine the research design that will be applied (Babbie & Mouton, 2001; Creswell & Plano Clark, 2010). Therefore, a cross-sectional survey design was applied in this study, as data about a phenomenon was collected at one time in order to investigate and describe it (Babbie & Mouton, 2001).

3.2.1 Study location

The sample population included South African adult consumers who live in the Gauteng Province within the Johannesburg municipal district. Approximately 12,91 million people (23,9%)

live in the Gauteng Province (StatsSA, 2015), comprising the largest share of the South African population. Gauteng is an appropriate study location since it is one of South Africa's most culturally diverse provinces (StatsSA, 2014). It is also the wealthiest province in South Africa (StatsSA, 2016) as the average household income is significantly higher than in other provinces.

The City of Johannesburg local municipality is situated in the Gauteng Province and covers 1 645km² of land area. It is the largest city in South Africa (in population), and the provincial capital of Gauteng (StatsSA, 2016). This municipality has a total population of 4,4 million of which 76.4% are Africans, 12.3% are Caucasian, 5.6% are coloured, and 4.9% are Indian or Asian (StatsSA, 2016). Johannesburg residents have high average annual incomes, with 23.7% reporting average annual household income of R153,801.00 and above, which would make more disposable income available to them to purchase luxuries (StatsSA, 2016).

As chocolate is regarded as a luxury item (Queally, 2014), it was important to conduct the study in an area where consumers can easily afford the product. Conducting a study in this area also means that it would be possible to find consumers who consume it at least once a year and some who consume it even more frequently, monthly or even weekly. Consumers would also have easy access to a wide variety of chocolate products in Gauteng from a retail perspective (more so than consumers who reside in rural areas) due to the ongoing large expansion of supermarkets in urban environments (See, 2016).

3.2.2 Sampling

3.2.2.1 Inclusion criteria

Inclusion criteria for respondents to have been able to participate in this study were as follows:

1) Specific inclusion criteria for this study, respondents:

- Had to be 18 years and older, in order for them to have given informed consent to participate in the study;
- Had to be permanent residents within the Johannesburg municipal area as it was the focus area of the study as outlined in section 3.2.1;
- Had to have finished schooling, thus achieved a minimum education level of Grade 12 or above. Respondents completed the survey online (thus independently, without the presence and support of an interviewer) which required a good level of comprehension of terms and

definitions. The completion of formal schooling where English is a compulsory subject thus improved the respondents' comprehension level;

- Should have consumed chocolate at least once in the past year in order to have a level of familiarity with the product category to be considered a chocolate consumer;
- Should not overtly have disliked chocolate as this would have skewed the results of the study (and to exclude non-users from the study); and
- Should have had access to the internet (via a desktop computer, laptop computer, tablet or smartphone) as the survey was completed through the web-based research platform, SurveyMonkey (www.surveymonkey.com).

2) Criteria for sensory evaluation which ensured that respondents were not limited in any way to experience and report on the sensory properties of foods were that they had to:

- Be non-smokers, as smoking significantly increases the risk of impairment of olfactory and gustatory functioning during the sensory evaluation of food products (Vennemann *et al.*, 2008);
- Have no allergies or sensitivities to the ingredients of chocolate (such as lactose intolerance, palm kernel allergy or sensitivity to artificial sweeteners) as allergic consumers were excluded from the study for safety reasons (these ingredients were listed in the screening questionnaire);
- Have no specific dietary requirements (such as vegan, banting, low glycemic index, diabetic diet, etc.) which the final list of products to be assessed could not accommodate. Products, for example, had high sugar content and were thus not suitable to be consumed by people with diabetes. Similarly, those following a banting diet and who exclude carbohydrates from their diet could not participate;
- Not have been taking medication during the time of the study, as numerous drugs have the potential to adversely impact a patient's sense of taste, either by decreasing function or producing perceptual distortions even or phantom tastes (Doty *et al.*, 2008); and
- Not have been suffering from any oral diseases as these can impact chemosensory functioning, i.e., the ability to taste is disturbed due to an impact on the transduction mechanisms which enable taste (Ship, 1999) or be wearing dentures which impact the ability to assess for example product texture (Yven *et al.*, 2005).

3) Furthermore, in order to assess familiarity through food frequency (refer to Appendix U), four sets of respondents were recruited based on the application of a previously validated quantitative food frequency questionnaire (QFFQ) (Labadarios *et al.*, 2005):

- Group 1: Daily users: measured by recording usage as “daily”;
- Group 2: Weekly users: measured by recording usage as “weekly”;
- Group 3: Monthly users: measured by recording usage as “monthly”; and
- Group 4: Rarely: measured by recording usage as “once a year/rarely”. A food consumed less often than once a month but at least once a year was marked as ‘seldom’ in the QFFQ and for the purposes of this study was indicated as “once a year” in the questionnaire.

3.2.2.2 Sampling technique

A sample of the population was used due to it being impossible to reach the entire population of adult consumers. This study implemented non-probability sampling as it is a technique where samples are gathered in a process that does not give all individuals in the population equal chances of being selected (Etikan *et al.*, 2016). As “commercial” emotion research is different from academic emotion research involving products, selecting consumers randomly or by convenience rather than from product use would result in the consumer group containing both users and non-users. As a result, the emotional profiles obtained would contain different levels of positive and negative emotions (King & Meiselman, 2010) and it would not be possible to differentiate between the two and assess the impact of other variables such as mood, familiarity, acceptability or attitude on the emotional response.

Therefore, purposive sampling was applied. Purposive sampling techniques may be defined as selecting information-rich cases (Palinkas *et al.*, 2015), e.g., individuals, groups of individuals, or institutions, based on specific objectives associated with answering a research study’s questions (Teddle & Yu, 2007), or phenomenon of interest. The specific type of purposive sampling which was applied was that of sampling to achieve comparability aimed at delivering different types of cases of a dimension that is of interest (Teddle & Yu, 2007), known as homogeneous sampling. Homogeneous sampling is a purposive sampling technique which aims to achieve a homogeneous sample, that is a sample whose units (e.g., people, cases, etc.) share the same or very similar characteristics (Etikan *et al.*, 2016), (e.g., a group of people that are similar in terms of age, gender, background, occupation, etc.). By achieving a homogenous sample for this study, there is a higher likelihood of delivering internal consistency and data

reliability which is required to indicate the relationships and significance of the relationships of the various concepts. Thus, the aim was not to achieve a sample representative of the population but rather a homogenous group that could deliver internally valid results.

3.2.2.3 Sampling frame

A university was identified as a recruitment ground, as university students would most likely comply with the basic inclusion criteria of the study (be above 18 years of age and have at minimum a matric qualification). Universities are also diverse from a race and gender perspective. Furthermore, the study required involvement from a participating institution in the various stages (i.e. permission to place notices on notice boards, making rooms and halls available for information sessions and for sample collection) as well as access to members of the organisation to act as gatekeepers. Universities were also expected to be more willing to offer the opportunity to others to participate in a research study.

Based on the specific criteria of residing in the Johannesburg municipal area, a shortlist was prepared of universities in this area. The various universities were then described and ranked in terms of being able to fulfil against the extended inclusion criteria (see Section 3.2.2.1). The University of the Witwatersrand (WITS) Business School was identified as an ideal recruitment ground for various reasons such as:

- A homogenous group that can deliver internally valid results;
- This specific student group is in addition to race and age also diverse in terms of working status and working professions and is likely to be of higher income;
- Students are accessible for information sessions, and sample collections and the institution was willing to support this research study;
- The added benefit of respondent maturity and calibre to be involved in a complex study; and lastly
- This institution could act as a gateway to the residents of Johannesburg with an on average higher level of literacy as students of this institution are enrolled in post-graduate studies.

A homogenous sample was achieved by, based on the inclusion criteria of the study, inviting PDM (Postgraduate Diploma in Management), MAP (Management Advancement Programme) and MBA (Master of Business Administration) students from the WITS Business School,

Parktown, Johannesburg, South Africa, to participate in the study after approval (Appendix C) had been obtained from decision-makers at WITS Business School.

3.2.2.4 Sample size

For this study, a large sample was required in terms of collecting accurate data to estimate the characteristics of the target population (Pietersen & Maree, 2007) and to provide statistically significant results (Delpont *et al.*, 2011). Because this was not a random sample, but a survey including consumers specifically engaged for their consumption frequency of chocolate, recruited into four different sub-segments (a minimum sample size of 50 respondents per sub-segment would be required to conduct data analysis), 200 completed questionnaires were recommended according to the Statistical Consultation Services of the North-West University. In anticipation of incomplete questionnaires, the recruitment target was set at 220 respondents, 10% higher than recommended. In order to recruit 220 respondents to the study, six information sessions were held on the campus of the WITS Business School (refer to Section 3.3.2). Approximately 350 students in total attended these sessions.

While the recruitment target for this study was 220 respondents or 55 per sub-segment, the final number of fully completed questionnaires received was only 149. While 301 students added their e-mail addresses to the list of interested students, 261 students provided electronic consent, 185 students were successfully screened, and 171 students responded to the request to collect chocolate sample packs, only 149 students completed the full survey (all questions answered, as others only completed some of the early questionnaire sections and did not complete the full survey).

Recruiting and retaining respondents for this study proved to be a difficult task. Firstly, the exclusion criteria meant that many students were unable to participate. Secondly, participation in the study was complex and time-consuming, spanning a few weeks with various stages of participation (Figure 3.1). It required a lot of time allocation to the study as well as willingness to complete all the various stages (consent, screening, parcel collection, survey). This was potentially too time-consuming for some students, many who were also working. Many respondents also did not progress from one stage of the study to the next. Thirdly, some students did start the survey but ended up not completing it as it was rather lengthy.

The 149 responses were, however, sufficient for data analysis to be performed in line with the original study plan for all but one study element - familiarity - which is the variable that dictated the recruitment target of 200 respondents in order to divide the respondents into four equal usage sub-segments of 50 respondents each. The remaining research study elements namely sensory attributes, emotional response, mood, acceptability and attitude required a minimum sample size of 50 for data analysis (de Winter, 2009) which was achieved. This is the absolute minimum that can yield statistically valid results and is needed for correlation (VanVoorhis & Morgan, 2007) and factor analysis (Pedhazur & Schmelkin, 2013) to be conducted. As outlined in Table 3.1, only the monthly consumption sub-segment contained the minimum required 50 respondents, while the daily, weekly and annual sub-segments included fewer than 50 respondents.

Table 3.1: Recruitment results of the study

Usage frequency	Number of respondents recruited by familiarity sub-segment
Daily	9
Weekly	30
Monthly	76
Rarely/once a year	34
TOTAL	149

As insufficient responses were collected for the daily, weekly and annual usage sub-segment of the overall chocolate consumption frequency element (for the familiarity variable) when the consumer sample was exhausted (as indicated in Table 3.1), data analysis could not proceed as planned based on the four sub-segments. The chocolate type consumption frequency data set was thus identified as an additional data set which could be considered in addition to overall chocolate consumption frequency to complement the dataset and analysis. In order to proceed with data analysis for this variable including both sets of data, the relationship between all the collected familiarity data sub-sets had to be determined to conclude on the underlying relationships in order to proceed with analysis as set out in the objectives of the study. Through the calculation of Spearman's rank order correlations (r), the relationship between the overall chocolate consumption frequency and the consumption frequency of the various chocolate types was determined, as the r -value quantifies the correlations between predicted values and

observed variables. Interpretation of the Spearman's rank order correlations is based on Cohen's guidelines (1977) where $r=0-r<0.3$ is viewed as small, $r\geq 0.3-r<0.5$ as moderate, and $r\geq 0.5$ as strong. It was found that the overall frequency of chocolate consumption showed a medium correlation with the consumption of Milk chocolate Tablets ($r=0.332$) which is the focus product of the study, as well as (but to a lesser degree) Countlines ($r=0.329$) and Filled tablets ($r=0.320$). Thus, further data analysis on familiarity included both overall consumption frequency and consumption frequency of Milk chocolate (as indicated in Table 3.2) to ensure reliability.

Table 3.2: Comparison between general and milk chocolate tablet consumption frequencies

Usage frequency	Number of respondents recruited for general chocolate consumption	Frequency of milk chocolate tablet consumption
Daily	9	9
Weekly	30	30
Monthly	76	58
Rarely/once a year	34	49
TOTAL	149	146

3.2.3 Selection of chocolate as the focus product of the study

Chocolate was chosen as a product for exploration in the present study because based on a review of the literature regarding the sensory properties and emotions, moods and attitudes related to chocolate, it appears to be a more complex food type (Wang *et al.*, 2017; Schouteten *et al.*, 2018; Tuentner *et al.*, 2018; Velarde *et al.*, 2018). This makes it well-positioned to provide insight into the various areas that would be investigated. Chocolate has also been studied by many researchers and tools from these to apply in similar studies have also been published by such researchers (Viaene & Januszewska, 1997; Ziegler *et al.*, 2001; Sune *et al.*, 2002; Golob *et al.*, 2004; Lasekan *et al.*, 2007; de Melo *et al.*, 2009; Kennedy & Heymann, 2009; Nightingale, 2009; Thamke *et al.*, 2009; Thomson *et al.*, 2010; Leite *et al.*, 2013; Norhayati & Ayob, 2014).

Chocolate has been classified as an emotional product, as affective states appear to be closely linked with chocolate consumption both as precursors and consequences (Macht & Mueller,

2007), and based on this it has been the subject of various studies (Macht & Dettmer, 2006; Macht & Mueller, 2007). It is the most frequently craved food (Hill & Heaton-Brown, 1994; Meule & Hormes, 2015), tastes good (Chiva, 1999) and may even be beneficial for health (Serafini *et al.*, 2003). It is a product which has the potential to arouse sensory pleasure, hence result in positive emotions (Macht & Dettmer, 2006), and is often consumed when people are feeling depressed (Macdiarmid & Hetherington, 1995; Willner *et al.*, 1998; Wansink *et al.*, 2003). It has been found to increase activation, reduce fatigue, elevate mood and evoke joy (Macht & Mueller, 2007). However, there have been studies which also found that chocolate is associated with negative emotions, particularly that of guilt (Macdiarmid & Hetherington, 1995), which may be induced by cognitions based on cultural and societal determined attitudes to health and body weight (Macht *et al.*, 2003). Different unbranded chocolate products have also been found to yield different emotional profiles (Thomson *et al.*, 2010).

Various objectives were set for the product to be the focus of the study, and chocolate was evaluated against these objectives for its ability to deliver against the primary research question that is stated for this study:

1. Emotional products are to be included to ensure that the maximum number of emotions are evoked. *Chocolate has been reported by various researchers to be a highly emotional product and various historical studies which have been conducted have resulted in extensive emotion lists being used to describe it* (Macht & Mueller, 2007).
2. More complex products should be included in order to uncover relationships, thus providing a high number of sensory properties as well as emotional responses to measure. *Based on a review of the literature of sensory properties and emotions that have been reported for chocolate, the product can be viewed as complex* (Macht & Mueller, 2007; Merkus, 2014).
3. Due to the limitation in the number of samples that can be presented to respondents, only a few samples must stretch the sensory parameters of the study. *Within the chocolate category in South Africa, multiple options can be evaluated for inclusion in the study as outlined later in this section, which includes both locally produced and imported chocolate, and the most varied ones can be selected.*
4. A product which already has widespread utilisation and thus has existing attitudes, behaviours and conceptualisations and varying levels of familiarity which respondents could easily access. *Based on published results, it is very widely consumed. InsightSurvey (2016) reported a per capita consumption of 1.3kg in 2015 in South Africa.*

5. A product category which generally does not have an overwhelming health, functional or convenience positioning or consumer perception locally, as this would evoke emotions which are specific to such positioning and would limit the future application of methodologies or results of the study. *The majority of local chocolate manufacturers position chocolate as an everyday luxury. Exceptions are for example Canderel chocolate, but this has a small consumer base and is probably consumed mainly by people with diabetes and should not impact the current consumer perception of the category.*
6. A product for which there are varying usage habits and for which consumers could thus be easily recruited for the various usage sub-segments. *Chocolate is frequently consumed by some but less so by others for financial or health reasons, or as consumers prefer other snacking options.*
7. A product that has not been reported to evoke mainly positive or negative emotions in order to investigate a wide range of emotions and to be able to link these to various sensory properties. *Chocolate has been reported to evoke both positive and negative emotions (Macdiarmid & Hetherington, 1995; Macht & Mueller, 2007).*
8. A product which has been studied by others and for which tools may be available to apply in this study. *Chocolate has been studied by many researchers and some tools to study the product with and results of their studies have been published by the researchers (Viaene & Januszewska, 1997; Ziegler et al., 2001; Sune et al., 2002; Golob et al., 2004; Lasekan et al., 2007; de Melo et al., 2009; Kennedy & Heymann, 2009; Nightingale, 2009; Thamke et al., 2009; Thomson et al., 2010; Leite et al., 2013; Norhayati & Ayob, 2014).*

To ensure that variability in chocolate type did not influence respondents and impact results, only Milk chocolate in tablet format was selected for the study, as it is the most popular format in South Africa (Research, 2011) and Plain milk chocolate is preferred to Dark chocolate (Ronquest-Ross et al., 2015). As a consumer-centric study, the aim was to include actual products available in the retail space to capture real responses to products that have a level of familiarity, and thus no model foods were included. Major South African retail stores (Shoprite, Checkers, Pick 'n Pay, Spar, Woolworths, Clicks and Dischem) were surveyed and a list was prepared of the Milk chocolate brands in tablet format most often found in these stores. Twelve products were identified and were selected for inclusion in the study. These were *Beacon* Milk Chocolate, *Belgian Harvest* Milk Chocolate, *Cadbury Dairy Milk* Chocolate, *Canderel* Milk Chocolate, *Clicks Smartbite* Milk Chocolate, *Cote D'Or* Milk Chocolate, *Lindt Extra Creamy* Milk

Chocolate, *Lindt* Swiss Classic Milk Chocolate, *Milka* Milk Chocolate, *Nestlé* Milk Chocolate, *Wawel* Milk Chocolate, and *Woolworths Organic* Milk Chocolate.

3.3 DATA COLLECTION AND ANALYSIS

3.3.1 Preparation of research materials

3.3.1.1 Preparation of the list of sensory descriptors for chocolate

Varela and Ares (2012) stated that sensory terms could be selected for studies by reviewing results from previous qualitative or quantitative consumer studies, and this approach was applied for this study. As a starting point, a list of sensory descriptors for chocolate was compiled by reviewing the sensory descriptor lists generated in 13 different studies focusing on chocolate (Viaene & Januszezwska, 1997; Ziegler *et al.*, 2001; Sune *et al.*, 2002; Golob *et al.*, 2004; Lasekan *et al.*, 2007; de Melo *et al.*, 2009; Kennedy & Heymann, 2009; Nightingale, 2009; Thamke *et al.*, 2009; Thomson *et al.*, 2010; Leite *et al.*, 2013; Norhayati & Ayob, 2014), of which four were prepared with consumer panellists and nine with trained panellists (one study reported the results of two separate studies). These studies spanned ten countries (Austria, Belgium, France, Germany, Malaysia, Nigeria, Poland, Slovenia, United Kingdom and the United States of America) and included various chocolate product types (Dark chocolate, Milk chocolate, Kids chocolate bars, Artificially sweetened chocolate and Prebiotic chocolates). In addition, the Blommer chocolate wheel of flavour was also consulted (BlommerChocolateCompany, 2009).

The process below was followed to compile the list of sensory descriptors for this project:

- 1) All the sensory descriptors reported in each study were captured in a spreadsheet;
- 2) Descriptors from all the studies were then condensed into a single list, and overlaps were combined (where wording matched precisely);
- 3) Generic terms (such as taste, flavour, texture) were eliminated;
- 4) The number of times the descriptor appeared in this list was then recorded;
- 5) Subsequently, descriptors with a low frequency (less than two reports) were eliminated, except the aroma and aftertaste descriptors as only two of the reviewed studies reported on these sensory categories respectively;
- 6) Definitions were subsequently generated for all descriptors;
- 7) Where an overlap between definitions was noted, descriptors were combined, and where descriptors or definitions were found to be opposing (for example hard and soft), one was selected as the primary descriptor;

8) Descriptors were then grouped under main sections (attributes were grouped according to the categories for sensory properties presented in Singh-Ackbarali and Maharaj (2014), namely appearance, aroma, flavour, texture and mouthfeel, and while Singh-Ackbarali and Maharaj (2014) listed sound as a category, it was excluded from this study as none of the sensory lists of chocolate studies included any sound-related attribute). The aftertaste was also added to the categorisation as some of the descriptor lists which were reviewed included this sensory category;

9) Descriptors were placed in alphabetical order, and lastly,

10) Reference products were identified for each descriptor and were included in the questionnaire.

A trained panel further shortened the list of descriptors (as per Appendix X) for presentation to the consumer respondents (refer to section 3.3.1.3 for detail on the trained panel process). Those attributes that were not applicable to the products evaluated by the trained panel were eliminated for the preparation of the final questionnaire.

3.3.1.2 Ensuring comprehension of sensory descriptors

Defining words mean that others can better understand what is being said and could provide consistency in consumer comprehension and interpretation. Even when questionnaires and descriptors are pre-tested, the verbalisation of sensory properties remains an issue as simple words do not precisely fit with concepts (Giboreau *et al.*, 2007). In order to implement this “untested” sensory descriptor list for chocolate amongst respondents without any prior training in attribute recognition or quantification, the respondents were provided with the sensory descriptor, a definition of the descriptor and reference product names or descriptors. Other research tools have adopted a similar approach. The emotion measurement tool, EmoSemio, works with not only a single adjective but rather a full sentence (Gutjar *et al.*, 2015b) in order to reduce ambiguity (Köster & Mojet, 2015). This approach is also sometimes employed in other study types such as Qualitative Descriptive Analysis (QDA), as descriptors are provided to respondents by the researcher and no training is provided (Varela & Ares, 2012). In some methodologies, assessors' descriptions have been considered as supplementary information in order to better understand the similarities of and variations between products (Lawless *et al.*, 1995; Pagès, 2005; Bécue-Bertaut *et al.*, 2008; Varela & Ares, 2012). Furthermore, definitions of descriptors are commonly used with trained panels, and the method is applied to achieve

concept alignment (Giboreau *et al.*, 2007). It has been proposed that the words used by the assessors to describe the samples could easily be connected to the samples (Varela & Ares, 2012) for the same reason as mentioned above: to improve discrimination.

A review of food sensory science books and research articles highlights the importance of descriptor definitions: *“they serve as a guide for the subjects during testing to minimise confusion over the meaning of each attribute”* and *“linking the attributes with definitions enables the subjects to proceed rapidly and misunderstandings are minimised”* (Stone & Sidel, 2004). Yet, definitions are not systematically provided in published work regarding sensory profiles. Where definitions have been reported (Gãmbaro *et al.*, 2002; Steiner, 2003; Young *et al.*, 2005; Giboreau *et al.*, 2007), these definitions were produced (selected from dictionaries, self-written or taken from other studies and used as is or modified) by the researchers or panels (Giboreau *et al.*, 2007). Some authors reported that definitions are prepared during the training sessions of panellists (Saint-Eve *et al.*, 2004), but there is usually little explanation of the process, and at the time of preparation of this proposal, no guidelines or rules regarding the preparation of definitions of sensory descriptors could be found in academic literature. It seems that individual know-how and experience govern writing, using and reporting of definitions (Giboreau *et al.*, 2007). Thus, for the purposes of this study, a definition of each sensory descriptor was generated through a review of past sensory studies, as well as by consulting dictionaries and finding consumer definitions and interpretations on various websites on the internet. The definitions of the generated descriptors were checked against the list of the basic principles of creating definitions which was created by a lexicographer to ensure correct interpretation by consumers (Landau, 1989). In addition to providing a definition for each descriptor (as indicated), a reference product was also provided when possible, as another linguistic device which can be used is to state a reference to a product, i.e., giving an object example to define the descriptor such as “old butter taste” to define rancid in, for example, dessert creams (Giboreau *et al.*, 2007).

3.3.1.3 Trained panel evaluation of chocolate samples and sensory research questionnaire

When the objective is to assess or measure sensory properties or emotional reactions, it is important that samples presented to respondents stretch the spectrum of the sensory space that is being assessed, or covers the whole emotional space of the product category with no

redundancy (Chaya *et al.*, 2015). In addition, questionnaires and thus sensory descriptors must also be specific to the products being measured, as it has been found that product-specific questionnaires are expected to be more discriminating compared to standardised questionnaires (Ng *et al.*, 2013). Thus, to refine the questionnaire by identifying those sensory descriptors that best describe and differentiate between the various samples and to select the chocolate samples that best represent this differentiation (those which most stretch the sensory spectrum), a trained sensory panel was employed to evaluate the twelve products using the questionnaire designed for the respondents (refer to Appendix Y), thus including the descriptors, definitions and reference products. As no data were available on the emotional response to chocolate in South Africa, it was not possible to evaluate these products to select emotion terms which would describe and differentiate between the samples. Therefore, the objective of working with a trained panel was to refine the list of sensory descriptors and identify the chocolates to be included in the consumer study.

This panel consisted of six people who had all been trained to assess and measure the intensity of the sensory properties of chocolate. They are all employees of Flavour & Fragrance manufacturer, *Firmenich* (www.firmenich.com), a large international supplier to many international and local manufacturers (refer to Appendix D). They had been exposed to multiple food product categories and thus had extensive exposure across categories, and they had received specific training on the chocolate category and more specifically on the products available in South African retail.

The researcher briefed them in July 2017 on the objectives of the overall study and the specific objectives of this portion of the research, which was to gather data to conclude on the presence and intensity of the various sensory properties within each chocolate sample. They were informed that the ultimate objective was to select the most applicable sensory properties to include in the consumer study and to identify the chocolates which would best represent the sensory spread (variation in the intensity of the various sensory properties) for inclusion in the consumer study. They were also informed when the evaluation sessions would take place, how long they would last and warned that they would have to consume a large quantity of chocolate over the period of the study. They were also informed that participating panellists would each receive an R200 Woolworths voucher as an incentive.

Once fully informed, they were then given the option to agree or decline to participate in the study. All (six) the panel members agreed to participate. After the briefing and obtaining their agreement to participate, they received the sensory questionnaire, which was designed for this study, containing all the 49 potential descriptors (please refer to Section 3.3.1.1) to review and ask questions to ensure full comprehension. No alterations were made after the review as all panellists were comfortable with the questionnaire layout and content, and the panel proceeded to evaluate the samples according to this questionnaire.

The panel proceeded to assess 12 chocolate products (as outlined in Section 3.2.3) during August 2017. The evaluation took place over six working days, spanning two weeks for two hours each day as the panel evaluated one sample per hour. Sessions were conducted early morning (10:00) and late afternoon (16:00), at least two hours after the panellists had consumed breakfast and lunch, as testing shortly after meals and coffee breaks may introduce bias and should be avoided (Meilgaard *et al.*, 2006). The sessions were spaced six hours apart also to reduce fatigue during evaluation. Evaluations took place within a sensory evaluation room. Panellists performed the evaluation independently in individual sensory evaluation booths. They consumed bottled mineral water (Nestlé brand) and water biscuits (Carrs brand) as palette cleansers before commencing evaluations.

3.3.1.3.1 Application of data analysis for sensory attribute selection

Data was subsequently captured in and analysed with Excel. Analysis of the data included:

1. Review of panellist performance, including panellist sensitivity, which resulted in the removal of the data of two of the panellists for certain attributes as well as the elimination of three sensory attributes for which only these two panellists recorded measurements for;
2. Determining the relevance of the sensory attributes concerning the chocolate samples evaluated (sensory properties which were not present in all 12 samples were not concluded to be relevant to quantifying the differences between the samples), which resulted in the elimination of a further 11 attributes;
3. Determining the level of discrimination between chocolates which the various sensory descriptors allow for which resulted in the elimination of a further eight attributes (descriptors which allowed for a variation in scores between samples below one for the minimum and maximum score); and

4. Factor analysis to verify that statistically significant relationships exist between the remaining sensory descriptors, which resulted in the removal of a further 11 attributes (as they were not found to be highly correlated to other descriptors).

The evaluation and subsequent data analysis thus resulted in the reduction of the list of sensory attributes from the original compiled list of 49 to 15 which best described and differentiated between the chocolate samples (namely adherence, bitter flavour, bitter aftertaste, burnt flavour, cocoa powder flavour, coffee flavour, creaminess, gloss, melting, milky flavour, mouth-coating, smoothness, sweet aroma, sweet flavour and vanilla flavour - refer to Appendix W for the complete process followed).

3.3.1.3.2 Application of data analysis for chocolate selection

It was also necessary to reduce the number of chocolates for this study as it would not have been possible for respondents to evaluate all 12 chocolates. However, to assess actual food choice in a realistic way, one needs a reasonable number of choice options (Gutjar *et al.*, 2015b).

To select the chocolate products which would be included in the study, the intensity to which the various sensory properties were present in the chocolates were reviewed, as outlined in Appendix W. This was done in order to identify the set of chocolates which would offer the best sensory spread (providing high, average and low ratings of each sensory attribute) for the study. This review of the results of the data analysis resulted in the selection of three chocolates to include in the study namely Canderel Milk Chocolate, Lindt Extra Creamy Milk Chocolate and Nestlé Milk Chocolate (refer to Appendix W).

King *et al.* (2010) recommended that the optimal number of samples per test is two, as this minimises order effects and respondent fatigue. Furthermore, it has been found that the number of terms included in a study which resulted in the identification of significant differences increased alongside an increase in the number of samples included in a study (King *et al.*, 2010). Lagast *et al.* (2017), however, reported after a systematic review of various studies that the number of products evaluated in studies varied widely and found that in the 49 studies reviewed that the number products included for tasting varied between one and 11. Some researchers choose to include many samples and combine those with several precautions to

reduce respondent fatigue, such as offering small portions for each tasting, providing breaks between tests, and performing data checks for potential order effects (Gutjar *et al.*, 2015b).

A computer-assisted self-completion interviewing (CASI) approach (Smith & Kim, 2015) for data collection for this study (refer to section 3.3.1.4) allowed for breaks to be taken to reduce fatigue, and small 20g portions of chocolate were presented to respondents (refer to section 3.6.1). Randomisation of presentation (refer to section 3.6.4) would reduce order effect, thus the risk to include three samples in the study was viewed as minimal.

3.3.1.4 Preparation of the research questionnaire

A questionnaire was compiled specifically for this study, incorporating various existing questionnaires and scales in its original form (some of which were specifically developed for chocolate) and other adapted questionnaires, while other sections were developed by the researcher. Questionnaires can deal with extensive lists of emotions (Meiselman, 2015) as well as other variables. It has been found that product-specific questionnaires are presumed to be more discriminating in comparison to a standardised questionnaire (Ng *et al.*, 2013).

The questionnaire was developed in English as a language generally understood and spoken by most South Africans (Alexander, 2007) as it is the second language of most South Africans and it is the most dominant language used for research in South Africa (Casale & Posel, 2011). It is also the language in which the students at WITS Business School's lectures are conducted. The questionnaire consisted of various sections as indicated in Figure 3.2, which also capture the tools and scales employed in each section, as well as the stage at which each section was presented in the questionnaire.

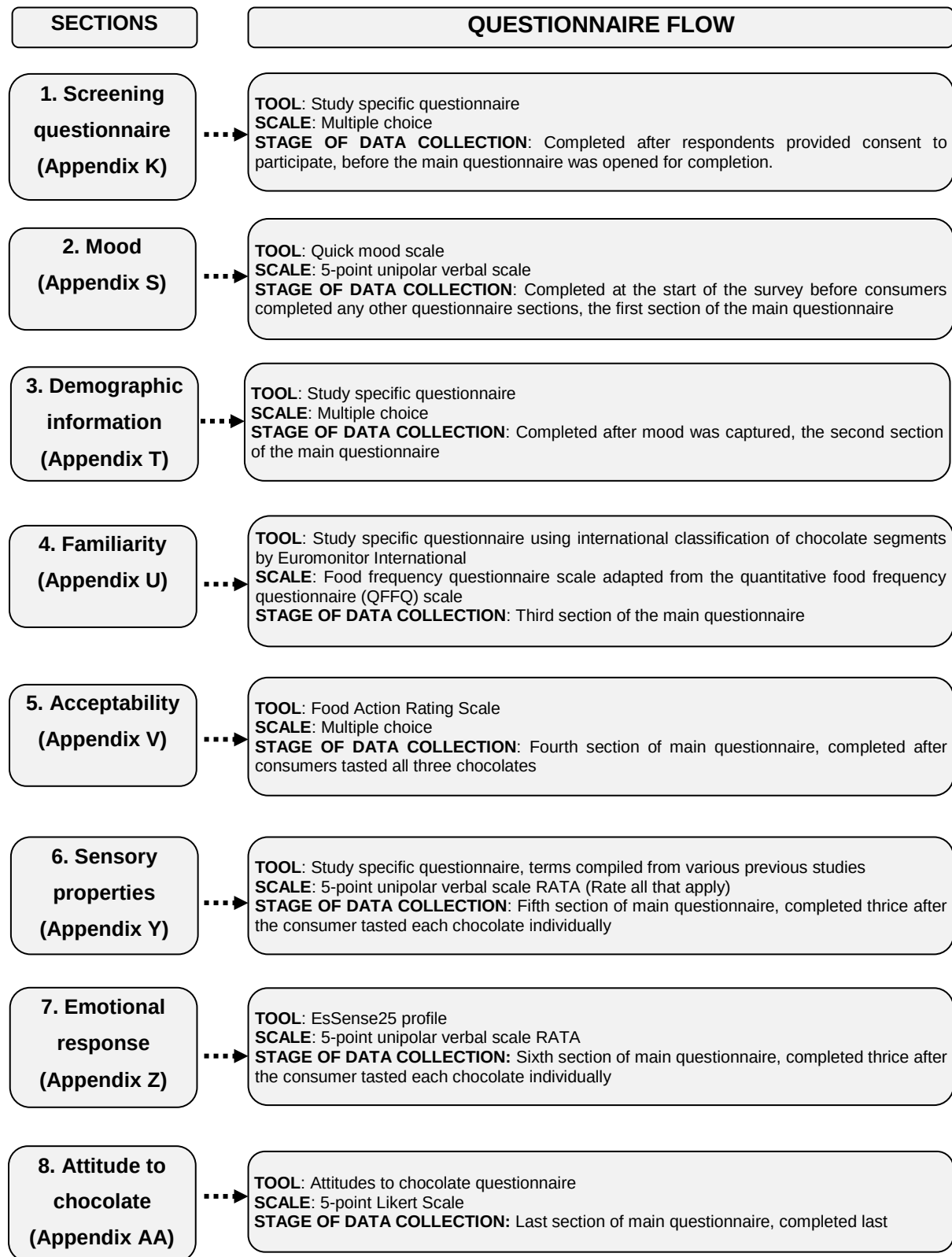


Figure 3.2: Questionnaire sections

It has been recommended that researchers should move away from pen and paper questionnaires to more engaging and interactive data collection methods, such as using smartphones, tablets or applications (Ng & Hort, 2014). The questionnaire in this study was applied as a CASI designed on the Survey Monkey platform (Advantage plan). A comparison of the results of Pen and paper personal interview (PAPI) with CASI found that CASI achieved more complete item response rates than paper and pencil methods (Johnson *et al.*, 2001; Bowling, 2005; Ng & Hort, 2014), which would be beneficial for this study where full completion of each section is required for correlation analysis between the various sections to be completed. It also has the benefit of the immediate recording of the data, and thus through the CASI approach the data was immediately available and there was no need for data capturing. This saved significant time and could improve data accuracy due to the length of the questionnaire of this study. It was also considered that CASI would reduce respondent fatigue by allowing respondents to complete the questionnaire at their own pace and not at the pace of an interviewer, and that it would also allow them to take breaks as needed. CASI also allowed the flexibility to record responses in the respondents' natural setting which is essential for emotion response studies. It allowed for the creation of an evoked chocolate consumption context (as respondents could complete the survey at home in a location and at a time where they would usually consume chocolate) to make the completion of the survey as natural as possible. Furthermore, self-administered questionnaires are best to capture honest emotional response as well as attitudinal questions accurately, as it has been found that sensitive health problems were under-reported in face-to-face or telephonic interviews, compared to self-administered questionnaires (Rhodes *et al.*, 1995; Garcia-Losa *et al.*, 2001). In this study, some of the questions regarding emotion or attitude may have been viewed as sensitive.

The order of presentation of each section in the questionnaire also needs to be carefully considered as one measure could impact another (King *et al.*, 2010). It has, for example, been recommended questions such as overall acceptability should be placed before emotions (King *et al.*, 2010). Liking ratings have also been found to be lower when asked after analytical questions, and thus should be asked first. This has also been interpreted as implying that consumers become more critical only after they have been asked to report on specific sensory properties (Earthy, 1997). Thus, the level of consumer "criticalness" needed when responding to questions was also considered when the questionnaire flow for this study was decided upon.

Furthermore, questions asked early on in questionnaires should also be easy and pleasant to answer, as it would encourage people to continue with the survey (Bethlehem, 2009). Grouping questions also makes it easier to answer and hence responses for all chocolate products to be assessed were grouped together (for example, the liking scales for all the products were presented simultaneously). Difficult and sensitive questions should be left to the end which was the approach for the last section of this questionnaire: consumers' attitude towards chocolate.

3.3.1.4.1 Screening questionnaire

The screening questionnaire (refer to Appendix K) aimed to record the information required to ensure compliance of respondents with the basic participation requirements (see Section 3.2.2) of the study. This included the age of respondents, highest level of education, whether they were regular smokers, had allergies or sensitivities to ingredients in the chocolates, had specific dietary requirements, whether they were at that point taking any medication, if they suffered from gum disease or wore dentures, how regularly they consumed chocolate and whether they disliked chocolate.

3.3.1.4.2 Main study questionnaire

Various studies have been conducted to explore the sensory properties of foods with both trained and consumer panels. They have applied various methodologies, tools and scales and have focused on a variety of different products (Labbe *et al.*, 2009; Worch *et al.*, 2010; Leite *et al.*, 2013; Agudelo *et al.*, 2015). Similarly, various studies have been conducted investigating the emotional response to food, and some studies have considered both sensory properties and emotions in their design (King *et al.*, 2010; King *et al.*, 2013; Dalenberg *et al.*, 2014; Mojet *et al.*, 2015). As none of these studies included a significant consumer behaviour angle, a study-specific questionnaire was designed to incorporate all the various concepts being investigated. The following section outlines the tools and scales that were selected for this study and the justification for each (refer to Figure 3.2).

Questionnaire section A: Mood of respondent

In order to assess the mood of the respondents, the Quick Mood Scale with a five-point unipolar verbal scale which was developed in a clinical setting (Woodruffe-Peacock *et al.*, 1998) was applied without any changes or adjustments. It consists of twelve adjectives which are the positive and negative of six dimensions, namely wide awake and drowsy, relaxed and anxious,

cheerful and depressed, friendly and aggressive, well-coordinated and clumsy, and clear-headed and confused. Although Cronbach's Alpha's were not calculated and reported by the researchers who developed this tool, their study compared this tool to an alternative at the time (the Profile of Mood States) and found significantly lower standard deviations across the various attributes (ranging between $SD=1.12$ and $SD=1.51$ for the Quick Mood Scale compared to $SD=5.03$ and $SD=8.17$ for the Profile of Mood States). A lower standard deviation value indicates that the data points tend to be closer to the mean and there was thus lower variability in the answers of the respondents (Field, 2009) when the Quick Mood Scale was used. The researchers reported that mood changed for every assessment conducted and every respondent group assessed with this tool, and thus it was not possible to statistically capture the reliability of the tool and the scales applied. Furthermore, the objectives for the development of the scale were, however, verified, which were that they had to be quick to administer and to score, had to be sensitive to changes in moods in order to capture these, and had to be acceptable to subjects. Respondents' mood was captured first before any other information was required from them in order not to alter their mood and to capture their true feelings at the start of the survey (Woodruffe-Peacock *et al.*, 1998) (refer to Appendix S).

Questionnaire section B: Demographic information

Basic demographic information was then gathered using a structured questionnaire as part of the main research questionnaire (refer to Appendix T). It was recorded early on during the survey as standard practice in research as not to influence the answers to subsequent questions. It was done, however, after respondent mood had been recorded. Drummond *et al.* (2008) found that placing demographic questions at the beginning of a survey increased the response rate for these questions and did not affect the response rate for the non-demographic questions which follow, and as demographics are an important part of data analysis (Gilovich *et al.*, 2010), these questions should be placed at the beginning of the survey. The variables of respondents which were recorded included gender (male and female), ethnicity (Black, Caucasian, Coloured, Indian or Asian), age bracket of respondents and the highest level of education achieved, as these are relevant to either emotion studies or studies in a South African context. These variables were, however, not incorporated into the data analysis of this study but were recorded for potential further analysis and reporting of the data after this specific study had been completed. This information was, however, used to describe the sample in terms of frequency distributions (refer to Appendix AB).

Questionnaire section C: Familiarity

Familiarity was assessed as per the approach of the QFFQ of Labadarios *et al.* (2005) to the indicate frequency of consumption, while the international classification of chocolate segments by EuromonitorInternational (2012) was applied to list the various segments and sub-segments of the category (Appendix U). The scale of the QFFQ was, however, applied with the following variations:

- a) The “seldom” section was labelled as “once a year/rarely”; and
- b) An option for “never” was included to record usage within specific sub-segments of the chocolate category.

As this portion of the questionnaire was created for this study, the internal consistency of the ten predictors and two factors that determined respondents’ familiarity with the chocolate category was measured using Cronbach’s Alpha coefficient, with $\alpha < 0.6$ viewed as poor, and $\alpha \geq 0.6$ viewed as questionable but acceptable (Hair, 2006). In this study, $\alpha \geq 0.5$ was thus viewed accepted with caution, $\alpha \geq 0.7$ as acceptable, and $\alpha \geq 0.8$ as good. All the constructs indicated acceptable scores for the total population ($\alpha \geq 0.7$). Table 3.3 provides information on the items’ internal consistency analyses.

Table 3.3: Internal consistency of familiarity data

Items	Cronbach's Alpha (α)	Reference
1. Small chocolates	0.772	Hair (2006)
Alfajores		
Bagged selflines/softlines		
Standard boxed assortments		
Twist wrapped miniatures		
Chocolates with toys		
Seasonal chocolate		
2. Large chocolates	0.718	Hair (2006)
Countlines		
Filled tablets		
Plain milk tablets		
Plain white tablets		

Questionnaire section D: Acceptability

Acceptability was the first section presented to the respondents once they had tasted the samples (refer to Appendix V). Many sensory researchers have investigated the impact of asking preference before or after attribute (sensory attribute) questions in a consumer questionnaire. As a result of the findings of such studies, overall liking or acceptability questions are usually asked first in advance of attribute (sensory property) questions, as question order has been found to be influential in product acceptance and preference tests (Popper *et al.*, 2004).

The Food Action Rating Scale (FACT) was utilised without any changes or modifications to capture consumers' perceived product acceptability, as it is a behaviourally or action-oriented approach to the scaling of food acceptability devised by Schutz (1965). It was successfully applied as recently as 2013 by Tan and Mattes (2013), and reliability tests using the scale showed that the scale yields highly reliable results. The scale was constructed through psychological scaling techniques and was developed based on attitudes and actions. It includes nine statements which represent different behavioural options regarding the frequency of consumption as well as motivationally related statements. It was applied and measured with a multiple-choice scale in this study. Although Cronbach's Alpha's were not reported, the FACT scale means was found to be highly correlated with hedonic scale means and thus has been recommended as an additional tool to measure overall food acceptance (Schutz, 1965).

Questionnaire section E: Sensory properties

After food acceptability, the response to the sensory properties (adherence, bitter flavour, bitter aftertaste, burnt flavour, cocoa powder flavour, coffee flavour, creaminess, gloss, melting, milky flavour, mouth-coating, smoothness, sweet aroma, sweet flavour and vanilla flavour) was recorded (refer to Appendix Y), as actual consumption is the basis for respondents to report their emotional response in the following questionnaire section. Thus, the product was tasted and evaluated, and through this section, the respondent developed an 'analytical' mind-set to prepare them to respond to the emotion-related questions. After the first product was tasted, the sensory properties questionnaire was completed, and the emotional response questionnaire was completed afterwards for the same product. This was then repeated for product two and product three.

The RATA measurement tool (a variation of CATA) was applied to record respondent responses. It was recently designed to measure the presence and intensity of sensory properties of food products. RATA is focused on intensity and is useful for in-depth characterisation (Meiselman, 2015), and is thus a more suitable technique in certain instances compared to CATA, especially when the intensity of terms is the main difference (Schouteten *et al.*, 2015), as these questions make it possible to obtain reliable scores for the intensity of sensory properties (Husson *et al.*, 2001; Worch *et al.*, 2010; Ares *et al.*, 2011). As respondents are asked not only to select but also rate all the words from a list that apply to the product being evaluated, RATA is likely to trigger a more analytical mind-set in respondents. RATA does, however, often lead to lower responses compared to other techniques due to the intense focus it requires from respondents (Schouteten *et al.*, 2015). A significant benefit of RATA is that it does not lead to consumer bias when performing simultaneous hedonic evaluation (Jaeger & Ares, 2015); it improves hedonic discrimination between samples (Ares *et al.*, 2014; Jaeger *et al.*, 2015) and opens up more opportunities for statistical analysis (Ng, 2013). RATA questions have the advantage of using a similar approach to CATA questions and therefore, also enable quick and easy data collection from large consumer samples (Schouteten *et al.*, 2015). RATA was employed to measure the intensity of sensory properties using a 5-point unipolar verbal scale based on reasons as mentioned above.

Questionnaire section F: Emotional response

Emotional response was recorded after sensory properties (refer to Appendix Z) as the emotional response to food is often based on the sensory qualities of a single taste (Gibson, 2006), and intrinsic sensory properties have a strong association with emotions (Ng *et al.*, 2013). In 2015, the EsSense questionnaire was reported to be the most commonly used format within food research (Schouteten *et al.*, 2015). EsSense measures 39 emotions via self-reported intensity scores on a five-point scale (1=Not at all, 2=Slightly, 3=Moderately, 4=Very, 5=Extremely) (King *et al.*, 2010; Dalenberg *et al.*, 2014), and measures the short and relatively intense response to products (King *et al.*, 2010). The emotion terms which it contains were derived from pre-existing affective questionnaires (Chaya *et al.*, 2015), specifically from published literature and consumer input derived from ten different studies (King *et al.*, 2010). It was also created with considerable consumer input during the development process (Chaya *et al.*, 2015). It contains mainly positive emotion terms (Dalenberg *et al.*, 2014) as only three among the 39 emotions are negative, namely, bored, disgusted and worried (King *et al.*, 2010).

King *et al.* (2010) stated that it also contains a group of emotions that is not clearly labelled as positive or negative, as the meanings of those emotions vary within context.

The EsSense questionnaire was validated to measure food emotions and was subjected to methodological research by various researchers (King *et al.*, 2010; Cardello *et al.*, 2012; Jaeger *et al.*, 2013a; King *et al.*, 2013; Ng *et al.*, 2013). It has also been applied to chocolate research studies with great success. In a study conducted by Cardello *et al.* (2012) which included chocolate as one of the products assessed, the emotion ratings obtained in repeated tests without evoked contexts (creation of or imagining a specific consumption setting) were highly correlated, and therefore the EsSense tool was deemed stable to measure emotional response to chocolate, with Cronbach's Alpha's ranging between $\alpha=0.50$ to $\alpha=0.77$. This tool was further validated in chocolate studies by various researchers such as Schouteten *et al.* (2014) who applied it to explore the texture of chocolate. Jaeger and Hedderley (2013) explored individual differences in emotion intensity, and Dorado *et al.* (2016) assessed first position effect.

This study implemented the EsSense25 Profile to measure emotional response (King & Meiselman, 2010), a reduced term version of the original EsSense Profile which facilitates tasks when certain constraints limit the ability to apply a full EsSense Profile (Nestrud *et al.*, 2016). Considering the length of the overall study questionnaire and the complexity of completing emotion questionnaires, the EsSense25 emotion list was applied, which is shorter and thus faster and easier to complete. The EsSense25 list was validated and was assessed against the original EsSense list of 39 descriptors by Nestrud *et al.* (2016) which was, in fact, performed by measuring the response to chocolate by consumers. The overall finding was that both lists performed similarly. Other benefits of the EsSense25 Profile include that the retained words in the shorter list have a more distinct meaning, because there are fewer words with similar meanings in the shortened list (Nestrud *et al.*, 2016), and the balance between positive and negative words is also more optimal as primarily positive words have been removed. The EsSense25 profile contains the following emotion terms:

- a) Positive (16 terms): Active, adventurous, calm, enthusiastic, free, good, good-natured, happy, interested, joyful, loving, nostalgic, pleasant, satisfied, secure and warm;
- b) Negative (3 terms): Bored, disgusted, worried; and
- c) Uncategorised (6 terms): Aggressive, guilty, mild, tame, understanding, wild.

The scale recommended for use along with the EsSense profile (Nestrud *et al.*, 2016) is a 5-point rating scale (also a unipolar verbal scale). However, as per the recommendation of Thomson *et al.* (2010), when the same or similar scales are used to measure emotion and sensory properties, the RATA approach was used for the sensory and emotion measurement sections in the questionnaire as well as to measure the intensity of the emotional response.

As both the sensory and emotion questionnaires contained long lists of descriptors or terms for respondents to assess, the order of these descriptors was carefully considered. Attribute order has been identified as an area of concern as it may potentially bias respondents' responses. Several studies have used alphabetical listing (King & Meiselman, 2010; De Pelsmaecker *et al.*, 2013; Jaeger *et al.*, 2013b; Reinbach *et al.*, 2014), as it has been indicated to facilitate response and reduce respondent fatigue (King *et al.*, 2013). King *et al.* (2013) reported that emotions, presented in a randomised order in an emotion list order, have been found to affect consumer responses. Thus, the emotion and sensory terms included in this survey were presented in alphabetical order.

Questionnaire section G: Attitude

Attitude was measured last by using the attitudes to chocolate questionnaire (ACQ) (refer to Appendix AA) without any changes or modifications (Benton *et al.* (1998). This was also measured using a 5-point Likert scale ranging from 1=Strongly disagree to 5=Strongly agree. To improve the knowledge on the causes and consequences of chocolate consumption, Benton *et al.* (1998) developed this questionnaire as a measurement tool to assess chocolate craving, negative feelings and guilt when consuming chocolate, and as a functional approach to measuring chocolate eating (Müller *et al.*, 2008). It highlighted the existence of three distinct clusters of emotions or factors underlying the preference for and use of chocolate, that of a) Craving, which is seeking comfort from chocolate under emotionally stressful conditions; b) Guilt, associated with dissatisfaction with weight and body image; and c) A functional cluster, which is for example where chocolate is consumed for its energy giving properties. This questionnaire was applied by the author (Van Gucht *et al.*, 2014) and was reported to yield valid results, although the Cronbach's Alpha scores of this study were not reported.

This questionnaire contains 24 statements which were reduced from an initial list of 80 statements recorded in exploratory interviews and subsequently subjected to factor analysis.

The order in which the statements were presented was as proposed by Van Gucht *et al.* (2014). However, one amendment was made to statement 15 where the calorific value was changed to kilojoule value which is the known term in South Africa for how much energy people obtain from consuming a food or drink. Consumer attitude was recorded after emotional response, as not to influence the response to those questions because the emotion section relates to the primary objective of this study. As attitude has an evaluative component (Aikman & Crites, 2007), it also benefitted the measurement of this section to include it last as the tasting of the product and the process of reporting on emotional response could bring to the fore conceptualisations that are triggered by an object (Thomson *et al.*, 2010), which made it easier for respondents to report on their attitude towards the product.

3.3.1.5 Pre-testing and finalising the questionnaire

Ten of the successfully screened students were invited to participate in the pre-test via e-mail a week after the database of successfully screened respondents had been prepared. They were invited to meet at the campus cafeteria of the WITS Business School campus on a Saturday morning at 08:00 and were briefed on the objective of the pre-test. While they were provided with the same information and information sheets (within the sample pack) as the respondents in the actual study would receive in order to simulate the study which will be taking place, they were requested to focus and provide feedback on specific elements while completing the survey, including to 1) Record words or phrases that they do not understand; 2) Point out any instructions that may be unclear during the survey; 3) Record how many blocks of each chocolate they consumed; 4) Indicate the level of fatigue they experienced after completing the survey; and 5) Indicate whether they took any breaks, and if so, the length of each.

They were given sample packs which were prepared as per the steps outlined in Sections 3.3.3.1 and 3.3.3.2. The link to the electronic survey (refer to Appendix R) was then sent to them via e-mail. They were asked to send an e-mail to the study e-mail address with their feedback as soon as they had completed the questionnaire. Survey Monkey recorded time taken to complete the questionnaire. Once all the feedback was received and reviewed, specific changes were made to the questionnaire and other research materials. The sensory descriptor “smoothness” was removed from the questionnaire as respondents reported that it had the same meaning as “creaminess”. Changes were made to the instructions of when and how much chocolate should be consumed when completing the survey, as some respondents

indicated that they had consumed all their chocolate before completing all the sections. The pre-test also determined that: 1) Each respondent should be provided with 20g of each chocolate to answer all questions; 2) The maximum time taken to complete the survey was 34 minutes; and 3) The respondents had to be supplied with a printout of all the scales used, as the SurveyMonkey website did not freeze the scales at the top of the screen during a question, which resulted in the scales disappearing from the top of the screen when respondents scrolled down to the bottom of each page.

3.3.2 Recruitment of respondents

Recruitment commenced upon ethical approval (refer to section 3.5.1). Firstly, advertisement posters were designed and placed on various notice boards on the campus of the WITS Business School to inform students that the study would take place, and should they be interested in participating, that information sessions would be held, stipulating the date, time and location of these sessions (refer to Appendix G). Secondly, an information pamphlet of the study was designed, which could be handed out to the students to review after the information session (refer to Appendix H).

A briefing session was held the Thursday of the week before the information sessions were to take place (during November 2017) with the gatekeeper to the study and two class representatives who acted as moderators, and who would take turns to be present at the information sessions. The objective of the briefing session was to present a mock presentation of the information session as a pilot run, and the attendees were asked to raise questions in case anything presented was not clear. They also reviewed the prepared information pamphlet and were asked to share feedback on the content. They raised a few minor points which they felt should be further clarified during the information sessions, and based on this, the script for the information session and the information pamphlet was adapted.

Upon this confirmation of what would be presented and shared at the information sessions, the actual information sessions were scheduled and held once a day over six days (Monday-Saturday) to allow for all interested students to attend as some students only visited the campus once a week. These took place at different times each day depending on the class schedule of that day, and they took place in a lecture hall on the campus of the WITS Business School. The sessions were led by the researcher, and one of the moderators for the study was present at

each session. The researcher made a verbal presentation, and the information pamphlet covering all the items discussed was handed out. The session covered: a) Objectives of the study; b) Who was invited to participate; c) The recruitment criteria; d) Expectations of participants; e) What respondents stood to gain from participation; f) Costs of and remuneration for participation; g) Application of and feedback to respondents regarding the findings of the study; h) Confidentiality of respondents; i) Voluntary nature of participation; j) Risks of participation and k) Contact details of the researcher.

Students were offered the opportunity to ask any questions they may have had, and the researcher answered all of those. The questions were furthermore noted, and adapted information was shared in subsequent sessions. The information sessions each lasted approximately 20 minutes. After the information session had been completed, all interested students were asked to write their e-mail addresses on a list provided. They were informed that they would receive an e-mail in the following two weeks with a link to the online consent form (Appendix F) in order to sign it electronically should they still wish to participate, as they would need to agree to the terms of the study. These students were also provided with a hard copy of the consent form to review before they received it for electronic signature.

Approximately two weeks after the respondents had attended the information sessions, an e-mail containing a link to access the consent form online was sent via the SurveyMonkey website through which they could gain access (as an independent party) (refer to Appendix F&I). The consent form contained all the necessary information to ensure that the participant was fully aware of what the study was about, his/her rights as a participant, approximately how long the questionnaire would take to complete, the risks and benefits of taking part in this study, along with the terms and conditions of the incentive vouchers. The participants were also informed that they should take time to consider whether they would like to participate before providing consent to participate in the study. They were further informed that they could contact the researcher should they have any questions during the research process via an e-mail address that was created for the study. They had to read the document and click on a box that indicated that they were providing consent to participate in the study. After they had provided consent, they received an electronic copy of the consent form from the e-mail address created for the study.

The respondents subsequently received a link to the screening questionnaire from the e-mail address created for the study (sent by the researcher), which provided them access to the survey on the Survey Monkey platform. The screening questionnaire instructed the respondents to merely select the correct options for each question and if they did not select the correct option for any of the questions (based on the screening criteria of the study), the survey closed, sending a notification to them thanking them for their interest but indicating that they did not comply with the recruitment criteria of the study. The ingredients contained in the various chocolates were also listed individually to ensure the respondents were not allergic to any of the ingredients. It took on average five minutes to complete the screening questionnaire. Once all consumers who provided consent had completed the screening questionnaire, a list of consumers who complied with all the inclusion criteria of the study was downloaded from the SurveyMonkey website. This list was then used as the respondent list for the study.

3.3.3 Data collection

3.3.3.1 Preparation and presentation of chocolates

Chocolates were purchased on 12 November 2017 from retail stores two weeks before sample pack distribution. Various stores were visited to purchase only products which were manufactured during the prior three months to ensure an equal level of freshness in order to avoid any variation in the respondent experience within each chocolate brand. Five kilograms of each of the three chocolate brands was purchased to allow for a sample size of 20g of each chocolate against the original recruitment target of 220 respondents, with an additional amount included for breakage and wastage. Sample packs were prepared the Monday before distribution and were stored at room temperature (approximately 20°C) in a storeroom at the laboratory where they were packed. All samples and sample packs were prepared and packed in a sterile laboratory environment (at the premises of Firmenich South Africa (<http://www.firmenich.com>) (refer to Appendix D). The laboratory assistants involved in packing the samples wore non-latex gloves and hairnets.

Samples can be presented blind (branded or unbranded), packaged or unpackaged, and can be tasted or not tasted. However, in a study where the EsSense profile was applied, different emotional profiles were indicated for blind taste and packaged taste conditions (Gutjar *et al.*, 2015a). Thus, the same product elicited different emotions based on either the intrinsic (sensory) or extrinsic (brand and packaging) properties (Gutjar *et al.*, 2015a). As the objective

of this study is to measure the emotional response to sensory properties (intrinsic), samples were presented blind and unbranded. Branding was removed by melting the surface of the chocolate with a hot spoon without distorting the surface or shape significantly, and the sample was then cooled down to room temperature (approximately 20°C).

Four blocks (20g) were then packaged in individual small zip-lock plastic bags (4cm x 4cm) and labelled with a three-digit code, and as per the section on preparation of sample packs (section 3.3.3.2), were packed in cooler bags to ensure they remain within room temperature range (15 °C - 25 °C) until consumed. This was repeated for all three samples sequentially, as only one chocolate brand was packed at a time to ensure they would not be mixed up. This took place on Monday, 20 November 2017, one week preceding distribution.

3.3.3.2 Preparation of sample packs

The combination of water and water biscuits was used in this study in order to cleanse the palate between chocolate samples. During the same week during which the chocolates were purchased (between 12 and 19 November 2017), water biscuits (Carrs water biscuits) and bottled mineral water (Nestlé water 330ml unit size) were also purchased to be used as palate cleansers. Respondents were each provided with three water biscuits weighing 8g per biscuit. Thus 24g of biscuits was provided, (one to be consumed before the first, second and third chocolate sample was assessed), sealed in a zip-lock bag, as well as a 330ml bottle of bottled water.

All four zip-lock bags (three containing chocolate and one containing biscuits) were then placed in a cooler bag (dimensions 23(W), 15(L), 17(H)) along with the bottle of mineral water. Storage instructions (as to not compromise sample quality and integrity) (Appendix O), a reminder of questionnaire instructions (such as the use of palate cleansers and the request to complete the questionnaire in one sitting) (Appendix P) and a document capturing the various scales were also included in the bag as three A4 documents (Appendix Q).

Packing of the sample packs took place on Monday, 20 November 2017, before distribution commenced (refer to Appendix N for the illustrated preparation steps of sample pack preparation). The cooler bags were subsequently stored at room temperature (approximately 20°C) until distribution. The cooler bag served as an incentive to respondents.

3.3.3.3 Distribution of sample packs

Approximately two weeks after the respondents had been notified that they had been successfully screened and could participate in the study via the SurveyMonkey message that appeared at the end of the screening questionnaire, the researcher sent out a schedule to all respondents indicating the location, dates and times where they could collect their sample packs on the campus of the WITS Business School (refer to Appendix M). There were again six days (Monday-Saturday) when collection could take place and collection times were based on the various class schedules. The researcher distributed sample packs from the cafeteria on the campus of the WITS Business School from 27 November 2017 – 2 December 2017 from 16:00-17:00 on two of the weekdays and from 13:00-14:00 on the other three, and from 10:00-11:00 on a Saturday morning. Respondents could thus collect their samples when they were on campus. Each sample pack was labelled with the e-mail address of the respondent and was alphabetically ordered in the room and packed on various tables to ensure fast and easy collection. After each pack had been collected, it was crossed out on a list to track collection and to compile a list of respondents to send the next e-mail containing the link to the research questionnaire (refer to Appendix R). This was sent to respondents within 24 hours after collection. The researcher pointed out to the respondents that they needed to read the three documents that were inserted into the cooler bag, and that they had to read the storage instructions on the day the sample pack was received. The inclusion of the instructions and scales in the document was also specifically explained (refer to Appendix O, P & Q).

3.3.3.4 Completion of the research questionnaire

3.3.3.4.1 Research setting

Highhouse (2009) stated that *“when consumers get caught up in the distinctiveness of the research setting, it implies that they are testing effects in settings rather than testing theories that should apply to multiple settings”*. The actual research setting was when and where respondents completed the online survey. The objective was to study a consumer’s everyday consumption experience in a natural context, and subsequently, the researcher did not want to remove the respondents from their normal, everyday situation but aimed to collect the data in a setting with as little disruption of the typical setting as possible (Reis & Judd, 2000; Swanborn, 2010). To achieve this through a resulting research location (where the survey was completed), respondents were requested to complete it where they usually consumed chocolate to mimic the “natural” setting where consumption usually took place.

3.3.3.4.2 Timing of survey completion

In terms of the time of day to complete the survey, King *et al.* (2010) found that time of day is not a critical variable when recording emotions associated with foods. Respondents were requested to complete the survey also when they would usually consume chocolate in order to mimic the time of day of actual consumption. Respondents were, however, requested to complete the survey in one sitting (thus during the morning or afternoon, for example, not to split it into various sessions during the day), but were allowed breaks in between as required (the survey could be paused at times as SurveyMonkey records all entries even if a respondent is logged out after completing some questions, or if poor data connection occurs). This was to ensure that there was no change in respondent mood from one session to the next.

In addition to completion in one sitting, respondents were instructed to complete the survey during the weekend following receipt of the samples to eliminate possible variables that an extended research period could pose, such as significant weather changes. The researcher was interested in only a restricted narrow time period to ensure that data collection was made under similar conditions (Badia *et al.*, 1990). Kuttanda and Philip (2018) found that, for example, while studying the impact of changing weather on mood and emotion, that there was a significant negative relationship between temperature and positive affect, while there was a significant positive relationship between negative affect and temperature. To aid this, samples were distributed during the week to students when they attended class, or early on a Saturday morning, and respondents were thus able to complete the survey over that weekend. This also benefitted the study as consumers are far more relaxed over weekends (Double, 2017), and this allowed for the more “natural” chocolate eating occasions in which respondents could complete the survey.

3.3.3.4.3 Completion of the research questionnaire

After the sample packs had been collected (within 24 hours after collection), respondents received an e-mail (refer to Appendix R) with a link to the online (web-based) survey, with a clear indication of the time frame within which it needed to be completed. It had to be completed on Friday the 1st, Saturday the 2nd or Sunday the 3rd of December 2017, the weekend following collection. They were able to complete the online questionnaire at a time and place that suited them best within these 72 hours to protect them from any possible discomfort or stress. This can occur when respondents feel that they are under pressure to

complete the online questionnaire during work-hours, which may have led to emotional discomfort and could in fact have influenced the emotional responses received.

Each survey section provided clear instructions on screen to avoid any confusion. There were also instructions in the sample pack and as part of the online survey for palate cleansing before and in between the samples they tasted. Respondents were expected to answer the questionnaire provided to them as honestly and as thoroughly as possible. After completing the questionnaire, the respondents were thanked and informed that their e-mail addresses would be added to the database to be used for the draw for the winners of the vouchers, after which the questionnaire was submitted and closed.

Randomisation was applied to the sensory and emotion portion of the questionnaire, as SurveyMonkey's software professional feature allows for randomisation of a specific set of questions which minimised bias and improved overall data quality. The three chocolate samples which respondents assessed were each marked with a three-digit code that correlated with those displayed in the survey on SurveyMonkey, and respondents assessed the samples in the order in which they appeared on the screen.

A total of 149 questionnaires were fully completed, which is an estimated 18.0% response rate vs. an estimate of 850 students enrolled at WITS Business School. This is a high response rate compared to response rates of students at other universities when an online study was conducted, such as the University of the Western Cape at 18.1%, Stellenbosch University at 11.9%, University of the Western Cape at 10.0% and Cape Peninsula University of Technology at 6.8% (du Toit *et al.*, 2014).

3.3.3.4.4 Respondent incentives

Respondents were not remunerated for their participation in this study; however, they could keep the cooler bag in which they received their samples. Furthermore, since the study population was students of the WITS Business School, many of whom also have corporate careers; it was brought to the researcher's attention that in order to motivate the students to take part, a form of remuneration should have been made available for their time and effort. This study required their participation in various stages, they were required to collect samples packs from the researcher, the survey was rather lengthy, and respondents had to use their personal

data or bandwidth or data to complete it. Therefore, the respondents were entered into a draw to win one of three Woolworths shopping vouchers (to the value of R500, R400 and R300) for their participation. Approximately two weeks after the data had been downloaded from SurveyMonkey, three winners were randomly selected with Microsoft Excel. These winners were contacted via e-mail to inform them that they had won, and the vouchers were handed to class representatives to present to the students.

3.3.4 Data management

After completion of the questionnaires, the data was automatically captured by the SurveyMonkey platform and then downloaded. The data from the survey was then converted to a format suitable for statistical analysis (CSV file converted to Excel). The data from the screening questionnaire was then linked to the data of the survey, copied into a new document, and the e-mail addresses of respondents were replaced with a random number. Removal of the e-mail addresses ensured that the data did not contain any information that will enable a person, other than the researcher, to identify the respondent, as respondents were assured that participation in this study is strictly confidential. This original file was then protected with a password and stored. A copy of the data was made and sent in a password-protected document to the Statistical Consultation Services of the North-West University (NWU) who conducted the analysis. Data was subsequently reviewed, cleaned and re-ordered as required to be imported into the software used for data analysis (IBM SPSS Statistics Version 25, Release 23.0.0). The purpose of analysing the quantitative data was to reduce the data to a form which could be interpreted for conclusions to be made, as it is important to interpret numerical data and results by finding meaning to the information (de Vos *et al.*, 2011). The data analysis conducted for this study is presented in Table 3.4. The Cronbach's Alpha's achieved for each section of the questionnaire as an output of the factor analysis of the researched variables, and other results obtained from further analysis of the data within each variable, are reported in the individual sections in the following Chapters.

Table 3.4: Statistical analysis performed on the collected data

Objective		Section in main questionnaire	Statistical analysis
1	Determine whether a relationship exists between the sensory properties of and the emotional responses to chocolate.	Section E & Section F	Conduct analysis to obtain factor scores which will indicate reliability and group and reduce the number of variables: a) Exploratory factor analysis; b) Confirmatory analysis / reliability analysis; c) Principal component analysis (PCA).
a)	Prepare a sensory profile for chocolate.	Section E	This will be conducted for each of the variables below:
b)	Prepare an emotional profile for chocolate.	Section F	1.1 Sensory properties; 1.2 Emotional response.
a)	Prepare a sensory profile for chocolate.	Section E	A profile is created for each sample assessed using:
b)	Prepare an emotional profile for chocolate.	Section F	a) T-test; b) Analysis of variance (ANOVA); c) Spearman's rank order correlations.
c)	Determine whether specific sensory properties can be linked to positive or negative emotions categories.	Section E & Section F	Descriptive Statistics (cross-tabulation analysis) between individual attributes and factors
2	Determine whether a relationship exists between the factors: a) Mood; b) Familiarity; c) Acceptability and d) Attitude, and the emotional response to chocolate.	Section A, Section C, Section D & Section G	Conduct analysis to obtain factor scores which will indicate reliability and group and reduce the number of variables: a) Exploratory factor analysis; b) Confirmatory analysis / reliability analysis; c) Principal component analysis (PCA). d) Descriptive Statistics (cross-tabulation analysis). This will be conducted for each of the variables below:

Table 3.4 continued

Objective		Section in main questionnaire	Statistical analysis
2	Determine whether a relationship exists between the factors: a) mood; b) familiarity; c) acceptability and d) consumer attitudes, and the emotional response to chocolate.	Section A, Section C, Section D & Section G	1.1 Mood; 1.2 Familiarity; 1.3 Attitude; 1.4 Acceptability. Descriptive Statistics (cross-tabulation analysis) between individual attributes and factors.
3	To compile a model indicating the relationship between the emotional response to the sensory properties of chocolate.	Section E & Section F	Structural equation modelling as well as Spearman's rank order correlations.

At no point was or will the data or identifying information be made available to any third party during and after analysis, and all information was managed in a strictly professional and confidential manner. Data which was gathered during the study was handled and stored by the principal investigator as a password-protected electronic document, and after completion of the study the data will be handed over to the NWU, Potchefstroom Campus, for safekeeping for a period of seven (7) years on a password-protected computer in Building F15, Room 112. Only the principal researcher, promotor and co-promotor will have access to the data.

3.3.4.1 Data dissemination

Data dissemination is the distribution or transmitting of statistical or other data to end-users. Despite widespread support from policy makers, funding agencies and scientific journals, not all academic researchers make their research findings available to others. This study has a very deliberate objective (stated under the implication-related objectives section) to share learnings and inform the academic community of the impact of the various behavioural variables on the emotional response to the sensory profile of chocolate. Thus:

- a) The researcher will aim to prepare various research articles to submit to academic journals, and as a result, Chapter 8 of this thesis is presented in an article format that represents this intention to disseminate information to the academic community.
- b) The aim is also to present the research at national and possibly international conferences in either poster or oral presentation format, and portions have been already been presented at:
- 1) SAAFOST Congress, Century City Conference Center, Cape Town, 3-6 September 2017 (Oral presentation);
 - 2) SAAFECS Congress, St Georges Hotel, Pretoria, 5-9 March 2018, (Oral presentation);
 - 3) Eighth European Conference on Sensory and Consumer Research (Eurosense), Verona, Italy, 2-5 September 2018, (Poster presentation).
- c) A summary of the results will also be shared with the students who participated in the study once the study is completed.

3.4 VALIDITY OF THE MEASUREMENT INSTRUMENT

Validity refers to the extent to which an empirical instrument reflects the real meaning of the concept under investigation (Rubin & Babbie, 2012), and measures what it intends to measure (Babbie & Mouton, 2001; Maree, 2007; Field, 2009). For the purpose of this study, validity indicates how successful the questionnaire would be to measure consumers' response to the sensory and emotional response to the products, as well as their mood, familiarity with, acceptability of and attitude towards chocolate in order to deliver against the objectives set for the project.

3.4.1 Face Validity

Questionnaires were selected or constructed after a thorough review of the literature and based on questionnaire design principles reported in the literature. Some of the questionnaires which were used in this study were used and validated in other studies, and well-known scales were used which had been successfully applied in many sensory and emotion research studies. Face validity, or whether the instrument appears at a glance to be valid (Delpont *et al.*, 2011), was achieved by consulting experts in the Department of Consumer Science, and by consulting the Statistical Consultation Services of the NWU to assess the analysability of questionnaires, and data they would yield.

3.4.2 Construct validity

Confirmatory factor analysis was performed to ensure construct validity of each of the scales of each section of the questionnaire, to determine whether the variables being investigated are interrelated or not (Pietersen & Maree, 2007; Malhotra, 2011), and to measure how valid the instruments were in testing the different constructs (Pietersen & Maree, 2007).

3.4.3 Content validity

To ensure content validity, qualified personnel within the department of Consumer Science who have backgrounds regarding the research topic were consulted. This was done to ensure that the scales and questionnaires would measure the various concepts by capturing all the relevant information within the scope of the variable being measured (Pietersen & Maree, 2007; Malhotra, 2011), as content validity often requires consultation with recognised subject matter experts to evaluate whether the instruments assess the defined content. A thorough literature study was conducted and further supports content validity.

3.4.4 Measures taken to reduce threats to validity

Internal validity refers to how well an experiment is done, especially whether it avoids confounding, which is a when the effect or association between an exposure and outcome is distorted by the presence of another variable or variables (Leatherdale, 2019). External validity refers to the generalisability of the approach or findings of a study (Gaus, 2017). Various factors could jeopardise internal and external validity. These and the precautions that were taken to reduce risks are summarised in Table 3.5 below.

Table 3.5: Threats to internal and external validity (Yu & Ohlund, 2010)

Element	Description	Precautions taken to reduce risks
Factors influencing internal validity		
History	This includes the events which occur before or after the measurement.	In order to account for any events that might have occurred before the respondents participated in the test which may have impacted their emotional state, respondents were asked to report their mood before they commenced with the survey via a validated mood scale.
Testing	The effects of taking a test on the outcomes of taking a second test.	Order of questionnaire sections was carefully considered to ensure minimal impact of this effect.
Selection of subjects	The biases which may result in selection of comparison groups.	No comparison groups were employed in this study, and bias was deliberately employed to select subjects based on the objective to recruit respondents based on varying usage frequencies.
John Henry effect	Being aware of the objective of a study and acting accordingly.	Respondents were not fully informed of all the elements and objectives of the study; however, they were provided with sufficient information to request informed consent. No subjects appeared to have become aware of the true objective of the study during data collection and hence no data needed to be removed from the data set.
Factors influencing external validity		
Reactive interaction effect of testing	A pre-test might increase or decrease a subject's sensitivity or responsiveness.	Different respondents were used for the pre-test and the actual survey.

Table 3.5 continued

Element	Description	Precautions taken to reduce risks
Factors influencing external validity		
Reactive effects of experimental arrangements	The effect of the experimental variable on respondents or objects being exposed to it in non-experimental settings.	As part of the pre-test, respondents were asked after completion of the survey how they felt about the format, flow, time taken to complete, etc., and this feedback was applied to improve the final questionnaire.

Furthermore, completion of the survey over a weekend avoided the results being influenced by events such as stressful periods at work, and respondents were further able to complete the online questionnaire at a time suitable for them. Respondents were also encouraged to answer questions honestly without the fear of their answers being used to penalise them and by assuring them that their information will be kept confidential.

3.4.4 Reliability

A pre-test was conducted to ensure that the questionnaire was a reliable instrument, and it was deemed necessary as the questionnaire was self-administered and was presented as CASI. The questionnaire which was used had been formulated in line with the objectives of this study (see Chapter 1), and throughout the research process, data was collected and analysed using the same structure, which increased the level of reliable results.

In order to measure whether highly correlated results were obtained through the use of the questionnaire which would reflect the homogeneity of study items, Cronbach's Alpha was used (Pietersen & Maree, 2007; Field, 2009) for both the total data set as well as the sub-segments or clusters to indicate internal consistency of data (Ferdenzi *et al.*, 2013) and clusters of data (Chaya *et al.*, 2015). Cronbach's Alpha values related to a specific portion of the questionnaire are reported in the chapter addressing that theme.

3.5 ETHICAL CONSIDERATIONS

An overview of related ethical considerations for this study is provided as required by the Health Research Ethics Committee (HREC) of the NWU. Details pertaining to the approval, protection

of respondents and researchers, voluntary participation, incentives and costs and recruitment are discussed briefly.

3.5.1 Ethical approval

The researcher did, by means of proposal submission, obtain the appropriate approval from the HREC of the Faculty of Health Sciences, Office for Research, Training and Support for research projects with human participants (Approval number NWU-00029-17-A1) (Refer to Appendix A and B). The study was conducted within the parameters presented to the ethics committee.

3.5.2 Protection of respondents

Researchers have an ethical obligation to protect the respondents within all possible reasonable limits from any type of harm, physical or emotional discomfort which may arise during a research project. As this is a study that involved food products, respondents were protected by providing them with all the information related to the ingredients of the products that they consumed for them to identify any ingredients for which they may have had an allergy or sensitivity. They were also informed that the main research survey could take up to one hour to complete which may cause some fatigue. No other risk of further harm or discomfort was anticipated.

3.5.3 Deception of respondents

Respondents received a detailed explanation of the study and its objectives without withholding of facts or misrepresentation of any study information to ensure they were fully informed of the purpose of the study and how the data will be used. They also had ample opportunity to ask questions before the survey commenced. All communicated information in the study is represented as the respondent provided it.

3.5.4 Voluntary participation

All respondents were informed that their participation would be voluntary at all times and that they were not obligated to participate in the research. Respondents were required to answer the questions honestly; however, they were given the option to discontinue the participation in the study at any point before data analysis was performed without being penalised or discriminated against. Even after they had received their samples, they could withdraw without

any penalty and the samples could also be kept in this instance. Twenty-two respondents accepted a sample pack but did not complete the survey.

3.5.5 Recruitment of respondents

Recruitment of respondents took place as outlined in Section 3.3.2. Permission was obtained from the head of the MBA program (Appendix C), Mr Conrad Viedge (who also acted as the gatekeeper for the study), as well as the head of the research department, Mr Anthony Stacey, to approach students and request their participation. The students were provided with all the relevant information about the study (as outlined in the informed consent section) in information sessions, and they also received a leaflet containing all the relevant information. They were also informed that if they decided to participate, they could decide to withdraw and terminate participation at any point.

3.5.6 Informed consent

Informed consent forms (refer to Appendix F) were provided to the respondents before screening and data collection commenced. The consent form explained the aim and nature of this study to respondents as well as the possible benefits and risks and contribution of the study to the field of Health Science. Respondents were not misled, nor was any information regarding the study withheld from them.

3.5.7 Anonymity, confidentiality and the right to privacy

Participation in this study was confidential and anonymous, and the data for this study was handled in this manner. The researcher ensured that the personal information of the participants was protected, and the respondents' specific results were never reviewed or reported on.

3.6 RISK AND BENEFIT ANALYSIS

Any study involves a level of risk, and these should be anticipated in order to be addressed before or as they arise. Outlined below are the risks relating to the respondents and the researcher during this study, and how these were managed. It is, however, clear that the benefits of this study outweigh any possible risks.

3.6.1 Risks

3.6.1.1 Physical risks

Minimal physical risk was anticipated to respondents, although due to the length of the questionnaire, which could have taken up to 60 minutes to complete, loss of concentration may have occurred. As respondents completed the survey during a time and at a location that was convenient to them and was aware of the length of time required to complete the questionnaire before they commenced, this was minimised. In addition, the online questionnaire was designed in a manner that was interactive and easy to complete which further addressed this risk. Respondents were not inconvenienced by travelling to a different location to participate and were able to continue their usual weekend activities both before and after the completion of the questionnaire.

3.6.1.2 Psychological risks

Minimal psychological risk was anticipated. The respondents may have felt uncomfortable about answering some questions such as their ethnic group. This was prevented by not making this question compulsory, and the reason for the inclusion of this variable was explained to them. If respondents felt that they did not want to indicate their ethnicity, they could have chosen to leave this question unanswered. Respondents might have found it difficult to answer questions related to, for example, the intensity of sensory properties. They might have felt uneasiness and embarrassment when answering questions related to their usage behaviour, their attitudes and their emotional responses. They were reassured at the beginning of the survey that there were no right or wrong answers and that the objective of the study was to capture natural human response, and that their responses were anonymous and confidential. Furthermore, as they completed it in the privacy of their homes, their answers were not seen by anybody else, which further reduced the psychological risk. They were also made aware of the value of their contribution to the study. Lastly, they were reminded at the start of the online survey that participation was voluntary and that they may withdraw at any time. These risks were, however, viewed as anticipated and reasonable in relation to what was expected from the respondents and the knowledge that the study stands to gain.

3.6.1.3 Social risks

Minimal social risk was anticipated. Respondents may have felt reluctant to provide personal information such as their highest level of education, as they may have felt that this might have a

negative impact on their social reputation or standing, which may have led to discrimination during data analysis. The precautionary measures which were in place to prevent these risks were always carefully managed by the researcher to protect the respondents. This occurred during the consent process by explaining the importance of privacy and confidentiality at all times throughout the research, in that personal data would not be captured, and that data analysis would be conducted on a group of respondents and not individual respondents. This gave the respondents confidence to be involved in the study as no identifying information would be made available to any third party whatsoever, and all information would be handled with great care to ensure confidentiality of respondents' information.

3.6.1.4 Legal risks

No legal risks to respondents or the researcher were anticipated as the study had been planned and was conducted ethically. As this was a food study and respondents might not have been aware of an allergic reaction to ingredients, respondents were asked to complete a consent form (Appendix F) before they were screened. Ingredients were listed in the screening questionnaire, and respondents were thus informed of these before assessing the samples to protect the researcher. A free public platform was used to complete the electronic questionnaires.

3.6.1.5 Economic risks

The study posed a very low economic risk as respondents completed the survey online and thus needed to cover only the cost of bandwidth or data on cell phones to do so. They would also not have to incur any loss of productivity or income as they could complete the survey at their own leisure when it suited them; as they were instructed to complete it over a weekend, they would not have had to, for example, complete it during their working day.

3.6.1.6 Dignitary risks

No dignitary risks or harm to respondents or the researcher was anticipated or recorded. The questions posed in the study did not violate any personal values or beliefs of the respondents.

3.6.2 Benefits

a) Respondents: The direct benefit to the respondent was that they should have found completing the survey interesting, and they would have enjoyed the survey and the samples.

The indirect benefit would be that they would help to prepare research reports and articles that will make an impact in the academic community when the findings are implemented, and the population will gain from the potential change in product design, labelling and marketing.

b) Researcher: The benefit was to gain knowledge and experience through the study and by understanding the consumer segment and product category.

3.6.3 Competence of the researcher

The researcher acted under the supervision of Dr. Annchen Mielmann with expertise on quantitative research in food- and consumer sciences and Dr. Neoline le Roux with expertise on consumer behaviour. These supervisors are from the Department of Consumer Sciences and both have experience in the field of the study as well as in quantitative data collection. Dr. Suria Ellis from the Statistical Consultation Services assisted with statistical procedures and analysis.

3.6.4 Contributions of the study

The results obtained from this study could contribute to new knowledge which could be published in various academic journals, thereby contributing to the research mission of the NWU. Ample research studies related to emotional response and emotional response to food have been conducted internationally, but to date, only a few of these studies which measured the relationship between the sensory properties of a food product and the emotions they evoke have been published, and no emotion-sensory research has ever been conducted (assumption based on lack of published literature) in South Africa. The impact of consumer behaviour variables such as mood, familiarity, acceptability or attitude is not generally considered in studies investigating the emotional response to the sensory properties of food. Thus, the study could be considered as a breakthrough and could contribute significantly to the field.

This study could indicate what the importance of considering consumer behaviour components is when scientific food research is conducted, which could put a new lens on the design of and approach to true consumer-focused studies. It could allow for the development of a model that could simulate a response to products which, once verified, could be re-used by others, or the methodology could be applied to design similar models for other food categories which could lead to the development of more “consumer-centric” products. Such models could reduce research time significantly and could be an on-going tool for product developers.

From a new product development point of view, the selection of a product formulation that is aligned to consumer preferences is essential for the food industry, which requires an understanding of consumers' perception of products, both from a sensory and hedonic point of view. From a consumer perspective, the study could highlight the relative importance of consumer behaviour components in sensory studies and could allow for the design of products based on a more "holistic" view of the consumer. Broadly, it could also bring together the two fields of sensory and consumer science.

3.7 CONCLUSION

The methodology outlined in this Chapter was implemented to collect the data required to answer the research questions of this study and fulfil the outlined objectives. A quantitative, descriptive cross-sectional study was conducted in the Johannesburg municipal district amongst students of the WITS Business School, implemented using an electronic questionnaire to collect quantifiable data. One hundred forty-nine respondents participated in all stages of the research project. After ethical approval for the study had been obtained, respondents were recruited through information sessions at the campus of the WITS Business School. Those interested provided consent to participate in the study. They were screened and then received and evaluated the sensory properties of three different chocolate brands with an online questionnaire designed for the study and completed various other sections of the questionnaire related to demographics, emotion and consumer behaviour. The data obtained from this questionnaire were analysed with the IBM SPSS software and will be reported in subsequent chapters as outlined in Chapter 1.

CHAPTER 4

THE SENSORY PROFILE OF CHOCOLATE

4.1 INTRODUCTION

As indicated in Chapter 2, the sensory and hedonic (pleasure) perceptions of products and the responses to these products are considered as critical factors for consumer food choice (Tuorila, 2007). Consumers' choice is assumed to be associated with mostly rational decisions based on specific food attributes (Manzocco *et al.*, 2013). Despite this, in many studies, sensory evaluation is focused on flavour alone. Lagast *et al.* (2017) reported that out of 60 studies they surveyed, 33 focused on only flavour-related sensory attributes, 15 combined flavour with other sensory attributes such as aroma, appearance and texture, and 22 excluded flavour and considered other attributes.

In order to determine the sensory profile of chocolate beyond flavour, the current study included appearance, aroma, flavour, mouthfeel and aftertaste attributes. A sensory list of 49 attributes was compiled from various studies (refer to Chapter 3 Section 3.3.1.1) and was then reduced to 14, as the data from a trained sensory panel was used to identify the sensory attributes which best describe and discriminate between the chocolate products included in this study (refer to Appendix W).

Despite consumers not being involved in the creation or reduction of this list of sensory descriptors used in this study, it was comparable to a list of sensory descriptors created by Schouteten *et al.* (2015) in which consumer-defined lexicons (attributes or descriptors) were established and used. In the study mentioned above, the evaluation of sensory attributes also resulted in the creation of and inclusion of 14 attributes, of which six were of the exact same wording as the descriptors which were included in this present study, namely bitter flavour, milky flavour, sweet flavour, creaminess, melting and mouth-coating. Two attributes were similar – smooth was included in the study by Schouteten *et al.* (2015) instead of creamy, and aftertaste was used instead of a bitter aftertaste. Three attributes differed in wording but measured similar concepts – chocolate flavour was used instead of cocoa powder flavour, brown colour vs. gloss

and chocolate aroma vs. sweet aroma (the latter of these sets of words was included in the present study). Three attributes from the study of Schouteten *et al.* (2015) were used as additional descriptors, namely granular, sticky and adherence, while in the present study one additional descriptor, namely, firmness, was included.

For the current study reported on in this chapter, three different Milk chocolates sold in the retail space in South Africa were evaluated by a consumer panel (n=149). The three products included in the study were selected as they were found to be sensorily varied by a trained panel through the same process mentioned above through which sensory attributes were selected for this study (refer to Appendix W). As the trained panel found them to be very varied for all sensory attributes measured when the products were evaluated with the same questionnaire that consumers would be using, it was expected that untrained consumers would also be able to identify these variations and rate the intensity of the sensory attributes accordingly. This was important as one of the objectives of the study (empirically related objective - primary objective 1c) was to link specific sensory attributes to specific emotion attributes. However, the data obtained through consumers' evaluation of the sensory attributes of chocolate was also important to: 1) Describe the sensory experience with the products; 2) Identify the sensory differences between them; and 3) Prepare a sensory profile for each chocolate and for the mean values of the sensory attributes of all three chocolates. The three products which were thus included were: 1) Canderel, an artificially sweetened Milk chocolate aimed at diabetics; 2) Lindt, a premium imported chocolate with an indulgence positioning; and 3) Nestlé, mainstream chocolate marketed as an everyday luxury.

Results are reported in this chapter in the following manner: Firstly, the sensory experience of respondents with the three chocolates is described, including a summary of the variations detected between samples. Secondly, the relationship between sensory attributes is summarised, both at a factor and individual attribute level. This is followed by an overview of the ingredients contained in each product that influenced the respondent's sensory experience. Lastly, the visual sensory profiles of the chocolates based on mean attribute ratings are shared.

4.2 STATISTICAL ANALYSIS

Through a Repeated Measures ANOVA and Bonferroni post-hoc test, the means of individual sensory attributes of the three chocolates were compared in order to identify significant ($P \leq 0.05$)

differences between the mean scores of the individual chocolates. Factor analysis, including Oblimin rotation with Kaiser normalisation was then conducted to reduce and group the number of sensory variables and to construct pattern matrixes for all three chocolates. The reliability of the applied tool (Appendix X) was also determined through factor analysis based on Cronbach's Alpha's of the extracted factors. Each extracted factor for each of the chocolates resulted in $\alpha \geq 0.6$ which is regarded as acceptable.

4.3 RESULTS AND DISCUSSION

4.3.1 Describing the sensory experience of chocolate

The mean sensory attribute ratings of the three chocolates by the consumer panel were reviewed to gauge whether respondents found the three chocolates to be different. Table 4.1 captures the mean ratings and standard deviations of all the measured attributes for each chocolate. Repeated Measures ANOVA was performed for the means of all three chocolates for each of the 14 individual sensory attributes in order to identify whether significant ($P \leq 0.05$) differences exist between these mean scores within the attribute set. The Bonferroni post-hoc test was then performed, which is an adjustment that is made to P values when several statistical tests are being performed simultaneously on a single data set, as the Bonferroni post-hoc test adjusts the significance cut-off based on α ($P\text{-value}/n$).

Table 4.1: Mean sensory values of the sensory attributes of the evaluated chocolates

Sensory attributes	Canderel Mean±SD	Lindt Mean±SD	Nestlé Mean ±SD	Sign. level
Appearance				
Gloss	1.41 ^a ±0.99	1.70 ^b ±0.95	0.91 ^c ±0.80	$P \leq 0.01$
Aroma				
Sweet aroma	1.39 ^a ±0.91	2.19 ^b ±0.95	1.80 ^c ±1.09	$P \leq 0.01$
Flavour				
Bitter	1.30 ^a ±1.11	0.39 ^b ±0.69	0.74 ^c ±0.97	$P \leq 0.01$
Burnt	0.80 ^a ±1.05	0.30 ^b ±0.70	0.83 ^a ±1.11	$P \leq 0.01$
Cocoa powder	1.93 ^a ±1.08	1.39 ^b ±1.14	1.59 ^b ±1.02	$P \leq 0.01$
Coffee	1.00 ^a ±1.05	0.50 ^b ±0.76	0.76 ^c ±1.03	$P \leq 0.01$
Milky	1.46 ^a ±1.00	2.81 ^b ±1.10	1.73 ^c ±1.01	$P \leq 0.01$
Sweet	1.00 ^a ±1.06	2.41 ^b ±1.14	2.39 ^b ±1.11	$P \leq 0.01$
Vanilla	0.65 ^a ±0.81	1.29 ^b ±1.14	0.82 ^a ±0.94	$P \leq 0.01$
Mouthfeel				
Adherence	1.62 ^a ±0.98	1.59 ^a ±1.19	1.60 ^a ±0.99	$P=0.95$
Creaminess	1.38 ^a ±0.93	3.00 ^b ±0.90	1.66 ^c ±1.05	$P \leq 0.01$
Melting	1.94 ^a ±0.96	2.71 ^b ±1.05	1.88 ^a ±1.07	$P \leq 0.01$
Mouth-coating	1.71 ^a ±1.04	1.92 ^a ±1.23	1.67 ^a ±0.98	$P=0.08$
Aftertaste				
Bitter aftertaste	1.30 ^a ±1.21	0.45 ^b ±0.87	0.94 ^c ±1.07	$P \leq 0.01$
Overall mean	1.35	1.62	1.38	

Notes: *Likert scale: 0=Not at all, 1=Slightly, 2=Moderately, 3=Very, 4=Extremely*; Interpretation of means: <1.0=Not present at all, ≥1.0-<2.0=Slightly present, ≥2.0-<3.0=Moderately present, ≥3.0-<4.0=Very present and 4.0=Extremely present; Means with different superscripts (^a, ^b, ^c) in the same row indicate that these mean values differ significantly from each other ($P \leq 0.01$).

4.3.1.1 Appearance

The glossiness of the three chocolates is significantly ($P \leq 0.01$) different from one another, with Lindt found to be the glossiest of the three.

4.3.1.2 Aroma

The sweet aroma of the three chocolates is significantly ($P \leq 0.01$) different from one another, with Lindt found to have the most intense sweet aroma.

4.3.1.3 Flavour

The three chocolates are significantly ($P \leq 0.01$) different from one another in terms of bitter flavour, coffee flavour and milky flavour. Lindt has the lowest burnt and coffee flavour and the highest milky flavour, while Canderel has the highest bitter and coffee flavour and the lowest milky flavour. Lindt is significantly ($P \leq 0.01$) lower in burnt flavour and higher in vanilla flavour compared to Canderel and Nestlé. Canderel is significantly ($P \leq 0.01$) higher in cocoa powder flavour and lower in sweet flavour compared to Lindt and Nestlé.

The high mean ratings of Canderel for many bitter-like sensory attributes (such as bitter flavour, burnt flavour, cocoa powder flavour, coffee flavour and bitter aftertaste) are in line with the findings of Goraya (2016) who reported that the use of artificial sweeteners deliver a more pronounced bitterness and Prakash *et al.* (2008) who showed an enhancing impact of stevia on non-sweet flavours such as bitterness. Lindt and Nestlé, on the other hand, had lower bitterness scores in line with the findings of Prawira and Barringer (2009) who found a weakening effect of sucrose on bitterness.

Mean ratings of the three chocolates indicate that overall, respondents found bitter flavour, burnt flavour, cocoa powder flavour, coffee flavour and bitter aftertaste not to be present or slightly present in all chocolate (<1 =not present at all, $\geq 1 - <2.0$ =slightly present), and thus their experience with these chocolates was not overtly bitter in nature. For the non-bitter flavour attributes, namely milky flavour, sweet flavour and vanilla flavour, vanilla flavour was at most slightly present in Lindt, ($\geq 1 - <2.0$), while milky flavour and sweet flavour were slightly ($\geq 1 - <2.0$) to moderately ($\geq 2.0 - <3.0$) present across samples.

4.3.1.4 Mouthfeel

Hardness, the size of product particles as well as melting speed are essential characteristics by which consumer evaluate chocolate products (Juodeikiene *et al.*, 2018). Creaminess is the only mouthfeel sensory attribute where all three chocolates different significantly ($P \leq 0.01$) from one another, with Lindt being significantly ($P \leq 0.01$) creamier than Nestlé and Canderel, and Nestlé

being significantly ($P \leq 0.01$) creamier than Canderel. For the attribute of melting, Lindt achieved a significantly ($P \leq 0.01$) higher value than Canderel and Nestlé. Respondents experienced all the mouthfeel attributes for all three chocolates slightly (≥ 1.0 - < 2.0) to moderately (≥ 2.0 - < 3.0).

4.3.1.5 Aftertaste

The three chocolates are significantly ($P \leq 0.01$) different from one another in the bitter aftertaste, with Canderel having the highest bitter aftertaste and Lindt the lowest. de Melo *et al.* (2009) reported in a study of artificially sweetened chocolates that there was no significant difference in intensity of aftertaste between two low-calorie sweeteners and sugar-containing chocolates. In this study, respondents did, however, detect a higher bitterness in Canderel, which may point to a lower bitterness threshold of South African consumers (which will be further discussed in Section 4.3.4.1). Differences in bitter perception have been found to have a genetic basis as genes adapt to local conditions, especially to the bitter toxins in food (Reed *et al.*, 2006).

4.3.2 Describing the sensory variation between the evaluated chocolates

A significant ($P \leq 0.01$) difference was found between the chocolates for 12 of the 14 measured attributes; however, not all three chocolates were significantly different from one another for these 12 sensory attributes (as summarised in Table 4.1), as for some attributes a significant variation was noted for only one of the chocolates in comparison to the other two. There was a significant ($P \leq 0.01$) difference between all three chocolates for eight of the measured sensory attributes.

These findings support the achievement of the objective to select chocolates which are varied in their sensory properties intentionally, and while this selection was carried out based on the data gathered with a trained panel (Appendix W), the consumer data confirms that sensory variation was achieved through the inclusion of these three samples. The results are also in line with those of a study performed by Jaeger *et al.* (2018), who also selected samples within that study to be diverse in terms of their sensory characteristics, with the results of that study and this present study matching the expectations that noticeable differences in the sensory attributes of the samples would be found. The results reported in the article mentioned above of Jaeger (in which the outputs of five separate research studies were reported) indicated that significant differences ($P \leq 0.05$) were found in 87.0-100.0% of the sensory terms. In this study, based on the P -values indicated in Table 4.1, significant differences between at least two samples were

identified for 12 (87.0%) of the sensory attributes measured, and significant differences among all three samples were indicated for eight (57.0%) of the sensory attributes measured. In conclusion, these chocolates were specifically selected due to their sensory differences and thus overall variation; respondents were able to convey this varied experienced and differentiate between the chocolates based on specific sensory attributes.

4.3.3 Determining correlations between evaluated chocolates and sensory attributes

4.3.3.1 Factor analysis for individual chocolates

A factor analysis of the data was performed using the Maximum Likelihood method of extraction for the data set of each chocolate. Initially, four factors with eigenvalues greater than one were extracted for all three chocolates. A series of factor analyses were conducted, which indicated that two factors gave the most interpretable solution for all three chocolates. For all three chocolates, based on two factors, the Bartlett's test of sphericity, which tests the overall significance of all the correlations within the correlation matrix, was significant (Canderel: $\chi^2=473$, $P\leq 0.01$; Lindt: $\chi^2=480$, $P\leq 0.01$; Nestlé: $\chi^2=537$, $P\leq 0.01$), indicating that it was appropriate to use the factor analytic model on this set of data. The Kaiser-Meyer-Olkin measure of sampling adequacy indicated that the strength of the relationships among variables was high for all three chocolates (Canderel KMO=0.708; Lindt KMO=0.693; Nestlé KMO=0.721). Thus it was acceptable to proceed with the analysis. An Oblimin rotation was performed since factors were expected to be correlated. The obtained pattern matrix is displayed in Table 4.2, and all factor loadings were above 0.4 and are thus displayed. For Canderel and Lindt, the two extracted factors together accounted for 41% of the variance. For Nestlé, the two factors accounted for 42% of the variance. The internal consistency of all factors was high; with acceptable ($\alpha\geq 0.6$) Cronbach's Alpha's for both factors for each of the chocolates.

Factor analysis in the current study thus revealed two factors which were sufficient to explain the underlying structure of sensory properties for all three chocolates. The pattern matrix in Table 4.2 revealed factor one to consist of five items and based on the attributes included in each factor, it was labelled "bitter". The second factor consisted of nine items and based on the attributes included in each factor, it was labelled "sweet". All attributes of the study loaded onto a factor. Inter-item correlation values were higher for the bitter factor (0.396; 0.334; 0.450) than for the sweet factor (0.203; 0.234; 0.215) for all three chocolates.

Table 4.2: Pattern matrix with factor extractions for sensory attributes of all three chocolates

	Canderel		Lindt		Nestlé	
Item	Bitter	Sweet	Bitter	Sweet	Bitter	Sweet
Cocoa powder flavour	0.746		0.359		0.639	
Bitter flavour	0.717		0.788		0.801	
Burnt flavour	0.688		0.752		0.755	
Coffee flavour	0.593		0.632		0.716	
Bitter aftertaste	0.685		0.747		0.779	
Sweet aroma		0.649		0.424		0.609
Milky flavour		0.621		0.755		0.703
Sweet flavour		0.584		0.621		0.426
Vanilla flavour		0.518		0.511		0.367
Adherence		0.427		0.298		0.352
Creaminess		0.647		0.740		0.718
Melting		0.492		0.645		0.560
Gloss		0.449		0.500		0.517
Mouth-coating		0.400		0.472		0.540
Inter-item correlation	0.396	0.203	0.334	0.234	0.450	0.215
Cronbach's Alpha	0.765	0.694	0.676	0.729	0.802	0.712
Mean factor score	1.270	1.500	0.610	2.180	0.970	1.610
Standard deviation	1.101	0.965	0.831	1.071	1.041	1.011

Notes: *Likert scale: 0=Not at all, 1=Slightly, 2=Moderately, 3=Very, 4=Extremely*; Mean factor loading score: <1.0=Not present at all, ≥1.0-<2.0=Slightly present, ≥2.0-<3.0=Moderately present, ≥3.0-<4.0=Very present and 4.0=Extremely present; Cronbach's Alpha: α≥0.5=Accepted with caution, α≥0.7=Acceptable, α≥0.8=Good. Shaded loadings indicate items that loaded meaningful on one factor.

For Canderel, within the bitter factor, cocoa powder flavour (0.746) and burnt flavour (0.688) had the highest inter-factor correlation values, while for the sweet factor; sweet aroma (0.649) and creaminess (0.647) was highest. For the bitter factor of Lindt, bitter flavour (0.788) and burnt flavour (0.752) had high values, while for the sweet factor, milky flavour (0.755) and creaminess (0.740) ranked highly. For Nestlé, in the bitter factor, bitter flavour (0.801) and a

bitter aftertaste (0.779) had high inter-factor correlation values, and for the sweet factor, the attributes milky flavour (0.703) and creaminess (0.718) had high scores. For both Canderel and Lindt, the attributes mentioned above were found to be significantly ($P \leq 0.01$) higher or lower in mean ratings compared to the two other chocolates, and for Nestlé the attributes had median ratings, but were indicated as significantly ($P \leq 0.01$) different to the other two chocolates. These attributes could thus, based on their inter-factor correlations and significance of their differences vs. the other chocolates studied, be considered as lead attributes within these factors and for these chocolates. Inversely, some of the attributes had lower inter-factor correlations, namely coffee flavour (0.593; 0.632; 0.716) within the bitter factor for all three chocolates, mouth-coating (0.400; 0.472) in the sweet factor for Canderel and Lindt, and vanilla flavour (0.367) within the sweet factor for Nestlé and were thus of lower relevance for these chocolates.

Flavour has been described as one of the most important elements when making product choices (Schifferstein *et al.*, 2013; Leitch *et al.*, 2015), and bitter and sweet are negatively correlated (Magelund, 2013). Based on mean factor scores, Canderel was rated the highest on bitter attributes (mean factor score=1.270), followed by Nestlé (mean factor score=0.970) and lastly Lindt (mean factor score=0.610). For the mean factors scores of the sweet factor, Lindt leads (mean factor score=2.180), followed by Nestlé (1.610) and lastly Canderel (mean factor score=1.500).

By calculating the ratio between mean factor scores (sweet mean factor score/bitter mean factor score), the overall flavour experience can be described, with a ratio of 1.2 for Canderel, 3.5 for Lindt and 1.7 for Nestlé. Thus, although the sweet mean factor scores of Canderel and Nestlé are similar, the bitter factor mean score is higher for Canderel, resulting in a lower sweetness to bitterness ratio for Canderel. The low bitter factor mean for Lindt and the high sweet factor mean, result in an overall “sweet” experience.

4.3.4 Correlations between individual sensory attributes of evaluated chocolates within factors

Various studies have indicated the existence of significant correlations between the sensory attributes of chocolate (Magelund, 2013; Owusu *et al.*, 2013), and thus the correlations between the sensory attributes within each extracted factor were reviewed.

4.3.4.1 Correlations between sensory attributes from the bitter factor

Human's detection threshold for bitter taste is extremely low (Van Doorn *et al.*, 1998), and many structurally unrelated compounds can give rise to bitter taste (Drewnowski & Gomez-Carneros, 2000). The diverse chemical structures of bitter compounds have suggested the existence of multiple bitter-taste receptors on the tongue. The bitter taste of chocolate was historically thought to be caused by the caffeine and theobromine content, and the interaction of theobromine and diketopiperazines during roasting (Rousseff, 1990). Recent studies suggest that the bitter taste of chocolate may also be due to the presence of a compound called catechins, which is present in higher amounts in bitter than in milk chocolate (Arts *et al.*, 1999). While the taste of theobromine is described as bitter and metallic, diketopiperazines are associated with a roasted malt flavour, while catechins in cocoa have been described as bitter or astringent with a sweet aftertaste. The bitter experience in chocolate is thus in itself complex and multi-faceted.

Spearman's rank order correlation values (r) were determined to describe the relationship between the sensory attributes of the bitter factor and was interpreted based on Cohen's guidelines (1977), as $r \geq 0.3$ was considered a moderate correlation, with correlations $r \geq 0.5$ considered to be strong, while $r = 0-0.3$ was considered as small (Cohen, 2013). As indicated in Table 4.3, all sensory attributes within the bitter factor achieved inter-item correlation values $r \geq 0.3$. The larger and thus stronger ($r \geq 0.5$) inter-item correlations were between bitter flavour and bitter aftertaste, in line with the findings of Gous *et al.* (2019) that the overall bitterness flavour level drives bitter aftertaste.

The lowest correlation value was noted between coffee flavour and a bitter aftertaste ($r = 0.585$). Between cocoa powder flavour and coffee flavour, coffee flavour had a higher correlation value with bitter flavour ($r = 0.468$). Smaller yet moderate ($r \geq 0.3$ - $r < 0.5$) inter-item correlations were also noted between burnt flavour and cocoa powder flavour ($r = 0.335$), and bitter aftertaste and both cocoa powder flavour ($r = 0.324$) and coffee flavour ($r = 0.320$). Similarly, Guinard and Mazzucchelli (1999) reported in a study where chocolate was the product under investigation, that bitter, roasted flavour and cocoa flavour notes were highly correlated. Cocoa powder flavour was thus differentiated from burnt flavour, as a cocoa powder flavour would not necessarily result in respondents experiencing a bitter aftertaste. Reed *et al.* (2006) indicated that the function of bitter receptors may be different as they may bind to different molecules, and

thus one bitter receptor may respond to one specific molecule but not to another, which could be the reason why not all bitter sensory attributes are equally correlated.

Table 4.3: Spearman's rank order correlations (r) between sensory attributes of the bitter factor

Sensory attributes	1. Bitter flavour	2. Burnt flavour	3. Cocoa powder flavour	4. Coffee flavour	5. Bitter aftertaste
1. Bitter flavour	1.000	0.483**	0.406**	0.468**	0.585**
2. Burnt flavour	0.483**	1.000	0.335**	0.420**	0.480**
3. Cocoa powder flavour	0.406**	0.335**	1.000	0.462**	0.324**
4. Coffee flavour	0.468**	0.420**	0.462**	1.000	0.320**
5. Bitter aftertaste	0.585**	0.480**	0.324**	0.320**	1.000

Notes: Interpretation of Spearman's rank order correlations based on Cohen's guidelines (1977) (r): $r=0$ - $r<0.3$ =Small, $r\geq 0.3$ - $r<0.5$ =Moderate, $r\geq 0.5$ =Strong; Tendencies to correlate ($r\geq 0.3$) are indicated in bold; *Correlation is significant at the $P\leq 0.05$ level (2-tailed), **Correlation is significant at the $P\leq 0.01$ level (2-tailed).

4.3.4.2 Correlations between sensory attributes from the sweet factor

While the bitter factor contains bitter sensory attributes, the sweet factor incorporates the various texture elements, namely adherence, creaminess, gloss and melting. It was reported by Chizoti *et al.* (2018) that sugar content influences texture properties until a certain level where a plateau is reached. It is thus assumed that in this study a similar relationship was at play and resulted in texture elements being grouped with "sweet" flavour attributes, as for example, creaminess appears to be related to perceived sweetness when comparing the means ranking of the chocolates for these sensory attributes.

Table 4.4 captures the various correlations between sensory attributes of the sweet factor. Large inter-item correlations ($r\geq 0.5$) were identified between the mouthfeel attributes creaminess and melting ($r=0.521$), between mouth-coating and adherence ($r=0.516$), as well as between mouthfeel attribute creaminess and the flavour attribute milky flavour ($r=0.614$). Various positive moderate ($r\geq 0.3$ - $r<0.5$) correlations were identified between various attributes,

including between milky flavour and vanilla flavour ($r=0.407$); milky flavour and melting ($r=0.420$); vanilla flavour and creaminess ($r=0.354$); sweet aroma and milky flavour ($r=0.341$); sweet flavour ($r=0.324$) and creaminess mouthfeel ($r=0.314$), and sweet flavour and gloss appearance ($r=0.341$).

Table 4.4: Spearman's rank order correlations (*r*) between sensory attributes of the sweet factor

Sensory attributes	1. Gloss appearance	2. Sweet aroma	3. Milky flavour	4. Sweet flavour	5. Vanilla flavour	6. Adherence mouthfeel	7. Creaminess mouthfeel	8. Melting mouthfeel	9. Mouth- coating mouthfeel
1. Gloss appearance	1.000	0.341**	-	-	-	-	-	-	-
2. Sweet aroma	0.341**	1.000	0.341**	0.324**	-	-	0.314**	-	-
3. Milky flavour	-	0.341**	1.000	0.350**	0.407**	-	0.641**	0.420**	-
4. Sweet flavour	-	0.324**	0.350**	1.000	-	-	-	-	-
5. Vanilla flavour	-	-	0.407**	-	1.000	-	0.354**	-	-
6. Adherence mouthfeel	-	-	-	-	-	1.000	-	-	0.516**
7. Creaminess mouthfeel	-	0.314**	0.641**	-	0.354**	-	1.000	0.521**	-
8. Melting mouthfeel	-	-	0.420**	-	-	-	0.521**	1.000	-
9. Mouth-coating mouthfeel	-	-	-	-	-	0.516**	-	-	1.000

Notes: Interpretation of Spearman's rank order correlations based on Cohen's guidelines (1977) (*r*): $r=0$ - $r<0.3$ =Small, $r\geq 0.3$ - $r<0.5$ =Moderate, $r\geq 0.5$ =Strong; Tendencies to correlate ($r\geq 0.3$) are indicated in bold; *Correlation is significant at the $P\leq 0.05$ level (2-tailed), **Correlation is significant at the $P\leq 0.01$ level (2-tailed).

4.3.5 The influence of chocolate ingredients on the sensory experience

According to Ares *et al.* (2011), perceived differences in the sensory attributes of samples can be explained by differences in their composition, which can further support the validity of sensory profiles. The various ingredients in the three chocolates are summarised in Table 4.5, compared to the consumer experience, as indicated by the ratings of the various sensory attributes. The ingredients and sensory experience of each evaluated chocolate will be discussed shortly and will indicate that the ingredients influenced the sensory experience of the three chocolates.

Table 4.5: Chocolate ingredients compared with the respondent experience of sensory attributes

Chocolate	Ingredients	Respondent feedback	Finding
CandereI	Sweetener (Maltitol), Inulin (Fibre), Milk Powder (Cow's Milk), Cocoa Butter, Cocoa Mass, Concentrated Butter (Cow's Milk), Emulsifier (Soy), Aspartame* (Non-Nutritive Sweetener), Flavouring.	• Highest in all bitter factor attributes. Significantly higher in bitter flavour and coffee flavour. • Lowest in all sweet factor flavour attributes. Significantly lower in sweet aroma, milky flavour and sweet flavour. • Significantly lower in gloss. • Highest in adherence, significantly lower in creaminess. Average in melting and mouth-coating.	• Main ingredient is a sweetener. • No cane sugar content. • Maltitol not as sweet as sugar. • No cane sugar content, high cocoa butter and butter content. • High fibre (inulin) content, lower cocoa butter and butter content.
Lindt	Sugar, Cocoa butter, Whole Milk Powder, Cocoa mass, Anhydrous milk Fat, Lactose (Cow's Milk), Skimmed Milk Powder, Barley Malt Extract (Gluten), Emulsifier (Soya Lecithin), Flavouring (Vanilla).	• Lowest in all bitter factor attributes. Significantly lower in bitter and burnt flavour, coffee flavour and bitter aftertaste. • Highest in all sweet factor attributes. Significantly higher in gloss, sweet aroma, milky flavour and vanilla flavour	• Main ingredient is sugar. • Main ingredient is sugar, also contains lactose.

Table 4.5 continued

Chocolate	Ingredients	Respondent feedback	Finding
Lindt	Sugar, Cocoa Butter, Whole Milk Powder, Cocoa Mass, Anhydrous Milk Fat, Lactose (Cow's Milk), Skimmed Milk Powder, Barley Malt Extract (Gluten), Emulsifier (Soya Lecithin), Flavouring (Vanilla).	• Highest in most mouthfeel attributes especially creaminess, melting and mouth-coating, significantly more creamy and melting. • Significantly higher in milky flavour. • Significantly higher in vanilla flavour	• Cocoa butter the second, cocoa mass the fourth and anhydrous milk fat the fifth ingredient. • Contains whole milk powder and skimmed milk powder. • Contains vanilla flavouring.
Nestlé	Cane sugar, Full Cream Milk Powder, Cocoa Mass, Vegetable fat (Palm Fruit, Shea Nut, Illipe Seed), Cocoa Butter, Whey powder, Emulsifiers (Soya Lecithin E322, E476), Flavouring.	• Average for all bitter factor flavour attributes with the exception of burnt which is the highest. • Average for many sweet factor attributes with the exception of gloss (significantly lower rating for gloss) and sweet flavour (high in sweet flavour) • Average for adherence and creaminess however lowest on melting and mouth-coating.	• Sugar is the first ingredient but also contains various vegetable fats and flavouring. • High cane sugar content • High vegetable fat content may influence lower gloss • Various different vegetable fats included in addition to cocoa mass and cocoa butter.

4.3.5.1 Canderel

The consumer panel found Canderel to be highest scoring for the bitter factor average (mean factor score=1.270; Table 4.2) and for all individual sensory attributes included in this factor, as well as lowest for all the flavour attributes of the sweet factor (mean factor score=1.500; Table 4.2). From the ingredient list in Table 4.5, it can be seen that Canderel contains only artificial sweeteners and no cane sugar, which respondents could have, in combination with the bitter compounds which are naturally found in cocoa beans, interpreted as bitter. Lagast *et al.* (2018) found that chocolates with low-calorie sweeteners such as tagatose and stevia differed significantly ($P \leq 0.05$) in sweetness and bitterness to chocolates with sucrose. It also corresponds with previous research showing an enhancing impact of stevia on non-sweet flavours such as bitterness (Prakash *et al.*, 2008) and a weakening impact of sucrose on bitterness (Prawira & Barringer, 2009). Furthermore, according to Guinard and Mazzucchelli (1999), low-fat chocolates tend to be more bitter, as fat can mask bitter compounds, and as a result, bitterness increases with a reduction in fat content. The ingredient list of Canderel indicates a high amount of inulin in the product, unlike Nestlé and Lindt which contains high amounts of cocoa butter and milk powder, as inulin is added for the benefits of product creaminess and thickness (Rad *et al.*, 2012).

From a texture point of view, Canderel was rated highest on adherence (mean=1.62), but lowest in creaminess (mean=1.38), and average in melting (mean=1.94) and mouth-coating (mean=1.71) (Table 4.1). This could also be due to the high product content of inulin in combination with less cocoa butter and cocoa mass than the other chocolates, which could explain the mouthfeel experience, especially the low score on creaminess. Shah *et al.* (2010) found no substantial impact on the hardness of chocolate when sucrose was replaced by stevia as a sweetening agent but reported that inulin and polydextrose which is used as bulking agents impacts texture.

4.3.5.2 Lindt

Lindt was found to be lowest for the bitter factor (mean factor score=0.680; Table 4.2) and for all the individual sensory attributes included in this factor, and the highest for the sweet factor (mean factor score=2.180; Table 4.2) and for all the individual sensory attributes included in this factor. This chocolate contains sugar as the main (first) ingredient, as well as lactose, which would result in high sweetness and low perceived bitterness. It also contained a vanilla

flavouring and was rated high on vanilla flavour (mean=1.29; Table 4.1). According to Magelund (2013), sweeter and less bitter flavour notes can be caused by the additional ingredients in chocolates such as milk powder and flavours. From a mouthfeel point of view, it is indicated in the ingredient list that Lindt contains cocoa butter as the second ingredient and cocoa mass as the fourth, as well as milk fat, which could have resulted in this intense experience of mouthfeel. It was also found to be the glossiest (mean=1.70; Table 4.1), which could be linked to the high sugar and maltose content.

4.3.5.3 Nestlé

Nestlé was rated average for the bitter factor flavour attributes (mean factor score=0.970; Table 4.2) and average on most attributes in the sweet factor (mean factor score=1.610; Table 4.2) with the exception of gloss (it was found to be the least glossy) (mean=0.91; Table 4.1), and low means for melting (mean=1.88; Table 4.1) and mouth-coating (mean=1.67; Table 4.1). This could be as sugar is the main ingredient, but it also contains a high level of other non-sweetening ingredients such as milk powder and various types of vegetable fat. It also contains barley malt extract which may have been interpreted as bitter and specifically burnt (as indicated in Table 4.1) and may have impacted sweetness. Low perceived gloss could possibly be due to the high level of milk powder and vegetable fat. From a texture point of view, it contains a high amount of milk powder and whey powder but also high amounts of vegetable fat, which could contribute to the dampened experience of the mouthfeel attributes, specifically melting and mouth-coating.

4.3.6 Chocolate sensory profiles

Sensory profiles were constructed for each of the three chocolates based on mean attribute ratings, and the resulting sensory profiles can be seen in Figure 4.1, 4.2, 4.3 and 4.4. The sensory profiles of the three chocolates were combined in Figure 4.1 to illustrate the variation in the sensory experience of the chocolates, which is based on the intensity to which the sensory attributes were experienced. This is in line with the findings of a study by Schouteten *et al.* (2015) where emotion and sensory terms were rated by consumers, which reported that the sensory profiles of products evaluated were also varied and thus clearly defined. There are, however, similarities in the profiles of Canderel and Nestlé for some sensory attributes, with only variations in intensity to which the attributes were experienced. The profiles were found to be almost identical (refer to Table 4.1 for mean attribute ratings) for the attributes mouth-coating

(Canderel mean=1.71; Nestlé mean=1.67), melting (Canderel mean=1.94; Nestlé mean=1.88), adherence (Canderel mean=1.62; Nestlé mean=1.60), and burnt flavour (Canderel mean=0.80; Nestlé=0.83), however significantly different ($P \leq 0.01$) for the other ten measured attributes. Lindt differed significantly ($P \leq 0.01$) from Canderel and Nestlé for most attributes.

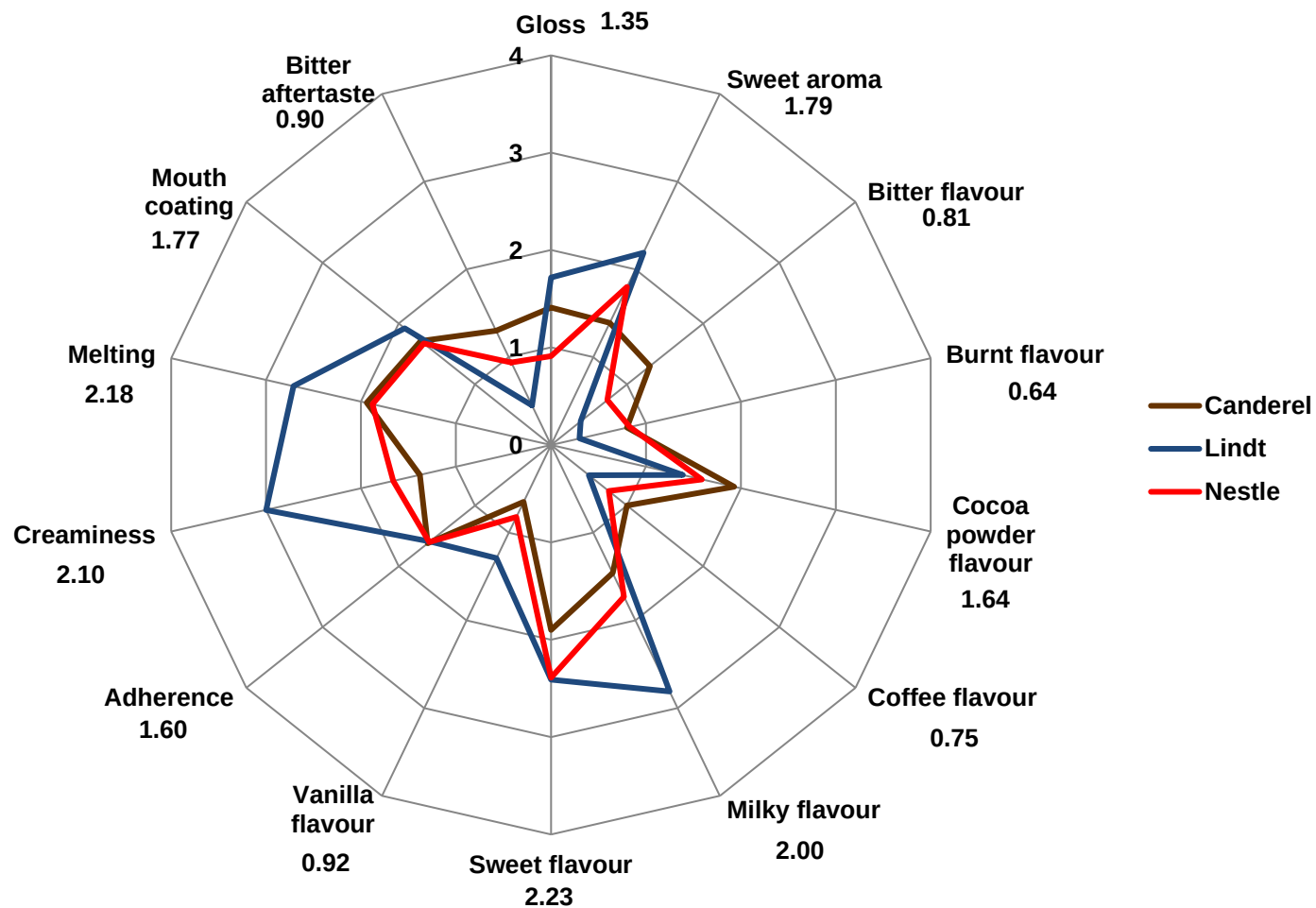


Figure 4.1: Comparison of sensory profiles of the three commercial chocolates

Notes: *Likert scale*: 0=Not at all, 1=Slightly, 2=Moderately, 3=Very, 4=Extremely; Mean factor loading score: <1.0=Not present at all, ≥ 1.0 -<2.0=Slightly present, ≥ 2.0 -<3.0=Moderately present, ≥ 3.0 -<4.0=Very present and 4.0=Extremely present.

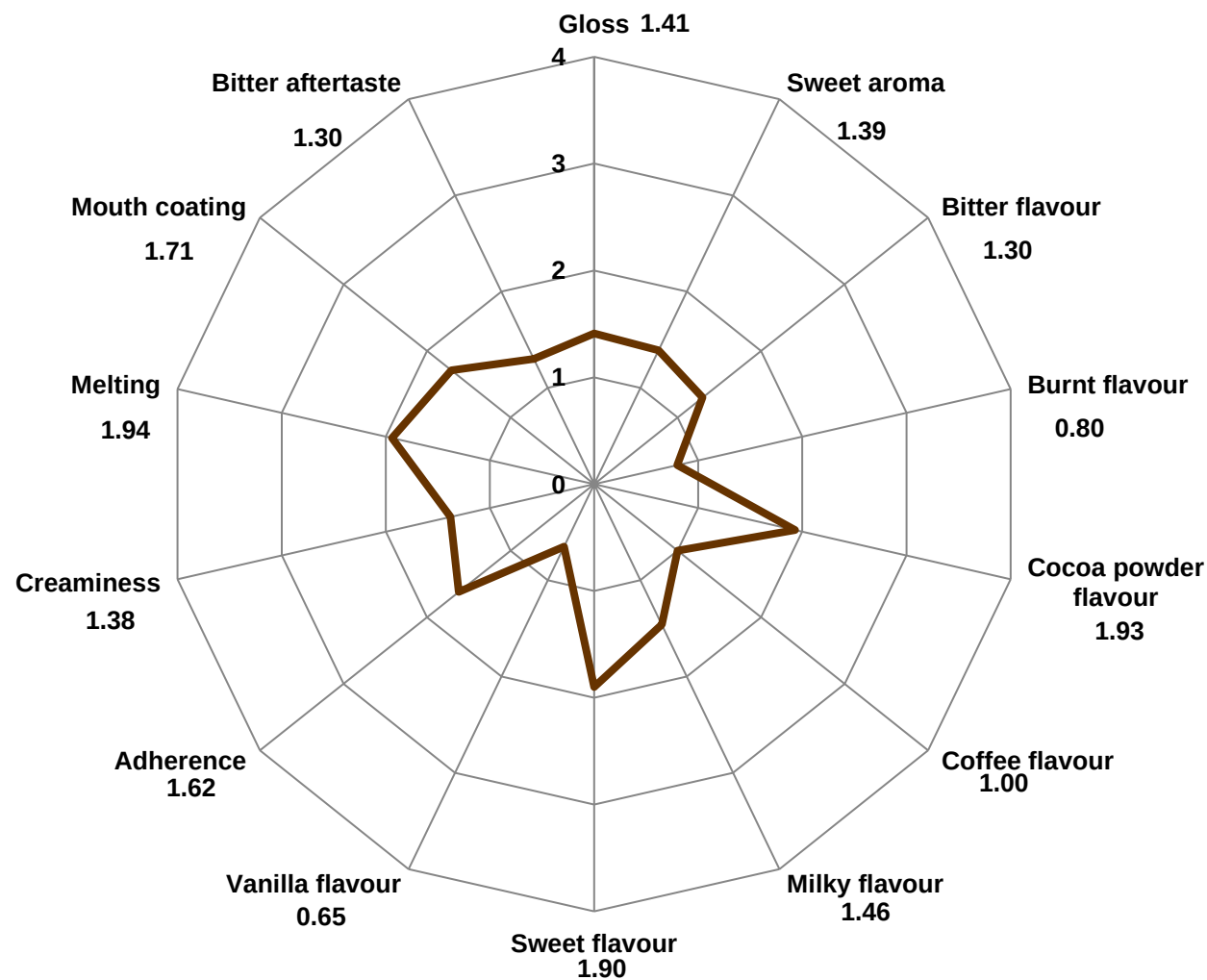


Figure 4.2: Sensory profile of Canderel

Notes: *Likert scale*: 0=Not at all, 1=Slightly, 2=Moderately, 3=Very, 4=Extremely; Mean factor loading score: <1.0=Not present at all, ≥1.0-<2.0=Slightly present, ≥2.0-<3.0=Moderately present, ≥3.0-<4.0=Very present and 4.0=Extremely present.

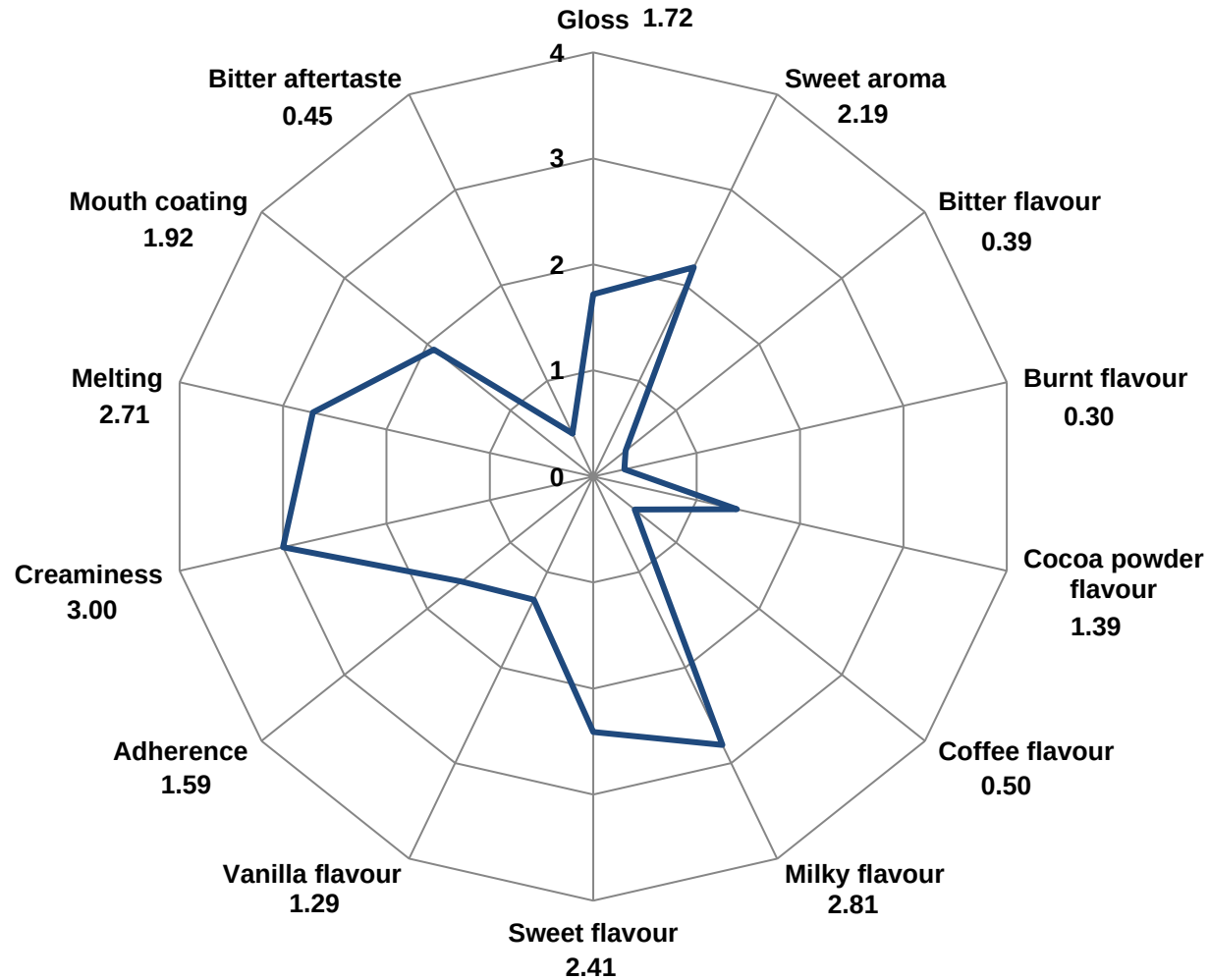


Figure 4.3: Sensory profile of Lindt

Notes: *Likert scale*: 0=Not at all, 1=Slightly, 2=Moderately, 3=Very, 4=Extremely; Mean factor loading score: <1.0=Not present at all, ≥1.0-<2.0=Slightly present, ≥2.0-<3.0=Moderately present, ≥3.0-<4.0=Very present and 4.0=Extremely present.

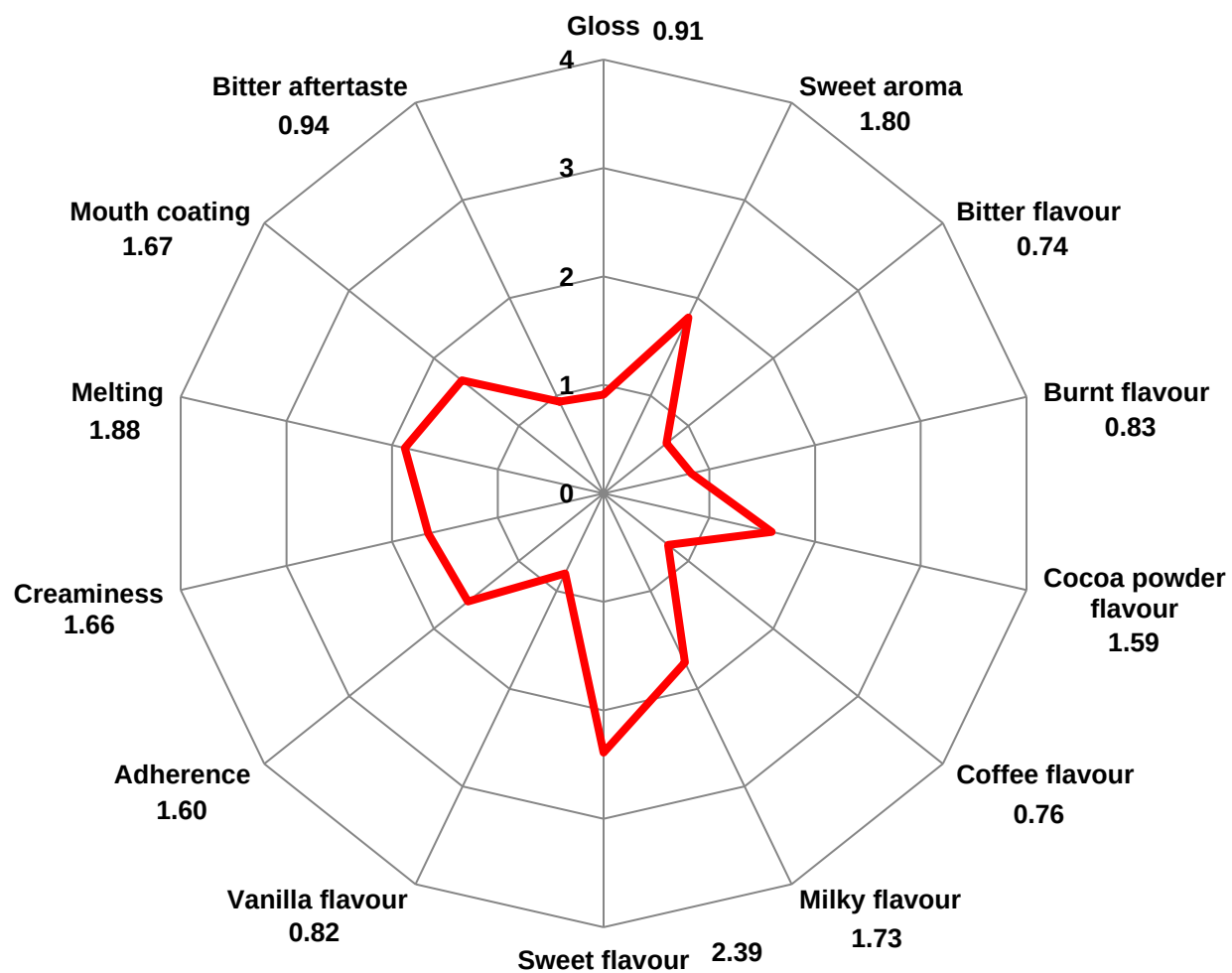


Figure 4.4: Sensory profile of Nestlé

Notes: *Likert scale*: 0=Not at all, 1=Slightly, 2=Moderately, 3=Very, 4=Extremely; Mean factor loading score: <1.0=Not present at all, ≥ 1.0 -<2.0=Slightly present, ≥ 2.0 -<3.0=Moderately present, ≥ 3.0 -<4.0=Very present and 4.0=Extremely present.

4.3.6.1 The sensory profile of Canderel

As indicated in Figure 4.2, Canderel had a constricted sensory profile compared to Lindt and Nestlé due to overall lower (mean) ratings and thus, intensity of sensory attributes. The attributes which respondents experienced most intensely for this chocolate (in comparison to the intensity ratings of all sensory attributes for this chocolate) were cocoa powder flavour (mean=1.93), melting mouthfeel (mean=1.94), and sweet flavour (mean=1.90).

4.3.6.2 The sensory profile of Lindt

The sensory profile of Lindt (Figure 4.3) illustrates the flavourful and intense mouthfeel experience of this chocolate. The overall average mean rating for all sensory attributes as summarised in Table 4.1, also indicates that the overall experience with this chocolate was at a higher intensity compared to Canderel and Nestlé. The attributes which respondents experienced most intensely for this chocolate (in comparison to the intensity ratings of all sensory attributes for this chocolate) were creaminess mouthfeel (mean=3.00), milky flavour (mean=2.81), and melting mouthfeel (mean=2.71).

4.3.6.3 The sensory profile of Nestlé

The profile of Nestlé (in Figure 4.4) is similar to Canderel in that it is also somewhat with overall low mean ratings (indicated in Table 4.1), however, as these values were higher than those of Canderel, it appears that respondents interpreted the sensory experience of Nestlé as a mainstream product through average sensory ratings amongst two more complex products with distinctive product profiles. The attributes which respondents experienced most intensely for this chocolate (in comparison to the intensity ratings of all sensory attributes for this chocolate) were sweet flavour (mean=2.39), melting mouthfeel (mean=1.88), and milky flavour (mean=1.73).

4.4 CONCLUSION

This chapter aimed to prepare a sensory profile for chocolate. In order to prepare and describe the sensory profiles, the intensity of the sensory experience with each chocolate was determined by calculating mean values for each sensory attribute, and the differences between these mean ratings determined the variation in the sensory experience between the three chocolates. Respondents (and chocolate consumers) were able to evaluate and rate the intensity of the sensory attributes of the three chocolates, resulting in the identification of various

significant differences between samples. Based on the mean ratings calculated for each attribute, significant differences were indicated for 12 of the 14 sensory attributes within the set of chocolates, and all three chocolates were found to be significantly different from each for eight of these sensory attributes. Sensory attributes which differentiated most between the samples were gloss, milky flavour, bitter flavour, melting, creaminess and bitter aftertaste. As the three chocolates were found to have multiple significant differences, separate sensory profiles were prepared which reflected the varied experience, rather than only one profile based on the mean values of the sensory attributes of all three chocolates combined. When comparing the sensory profiles of the chocolates to the ingredient contained, they are clearly influenced by and thus anchored in the make-up of the product. In summary, consumers could accurately convey their experiences of the sensory attributes, and this data could (and thus can) be used to construct distinct sensory profiles of chocolates. Furthermore, consumers can be employed to provide information regarding the sensory attributes of foods, and as it is from their perspective, it could be more actionable from a development and marketing perspective than data obtained with a trained panel.

CHAPTER 5

THE EMOTIONAL PROFILE OF CHOCOLATE

5.1 INTRODUCTION

Information on what makes people feel good (or bad) and what exactly they feel when using or consuming a product is vital to understand product experiences fully, because different emotions can have different effects on consumers and ultimately user behaviour (Schifferstein & Desmet, 2010). To assess the emotional response to chocolate and to generate emotional profiles of these chocolates based on the consumption experience, the EsSense25 profile (King & Meiselman, 2010) was provided to respondents in a questionnaire format to rate the presence of and intensity to which emotions were experienced during the consumption of the three unbranded chocolates, as different unbranded chocolate products have been found to yield different emotional profiles (Thomson *et al.*, 2010).

In this chapter, results are reported in the following manner: The emotions associated with chocolate are firstly summarised based on the frequency of selection of the various emotion descriptors. This is followed by an overview of the intensity of the emotional experience of the three chocolates based on mean values assigned to these descriptors. A summary of the factor analysis conducted which classified emotions into groups and showcased the overall relationship between emotion attributes is then presented. The relationship between individual emotions within each chocolate is then reviewed. Lastly, the overall relationship between emotions is visualised through a PCA plot, followed by a visualisation of the individual emotional experiences of the three chocolates through spider graphs. An emotional profile of chocolate, as one of the study objectives, is thus presented in Section 5.7.

5.2 STATISTICAL ANALYSIS

Statistical analysis was conducted as presented in Table 3.4. Through descriptive statistics, mean ratings were calculated in order to describe the sensory experience of the respondents. This was followed by Repeated Measures ANOVA and Bonferroni post-hoc tests, through which the means of individual emotion attributes of the three chocolates were compared in order to

identify significant ($P \leq 0.05$) differences between the mean scores of the individual chocolates. Factor analysis including Oblimin rotation with Kaiser normalisation was then conducted to reduce and group the number of emotion variables and to construct pattern matrixes for all three chocolates. The relationships between emotions are visualised through PCA. The reliability of the applied tool (Appendix Z) was also determined through factor analysis based on the Cronbach's Alpha's of the extracted factors. Each extracted factor for each of the chocolates resulted in $\alpha \geq 0.6$ which is regarded as acceptable.

5.3 RESULTS AND DISCUSSION

5.3.1 Emotions experienced during chocolate consumption

5.3.1.1 Relevance of emotions included

As a standard emotion questionnaire was employed, not all attributes will be relevant or of equal value in capturing the emotional experience evoked by the consumption of chocolate, and any list of emotion words could contain considerable redundancy (Prescott, 2017). Nestrud *et al.* (2016) illustrated this by measuring emotional response to food names of four different food categories with the EsSense profile (King & Meiselman, 2010), namely apple pie, steamed broccoli, potato chips and roast turkey, and found that there is a low incidence of some emotions being selected to describe the emotional experience associated with the various food products. Emotions with low incidence from the EsSense25 lexicon (King & Meiselman, 2010) across these four categories included aggressive, disgusted, guilty, wild and worried, three terms which were uncategorised and two which were classified as negative according to the EsSense25 profile. Jaeger *et al.* (2018) also reported that guilty, wild and worried were the least frequently used words by consumers in another study and also mentioned findings of one further study in which there was a zero percent frequency of use of the words wild and worried.

The application of a RATA scale in this study offered respondents the opportunity to rate the intensity to which they experienced the emotion by scoring it between one and four on the scale, but also to indicate when the emotion was not experienced and was thus not applicable, which was then scored as 0 on the scale. Table 5.1 captures the emotions which are relevant to the chocolate eating experience (the emotions have been categorised as positive, negative or unclassified based on the EsSense25 classification). It captures both the percentage of responses where zero (not applicable) was selected, indicating that the emotion was not experienced during consumption, and the ratings from one to four which indicate the emotions

were experienced slightly, moderately, very or extremely. A frequency of use of 10% has been indicated as a critical level for the identification of emotions associated with the food experience (Laros & Steenkamp, 2005), and based on this, all emotions measured in this study played a role during chocolate consumption, as all achieved frequency score higher than 10%. The emotion attributes which had a low overall incidence or association with chocolate (% ratings 1-4) for all three chocolates were in line with the findings of Nestrud *et al.* (2016) and Jaeger *et al.* (2018), with the negative emotions, aggressive (14.9%), worried (16.9%), wild (27.0%), disgusted (29.2%), guilty (36.5%) and bored (41.2%) indicated as having low presence (in descending order).

Table 5.1: Emotions relevant to the chocolate eating experience (% frequency of use)

	Canderel		Lindt		Nestlé		Mean of 3 chocolates	
	0	1-4	0	1-4	0	1-4	0	1-4
Positive emotions								
Active	47.1	52.9*	48.5	51.5*	37.5	62.5*	44.4	55.6*
Adventurous	52.2	47.8	49.3	50.7*	34.6	65.4*	45.4	54.6*
Calm	18.4	81.6*	18.4	81.6*	12.5	87.5*	16.4	83.6*
Enthusiastic	44.9	55.1*	38.2	61.8*	22.1	77.9*	35.1	64.9*
Free	36.0	64.0*	33.8	66.2*	21.3	78.7*	30.4	69.6*
Good	20.6	79.4*	21.3	78.7*	10.3	89.7*	17.4	82.6*
Good-natured	27.2	72.8*	26.5	73.5*	16.9	83.1*	23.5	76.5*
Happy	22.1	77.9*	22.8	77.2*	5.10	94.9*	16.7	83.3*
Interested	34.6	65.4*	33.8	66.2*	16.9	83.1*	28.4	71.6*
Joyful	36.8	63.2*	32.4	67.6*	14.7	85.3*	28.0	72.0*
Loving	34.6	65.4*	33.8	66.2*	17.6	82.4*	28.7	71.3*
Nostalgic	54.4	45.6	52.9	47.1	37.5	62.5*	48.3	51.7*
Pleasant	25.7	74.3*	19.9	80.1*	14.7	85.3*	20.1	79.9*
Satisfied	38.2	61.8*	28.7	71.3*	16.9	83.1*	27.9	72.1*
Secure	39.0	61.0*	41.9	58.1*	27.2	72.8*	36.0	64.0*
Warm	35.3	64.7*	35.3	64.7*	16.9	83.1*	29.2	70.8*
Negative emotions								
Bored	47.8	52.2*	51.5	48.5	77.2	22.8	58.8	41.2
Disgusted	61.8	38.2	63.2	36.8	87.5	12.5	70.8	29.2

Table 5.1 continued

	Canderel		Lindt		Nestlé		Mean of 3 chocolates	
	0	1-4	0	1-4	0	1-4	0	1-4
Negative emotions								
Worried	83.8	16.2	80.9	19.1	84.6	15.4	83.1	16.9
Unclassified emotions								
Aggressive	83.1	16.9	83.1	16.9	89.0	11.0	85.1	14.9
Guilty	65.4	34.6	59.6	40.4	65.4	34.6	63.5	36.5
Mild	36.0	64.0*	28.7	71.3*	30.1	69.9*	31.6	68.4*
Tame	47.8	52.2*	45.6	54.4*	36.0	64.0*	43.1	56.9*
Understanding	41.2	58.8*	39.0	61.0*	25.7	74.3*	35.3	64.7*
Wild	79.4	20.6	76.5	23.5	63.2	36.8	73.0	27.0

Notes: *Likert scale: 0=Not at all, 1=Slightly, 2=Moderately, 3=Very, 4=Extremely*; *Meaningful emotional incidence (%1=4 ratings >50%).

5.3.1.2 Frequency of emotional attribute experienced during chocolate consumption

Emotion questionnaires do deliver significant differences in the frequency of use of some of the emotion terms (Ares *et al.* 2011). Table 5.1 also captures the frequency of emotions experienced during the consumption of chocolate (those rated between one and four where 1=Slightly present, 2=Moderately present, 3=Very present, 4=Extremely present, as data from RATA scales can be analysed using two different approaches, either frequency of selection or weighted frequency of selection (Ares *et al.*, 2014). To determine the presence of emotion in this study, the frequency of selection is important as this indicated the incidence of the emotion being experienced, while the intensity to which the emotion was experienced (weighted frequency) is discussed in the following section.

As no reported data could be found on the threshold for meaningful emotional incidence (such as the proposal of 10% considered as the critical level for emotions related to a food experience - which would thus include chocolate), a threshold value of 50% is proposed for this study (percentage of ratings between one and four is above 50%). A total of 18 emotions out of 25 had a meaningful association with Canderel and Lindt, and 19 emotions were associated with Nestlé. Jaeger *et al.* (2018) reported that the average percentage of emotion words used to describe samples in 10 studies surveyed ranged from 15% to 27%. However, Jiang *et al.* (2014) stated that the number of words to describe emotion towards specific merchandise varies. Product type certainly plays a role, as the number of emotions associated with the acceptability of herbs, spices and carbonated beverages was found to be higher than that of emotions related to the acceptability of meat and fish (King *et al.*, 2010). Product category is also of importance, for instance, more emotional terms were selected in a chocolate research study compared to a yoghurt research study (Schouteten *et al.*, 2015), with chocolate being classified as a highly emotional product. The high incidence of the use of emotion words in this study is furthermore in line with previous studies reporting that an extended set of words is required to describe the emotional response to chocolate (Thomson *et al.*, 2010; Cardello *et al.*, 2012), which was also found to be true for wine (Ferrarini *et al.*, 2010) and potato chips (Cardello *et al.*, 2012).

5.3.1.3 Classification of the emotional experience during chocolate consumption

The 18 emotions associated with Canderel and Lindt and the 19 emotions associated with Nestlé were predominantly positive (based on the EsSense25 classification). While Jiang *et al.* (2014) reported that conflicting emotions could be found for many foods (such as guilty, boring

and joy); the chocolate eating experience appears to be mainly positive in the present study. Kytö *et al.* (2018) also reported that positive emotions were selected more often than negative emotions, which is also in line with various studies showing that foods generally evoke more positive than negative emotions (Desmet & Schifferstein, 2008; Kim *et al.*, 2017).

The results may point to an overall positive emotional experience driven by the imbalance between positive and negative emotions of the EsSense25 profile (King & Meiselman, 2010), of which the majority of emotions are positive. However, as chocolate is a popular and favourite food, in a study by Laros and Steenkamp (2005), positive emotion terms were also used with higher frequency to describe feelings elicited by favourite food consumption. Macht and Dettmer (2006) reported that chocolate elicits mainly positive emotions due to sensory pleasure during and immediately after consumption. Desmet and Schifferstein (2008) also reported in a study on breakfast drinks that participants generally used a large number of predominantly positive emotion words to convey their emotional response, which is consistent with the hedonic asymmetry of food and food-related emotion lexicon. Desmet and Schifferstein (2008) applied 22 emotion descriptors in a study; they were equally divided between pleasant (positive) and unpleasant (negative) ones, and when respondents rated the relevance of these emotions during the tasting or eating of various foods, pleasant emotions were reported to occur more often than unpleasant ones.

5.3.1.4 Variations in the incidence of individual emotion attribute usage

When Manzocco *et al.* (2013) studied spoilage of fruit salads over time and how emotional response changed due to the spoilage that occurred, they found that positive emotions calm, friendly, peaceful, quiet and relaxed were frequently experienced during consumption of the fresh product. However, some of these emotion attributes (namely quiet, peaceful, friendly) decreased in the frequency of use as the fruit salads spoiled, and by contrast, other emotions (namely relaxed and calm) were not affected by the level of spoilage. Thus, certain emotions could be more or less impacted by the variations in the sensory profiles of the chocolates. When thus reviewing the variations in the emotional attributes with meaningful associations with the chocolates as summarised in Table 5.1, it was noted that Canderel was not associated with adventurous (47.8%) but rather with bored (52.2%), and Nestlé, was associated with the additional emotion nostalgic (62.5%).

5.3.2 Ranking and intensity of weighted mean scores of emotional attributes

In the previous section, the potential of each emotional attribute to contribute to the description of the chocolate consumption experience in terms of presence and overall relevance was discussed. In this section, as summarised in Table 5.2, the weighted mean for each emotional attribute for each chocolate is presented which has been ranked in descending order, with higher means indicated at the top of the table and the lower means at the bottom. This mean value thus combines 0 (not present) ratings with 1-4 (present) ratings on a weighted basis to provide a value which quantifies the overall importance and intensity of each emotional attribute for each of the chocolates, and to allow direct comparison of the chocolates.

Emotional attributes which are common amongst the top ten ranked attributes for all three chocolates include calm (Canderel mean=1.59, Lindt mean=1.64, Nestlé mean=2.02), good (Canderel mean=1.57, Lindt mean=1.61, Nestlé mean=2.26), good-natured (Canderel mean=1.41, Lindt mean=1.45, Nestlé mean=2.02), happy (Canderel mean=1.58, Lindt mean=1.74, Nestlé mean=2.38), pleasant (Canderel mean=1.47, Lindt mean=1.63, Nestlé mean=2.12) and interested (Canderel mean=1.29, Lindt mean=1.40, Nestlé mean=2.07), all positive emotions. These findings are similar to that of Jaeger *et al.* (2018) who reported that for chocolate the top five most frequently used words were linked to positive valence, namely good, happy, pleasant, satisfied and pleased. Many of these attributes are interestingly also similar to the results published by Kanjanakorn and Lee (2017), who studied emotional response before and after coffee consumption, and found a higher mean intensity for emotions satisfied, good, good-natured, pleasant, pleased, polite and happy. Thomson *et al.* (2010) stated that some of the most influential conceptualisations might seem counterintuitive, for example, trustworthiness is one of the main conceptualisations engendered by dark chocolate. In the present study, good-natured was highly ranked for all three chocolates (Canderel mean=1.41, Lindt mean=1.45, Nestlé mean=2.02).

Canderel furthermore (other top-ranked emotions in addition to the overlapping emotions in the top 10 reported above) evoked the emotions warm (mean=1.32), free (mean=1.32), loving (mean=1.31), and mild (mean=1.05); Lindt evoked joyful (mean=1.49), satisfied (mean=1.48), free (mean=1.31), and mild (mean=1.27); and Nestlé evoked satisfied (mean=2.27), loving (mean=2.08), and warm (mean=1.99). These emotions were also all positive emotions (based on the classification of the EsSense25 profile). All negative emotions (as classified by

EsSense25, namely bored, disgusted and worried) ranked low in this mean ranking for all three chocolates, with all means <1 (not present at all). Uncategorized emotions (as classified by EsSense25, namely aggressive, guilty, mild, tame, understanding and wild) also had low rankings for all three chocolates, with all means at either <1 (not present at all) or ≥ 1 - <2.0 (slightly present). As reported in Section 5.3.1.3, the overall experience with chocolate in this study was thus positive, and the weighted means and ranking of these values further support this finding. Overall mean scores for the emotion attributes indicate that the consumption of Nestlé (mean=1.49) evoked the most intense emotional experience and Canderel (mean=1.07) the least.

Table 5.2: Ranking (descending order) of weighted mean scores of emotions experienced during chocolate consumption

Canderel		Lindt		Nestlé		All three chocolates	
Emotion	Mean	Emotion	Mean	Emotion	Mean	Emotion	Mean
Calm	1.59	Happy	1.74	Happy	2.38	Happy	1.90
Happy	1.58	Calm	1.64	Satisfied	2.27	Good	1.81
Good	1.57	Pleasant	1.63	Good	2.26	Calm	1.75
Pleasant	1.47	Good	1.61	Pleasant	2.12	Pleasant	1.74
Good-natured	1.41	Joyful	1.49	Joyful	2.10	Satisfied	1.69
Free	1.32	Satisfied	1.48	Loving	2.08	Good-natured	1.63
Satisfied	1.32	Good-natured	1.45	Interested	2.07	Joyful	1.63
Warm	1.32	Loving	1.41	Calm	2.02	Loving	1.60
Loving	1.31	Interested	1.40	Good-natured	2.02	Interested	1.59
Joyful	1.30	Warm	1.35	Warm	1.99	Warm	1.55
Secure	1.30	Free	1.31	Free	1.83	Free	1.49
Interested	1.29	Mild	1.27	Secure	1.76	Secure	1.42
Understanding	1.14	Understanding	1.26	Enthusiastic	1.71	Understanding	1.35
Mild	1.05	Secure	1.19	Understanding	1.65	Enthusiastic	1.29
Enthusiastic	1.04	Enthusiastic	1.11	Adventurous	1.39	Mild	1.23
Bored	0.99	Tame	1.04	Mild	1.36	Active	1.09
Tame	0.93	Active	1.01	Active	1.35	Tame	1.09
Active	0.91	Adventurous	0.95	Nostalgic	1.34	Adventurous	1.07

Table 5.2 continued

Canderel		Lindt		Nestlé		All three chocolates	
Emotion	Mean	Emotion	Mean	Emotion	Mean	Emotion	Mean
Adventurous	0.88	Nostalgic	0.90	Tame	1.29	Nostalgic	1.01
Nostalgic	0.80	Bored	0.86	Wild	0.71	Bored	0.73
Disgusted	0.71	Guilty	0.75	Guilty	0.70	Guilty	0.70
Guilty	0.68	Disgusted	0.59	Bored	0.32	Disgusted	0.50
Wild	0.37	Wild	0.43	Worried	0.25	Wild	0.50
Aggressive	0.27	Worried	0.34	Disgusted	0.19	Worried	0.28
Worried	0.25	Aggressive	0.24	Aggressive	0.17	Aggressive	0.23
Mean	1.07	Mean	1.14	Mean	1.49	Mean	1.23

Notes: *Likert scale: 0=Not at all, 1=Slightly, 2=Moderately, 3=Very, 4=Extremely*; Interpretation of mean scores: <1.0=Not present at all, ≥1.0-<2.0=Slightly present, ≥2.0-<3.0=Moderately present, ≥3.0-<4.0=Very present and 4.0=Extremely present.

5.3.3 Describing the emotional experience of chocolate

5.3.3.1 Comparison of the emotional experience of the three chocolates

The mean emotion attribute ratings of the three chocolates were reviewed to gauge whether respondents found the three chocolates to be different. Table 5.3 captures the mean ratings and standard deviations of all the emotions associated with each chocolate (emotions have once again been categorised as positive, negative or unclassified based on the EsSense25 classification). Repeated Measures ANOVA were performed for the means of all three chocolates for each of the 25 individual emotion attributes in order to identify whether significant ($P \leq 0.05$) differences exist between these mean scores within the set. The Bonferroni post-hoc test was then performed, which is an adjustment made to P values when several statistical tests are being performed simultaneously on a single data set, as the Bonferroni post-hoc test adjusts the significance cut-off based on α (P -value) / n (Napierala, 2012).

Based on the mean ratings calculated for each attribute, significant ($P \leq 0.05$) differences were indicated for 22 of the 25 emotion attributes within the set of chocolates, but for none of the attributes were all three chocolates found to be significantly ($P \leq 0.05$) different from each other. Only the emotions aggressive (Canderel mean=0.27, Lindt mean=0.24, Nestlé mean=0.17), guilty (Canderel mean=0.68, Lindt mean=0.75, Nestlé mean=0.70) and worried (Canderel

mean=0.25, Lindt mean=0.34, Nestlé mean=0.25) were experienced in similar (low) intensity across all three chocolates. Across the various emotions, Nestlé was the chocolate that was found to be most often significantly ($P \leq 0.05$) different to Canderel and Lindt, except for the emotion mild, where Canderel was found to be significantly ($P \leq 0.05$) different to Lindt and Nestlé. It appears thus that the emotional experience of Canderel and Lindt was similar, but Nestlé evoked the experience of different emotions to the other two chocolates.

Table 5.3: Variations in mean ratings of emotions experienced during chocolate consumption

	Canderel Mean ±SD	Lindt Mean ±SD	Nestlé Mean ±SD	Sign. level
Positive emotions				
Active	0.91 ^a ±1.05	1.01 ^a ±1.15	1.35 ^b ±1.26	$P \leq 0.01$
Adventurous	0.88 ^a ±1.09	0.95 ^a ±1.12	1.39 ^b ±1.27	$P \leq 0.01$
Calm	1.59 ^a ±1.09	1.64 ^a ±1.07	2.02 ^b ±1.16	$P \leq 0.01$
Enthusiastic	1.04 ^a ±1.14	1.11 ^a ±1.07	1.71 ^b ±1.17	$P \leq 0.01$
Free	1.32 ^a ±1.28	1.31 ^a ±1.17	1.83 ^b ±1.27	$P \leq 0.01$
Good	1.57 ^a ±1.17	1.61 ^a ±1.19	2.26 ^b ±1.24	$P \leq 0.01$
Good-natured	1.41 ^a ±1.13	1.45 ^a ±1.13	2.02 ^b ±1.29	$P \leq 0.01$
Happy	1.58 ^a ±1.13	1.74 ^a ±1.26	2.38 ^b ±1.12	$P \leq 0.01$
Interested	1.29 ^a ±1.19	1.40 ^a ±1.25	2.07 ^b ±1.30	$P \leq 0.01$
Joyful	1.30 ^a ±1.20	1.49 ^a ±1.26	2.10 ^b ±1.29	$P \leq 0.01$
Loving	1.31 ^a ±1.18	1.41 ^a ±1.26	2.08 ^b ±1.34	$P \leq 0.01$
Nostalgic	0.80 ^a ±1.05	0.90 ^a ±1.11	1.34 ^b ±1.33	$P \leq 0.01$
Pleasant	1.47 ^a ±1.15	1.63 ^a ±1.12	2.12 ^b ±1.25	$P \leq 0.01$
Satisfied	1.32 ^a ±1.30	1.48 ^a ±1.22	2.27 ^b ±1.35	$P \leq 0.01$
Secure	1.30 ^a ±1.28	1.19 ^a ±1.21	1.76 ^b ±1.39	$P \leq 0.01$
Warm	1.32 ^a ±1.22	1.35 ^a ±1.24	1.99 ^b ±1.29	$P \leq 0.01$
Negative emotions				
Bored	0.99 ^a ±1.16	0.86 ^a ±1.06	0.32 ^b ±0.67	$P \leq 0.01$
Disgusted	0.71 ^a ±1.08	0.59 ^a ±0.91	0.19 ^b ±0.55	$P \leq 0.01$
Worried	0.25 ^a ±0.68	0.34 ^a ±0.80	0.25 ^a ±0.68	$P = 0.396$

Table 5.3 continued				
	Canderel Mean ±SD	Lindt Mean ±SD	Nestlé Mean ±SD	Sign. level
Unclassified emotions				
Aggressive	0.27 ^a ±0.69	0.24 ^a ±0.60	0.17 ^a ±0.55	$P=0.303$
Guilty	0.68 ^a ±1.12	0.75 ^a ±1.14	0.70 ^a ±1.08	$P=0.518$
Mild	1.05 ^a ±0.95	1.27 ^{ab} ±1.04	1.36 ^b ±1.18	$P\leq 0.01$
Tame	0.93 ^a ±1.08	1.04 ^a ±1.18	1.29 ^b ±1.22	$P\leq 0.01$
Understanding	1.14 ^a ±1.14	1.26 ^a ±1.23	1.65 ^b ±1.27	$P\leq 0.01$
Wild	0.37 ^a ±0.81	0.43 ^a ±0.86	0.71 ^b ±1.10	$P\leq 0.01$

Notes: *Likert scale*: 0=Not at all, 1=Slightly, 2=Moderately, 3=Very, 4=Extremely; Interpretation of mean scores: <1.0=Not present at all, 1.0≥<2.0=Slightly present, ≥2.0-<3.0=Moderately present, ≥3.0-<4.0=Very present and 4.0=Extremely present; Means with different superscripts (a, b, c) in the same row indicate that these mean values differ significantly ($P\leq 0.01$) from each other.

5.3.3.2 Emotion discrimination between samples

Being discriminate can be viewed as one of the criteria when judging whether an emotion term has a clear meaning or not, but more statistically (Jiang *et al.*, 2014). Some studies have shown that emotions can be highly discriminating, as all emotion factors included in a study by Chaya *et al.* (2015) discriminated between samples, and through the application of the EsSense tool, Jaeger *et al.* (2018) found that it was possible to differentiate between products from the same product category which resulted in distinguishable groups of products. However, King *et al.* (2013) indicated that the number of significant difference in emotions increased with the number of products included in a test (King & Meiselman, 2010), and discrimination may thus be dependent on the number of samples and/or methodology and not necessarily on the types of samples included.

In this study, no single emotion attribute was able to discriminate between all three the samples as indicated in Table 5.3. The emotion list, however, discriminated between Nestlé and the other two chocolates, as it was indicated as significantly ($P\leq 0.05$) different to the other two chocolates for the majority of the measured emotion attributes. Emotions in this study which achieved $P\leq 0.01$ were all positive emotions, and those which were not significantly ($P\leq 0.05$)

different between the samples included the negative emotions (based on the classification of the EsSense25 profile), namely worried, guilty and aggressive. However, emotion words with negative meanings are not expected to be irrelevant (Kuesten *et al.*, 2014; Meiselman, 2015; Meiselman, 2017). They are rather expected to be applicable in certain instances, for example, to describe disliked samples (Kuesten *et al.*, 2014; Piqueras-Fiszman & Jaeger, 2014; Jaeger *et al.*, 2017).

Jaeger *et al.* (2018) found significant ($P \leq 0.05$) differences between samples for the emotions active, adventurous, daring, energetic, free, guilty, quiet, tame, wild and worried. Jaeger *et al.* (2018) also reported that emotion words linked to the positive pole (pleasure) of the valence dimension (namely happy, glad, good, pleasant, pleased, satisfied, loving and affectionate) were discriminating, as were words linked to the negative pole (displeasure) of this dimension (namely disgusted, worried, aggressive, and guilty). Positive words are, however, generally less discriminatory, as Fredrickson (1998) suggested that people do not need to make subtle distinctions between various positive emotions. Emotion words with positive meanings are, however, believed to be more applicable to characterise samples than emotion words with negative meanings, as this corresponds with a general positive affective disposition towards food and eating, which is also reflected in the lists of emotion words used in food-related research (Desmet & Schifferstein, 2008).

5.4 THE RELATIONSHIP BETWEEN EMOTIONS EXPERIENCED DURING CHOCOLATE CONSUMPTION

5.4.1 Factor analysis to group emotions

In order to investigate and understand emotions, some studies point to the need to classify emotions as either positive or negative (Laros & Steenkamp, 2005; King *et al.*, 2010), while some researchers prefer just reporting terms with high inter-item correlations (Jiang *et al.*, 2014). Most studies classify emotion only by its positive or negative effects as it keeps the study model simple and easy to analyse (Jiang *et al.*, 2014). The positive or negative valence of emotions, representing a distinction in the pleasantness dimensions, plays an important role in describing and categorising different emotions (Schifferstein & Desmet, 2010). Attributes that are considered neutral (such as surprise) have no intrinsic valence, as it could be positive or negative, and most researchers agree that to qualify as an emotion, a state must have a specific valence (Turner & Ortony, 1992). While it is considered that some emotions are neither positive

nor negative, through PCA, terms such as daring, eager, guilty, mild, polite, quiet, steady, or curious and proud (Jiang *et al.*, 2014) can result in a classification and understanding of whether they are deemed as positive or negative instead of unclassified (according to the EsSense25 profile) within the context of a study (Ng *et al.*, 2013).

A factor analysis of the collected data was performed using the Maximum Likelihood method of extraction for the data set of each chocolate. Initially, five factors with eigenvalues greater than one were extracted for all three chocolates. A series of factor analyses were conducted which indicated that two factors gave the most interpretable solution for all three chocolates. For all three chocolates, based on the two factors, the Bartlett's test of sphericity, which tests the overall significance of all the correlations within the correlation matrix, was significant (Canderel: $\chi^2=2,992$, $P\leq 0.01$; Lindt: $\chi^2=3,094$, $P\leq 0.01$; Nestlé: $\chi^2=2,993$, $P\leq 0.01$) indicating that it was appropriate to use the factor analytic model on this set of data. The Kaiser-Meyer-Olkin measure of sampling adequacy indicated that the strength of the relationships among variables was high for all three chocolates (Canderel KMO=0.928, Lindt KMO=0.943, Nestlé KMO=0.941). Thus, it was acceptable to proceed with the analysis. An Oblimin rotation was performed since factors were expected to be correlated. The obtained pattern matrix is displayed in Table 5.4, and all factor loadings were above 0.4, except for guilty (0.298) and all are thus displayed. For Canderel, the two extracted factors together accounted for 60.71% of the variance, for Lindt 62.65% and for Nestlé, 60.71%. The internal consistency of all factors was high, with acceptable Cronbach's Alpha values for both factors for each of the chocolates ($\alpha=0.968$ for the positive factor and $\alpha=0.613$ for the negative factor).

Factor analysis in the current study thus revealed two factors which were sufficient to explain the underlying structure of sensory properties for all three chocolates, which was a much simpler classification than what resulted from other studies. Cardello *et al.* (2012) reported in a study with 39 emotion terms that a high percentage of variability could be explained with six or fewer emotion factors, while Porcherot *et al.* (2010) proposed a six-factor solution, and an eight-factor solution was proposed by Pineau *et al.* (2010). The pattern matrixes in Table 5.4, 5.5 and 5.6 revealed factor one to consist of 20 items and based on the attributes included in each factor, it was labelled "positive emotion". The second factor consisted of five items and based on the attributes included in each factor; it was labelled "negative emotion". All attributes of the study loaded onto a factor. Inter-item correlation values were higher for the bitter factors than for

the sweet factors for all three chocolates. Overall, for these samples, the 25-item total scale seems to capture a general and internally consistent dimension of emotional expressivity that includes both positive and negative emotions.

5.4.1.1 Factor analysis of Canderel

For Canderel, as shown in Table 5.4, various emotions had substantial positive loadings on the first factor, with a mean factor loading value of 0.780. The four emotions with the highest loadings were the positive emotions joyful (0.897), secure (0.887), free (0.879) and good (0.879). The second factor had a mean factor loading of 0.593, substantially lower than the first factor, containing five emotions namely aggressive, worried, bored, disgusted and guilty with loading values for three of the emotions above the mean factor loading, namely aggressive (0.755), worried (0.727) and bored (0.667). The positive factor thus had an overall higher mean factor loading pointing to more significant inter-item correlations with the factor and had a higher Cronbach's Alpha ($\alpha=0.968$) than the negative factor ($\alpha=0.613$), indicating a higher internal reliability of the factor.

Table 5.4: Pattern matrix with factor extractions for Canderel to group emotions

Factor	Positive	Negative
Component	1	2
Joyful	0.897	
Secure	0.887	
Free	0.879	
Good	0.879	
Loving	0.868	
Pleasant	0.867	
Happy	0.866	
Interested	0.861	
Warm	0.854	
Enthusiastic	0.841	
Satisfied	0.832	
Good-natured	0.819	

Table 5.4 continued		
Factor	Positive	Negative
Component	1	2
Understanding	0.804	
Adventurous	0.796	
Active	0.740	
Calm	0.688	
Nostalgic	0.616	
Tame	0.608	
Wild	0.531	
Mild	0.496	
Aggressive		0.755
Worried		0.727
Bored		0.667
Disgusted		0.579
Guilty		0.298
Inter-item correlation	0.592	0.269
Cronbach's Alpha	0.968	0.613
Mean factor loading	0.780	0.593
Standard deviation	1.131	0.944

Notes: *Likert scale*: 0=Not at all, 1=Slightly, 2=Moderately, 3=Very, 4=Extremely; Mean factor loading: <1.0=Not present at all, ≥1.0-<2.0=Slightly present, ≥2.0-<3.0=Moderately present, ≥3.0-<4.0=Very present and 4.0=Extremely present; Cronbach's Alpha: α=0.5=Accepted with caution, α>0.7=Acceptable; α>0.8=Good. Shaded loadings indicate items that loaded meaningful on one factor.

5.4.1.2 Factor analysis of Lindt

For Lindt, as shown in Table 5.5, various emotions had substantial positive loadings on the first factor, with a mean factor loading of 0.802. The four emotions with the highest loadings were the positive emotions loving (0.905), joyful (0.895), happy (0.888) and secure (0.877). The second factor had a mean factor loading of 0.609, substantially lower than the first factor, containing the same five emotions as for Canderel, with loading values for three of the emotions above the mean factor loading, including worried (0.709), disgusted (0.694) and aggressive

(0.639). The positive factor thus had an overall higher loading and had a higher Cronbach's Alpha ($\alpha=0.972$) than the negative factor ($\alpha=0.654$), pointing to more meaningful inter-item correlations and higher internal reliability.

Table 5.5: Pattern matrix with factor extractions for Lindt to group emotions

Factor	Positive	Negative
Component	1	2
Loving	0.905	
Joyful	0.895	
Happy	0.888	
Secure	0.877	
Interested	0.875	
Pleasant	0.874	
Understanding	0.853	
Free	0.845	
Good	0.843	
Satisfied	0.841	
Enthusiastic	0.837	
Good-natured	0.829	
Warm	0.818	
Adventurous	0.788	
Active	0.758	
Calm	0.703	
Mild	0.700	
Tame	0.687	
Nostalgic	0.668	
Wild	0.561	
Worried		0.709
Disgusted		0.694
Aggressive		0.639
Guilty		0.550
Bored		0.541

Table 5.5 continued		
Factor	Positive	Negative
Component	1	2
Inter item correlation	0.627	0.291
Cronbach's Alpha	0.972	0.654
Mean factor loading	0.802	0.609
Standard deviation	1.156	0.901

Notes: *Likert scale: 0=Not at all, 1=Slightly, 2=Moderately, 3=Very, 4=Extremely*; Mean factor loading: <1.0=Not present at all, ≥1.0-<2.0=Slightly present, ≥2.0-<3.0=Moderately present, ≥3.0-<4.0=Very present and 4.0=Extremely present; Cronbach's Alpha: α=0.5=Accepted with caution, α>0.7=Acceptable, α>0.8=Good. Shaded loadings indicate items that loaded meaningful on one factor.

5.4.1.3 Factor analysis of Nestlé

For Nestlé, as shown in Table 5.6, various emotions had substantial positive loadings on the first factor, with a mean factor loading of 0.795. The four emotions with the highest loadings were the positive emotions loving (0.893), warm (0.887), secure (0.884) and free (0.882). The second factor had a mean factor loading of 0.525, substantially lower than the first factor, containing the same five emotions as Canderel and Lindt, with loading values for three of the emotions above the mean factor loading (disgusted (0.705), worried (0.702) and bored (0.540). The positive factor thus had an overall higher loading indicating a more meaningful inter-item correlation with the factor and had a higher Cronbach's Alpha (α=0.970) than the negative factor (α=0.466) pointing to a higher internal reliability.

Table 5.6: Pattern matrix with factor extractions for Nestlé to group emotions

Factor	Positive	Negative
Component	1	2
Loving	0.893	
Warm	0.887	
Secure	0.884	
Free	0.882	
Joyful	0.879	

Table 5.6 continued		
Factor	Positive	Negative
Component	1	2
Enthusiastic	0.878	
Understanding	0.848	
Good-natured	0.845	
Happy	0.829	
Good	0.828	
Interested	0.827	
Pleasant	0.826	
Satisfied	0.797	
Adventurous	0.777	
Tame	0.741	
Active	0.716	
Nostalgic	0.676	
Calm	0.670	
Mild	0.614	
Wild	0.596	
Disgusted		0.705
Worried		0.702
Bored		0.540
Aggressive		0.465
Guilty		0.275
Inter item correlation	0.615	0.192
Cronbach's Alpha	0.970	0.466
Mean factor loading	0.795	0.525
Standard deviation	1.253	0.705

Notes: *Likert scale*: 0=Not at all, 1=Slightly, 2=Moderately, 3=Very, 4=Extremely; Mean factor loading: <1.0=Not present at all, 1.0≥-<2.0=Slightly present, ≥2.0-<3.0=Moderately present, ≥3.0-<4.0=Very present and 4.0=Extremely present; Cronbach's Alpha: α=0.5=Accepted with caution, α>0.7=Acceptable, α>0.8=Good. Shaded loadings indicate items that loaded meaningful on one factor.

5.4.2 Adjustment to the negative emotion factor

It was noted that the removal of the attribute “guilty” from the “negative” factor of all three chocolates would improve the Cronbach’s Alpha’s for Canderel and Nestlé, and this attribute was thus removed to stand alone outside of the “positive and “negative” factor as ‘unclassified’ in this study. Table 5.7 summarises the Cronbach’s Alpha’s of the “negative” factor with the exclusion of “guilty”.

Table 5.7: Negative factor Cronbach’s Alpha’s excluding the guilty attribute

Factor	Attributes	Canderel	Lindt	Nestlé
‘Negative’	Aggressive, bored, disgusted, guilty, worried	0.613	0.654	0.466
‘Negative’ without guilty	Aggressive, bored, disgusted, worried	0.682	0.650	0.585

Note: Cronbach’s Alpha: $\alpha=0.5$ =Accepted with caution, $\alpha>0.7$ =Acceptable, $\alpha>0.8$ =Good.

5.4.3 Classification of unclassified emotions based on factor analysis

The EsSense25 profile (King & Meiselman, 2010) contains various emotions which are indicated as unclassified, including aggressive, daring, guilty, mild, quiet, tame and wild, and they could be deemed as either positive or negative depending on the product being studied or other study design elements. King *et al.* (2010) presented various emotion terms to consumers, requesting that they classify these as positive, more positive, negative, more negative or not clear classification, and the above terms were also presented and were included in the “not clear classification” section by consumers in that study.

In order to determine whether these seven unclassified emotion attributes were positive or negative in the context of chocolate consumption, factor loadings from exploratory factor analysis were reviewed. Although guilty was excluded from the negative factor based on the Cronbach’s Alpha values, it was still deemed necessary to classify it as either positive or negative. Guilty was specifically mentioned as an emotional attribute which would be impacted by product type, as King *et al.* (2010) found that guilty was most intense for chocolate, pizza, and fried chicken, while least intense for mashed potatoes.

The various unclassified emotions loaded onto both positive and negative factors as captured in Table 5.8. Mild, tame, understanding and wild were included in the positive factor of all three chocolates, each with high factor loading scores (≥ 0.496) and was thus in this study categorised as positive emotions. Aggressive and guilty were both related to the negative factor for all three chocolates, although as per above, guilty was excluded from the negative factor and had a low factor loading score for Canderel and Nestlé. Wild was the only attribute which had factor loadings on both the positive and negative factors; however, the loading was higher on the positive factor, and it was thus classified as positive, seeing that it had a better internal correlation with the positive factor.

Table 5.8: Factor loading of unclassified emotions of three chocolate samples

Attribute	Canderel		Lindt		Nestlé	
	Positive factor loading	Negative factor loading	Positive factor loading	Negative factor loading	Positive factor loading	Negative factor loading
Aggressive	-	0.755	-	0.639	-	0.465
Guilty	-	0.298	-	0.550	-	0.275
Mild	0.496	-	0.700	0.252	0.614	-
Tame	0.608	-	0.687	-	0.741	0.265
Understanding	0.804	-	0.853	-	0.848	-
Wild	0.531	0.347	0.561	0.323	0.596	0.343

Note: Shaded loadings indicate items that loaded meaningful on one factor.

5.4.4 Valence of the chocolate emotion experience

With most emotions indicated as associated with all chocolates, and similar attributes highly associated with all three chocolates, the application of the outcome of the factor analysis and the classification of emotions into positive and negative factors could indicate the overall experience of each chocolate, as eating chocolate evokes both positive and negative emotional changes (Macht & Dettmer, 2006).

In order to compare the level of positivity of the chocolate eating experience between the chocolates, the relationship between the positive factor mean score and negative factor mean score for each chocolate was considered. For Canderel (as indicated in Table 5.4) the ratio of

positive emotion mean factor loading value of 0.780 vs. the negative emotion mean factor loading value of 0.593 (ratio of 1.32) indicates a somewhat positive emotional experience. For Lindt (as indicated in Table 5.5), the ratio of positive mean factor loading value of 0.802 vs. the negative emotion mean factor loading value of 0.609 (ratio of 1.32) is on par with Canderel, also indicating a somewhat positive emotional experience. For Nestlé (as indicated in Table 5.6), the ratio of the positive emotion mean factor loading value of 0.795 vs. the negative emotion mean factor loading value of 0.525 (ratio of 1.51), exceeds that of Canderel and Lindt, indicating a more positive emotional experience.

A study by King *et al.* (2010) reported that consumers classified some emotions as positive and others as “more positive”, including the attributes active, affectionate, calm, carefree, irresistible, satiating and secure. In this study (as indicated in Table 5.4, 5.5 and 5.6), factor loadings for joyful (Canderel=0.897, Lindt=0.895, Nestlé=0.879); secure (Canderel=0.887, Lindt=0.877, Nestlé=0.884), and loving (Canderel=0.868, Lindt=0.905, Nestlé=0.893), were present in the list of top five emotions within the positive factor with the highest inter-factor correlation values. “Less” positive emotions across the three chocolates based on factor loadings included nostalgic (Canderel=0.616, Lindt=0.668, Nestlé=0.676); calm (Canderel=0.688, Lindt=0.703, Nestlé=0.670); mild (Canderel=0.531, Lindt=0.700, Nestlé =0.614) and wild (Canderel=0.496, Lindt=0.561, Nestlé=0.596).

5.5 THE RELATIONSHIP BETWEEN INDIVIDUAL EMOTIONS

Analysis of terms used for emotions has found that like-valenced terms tend to correlate very highly with one another. In order to assess the correlations between emotion attributes and to determine which emotion terms are similar, a correlation analysis was performed for each chocolate. This was done to further understand the full emotional experience of the respondents. Spearman's rank order correlation values (r) were determined to describe the relationship between the individual emotional attributes and were interpreted based on Cohen's guidelines (1977), as $r \geq 0.3$ was considered a moderate correlation, with correlations above 0.5 considered to be strong (Cohen, 2013).

5.5.1 Individual emotion correlations of Canderel

Reviewing the correlations between emotion attributes for Canderel, as indicated in Table 5.9, reveals that attributes from the “positive” factor show various positive correlations with other

attributes within this factor. Emotion attributes from the negative factor also show positive correlations with other attributes within that factor as well as with guilty. Emotion attributes from the positive factor are negatively correlated to attributes from the negative factor. Attribute correlations within factors are generally scored high except for attributes such as mild, nostalgic, tame and wild (unclassified attributes according to EsSense25) (King & Meiselman, 2010). It was noted that negative emotions generally had lower correlation scores with one another than with positive emotions, showing weaker relationships. The only significant ($P \leq 0.05$) correlations between negative and positive emotions are for the negative emotions bored, disgusted and worried. The emotions aggressive, guilty and worried have very few correlations with other measured emotions and thus do not seem to be entrenched in the overall emotional experience.

Table 5.9: Spearman's rank order correlations (r) between emotional attributes of Canderel

	Active	Adventurous	*Aggressive	*Bored	Calm	*Disgusted	Enthusiastic	Free	Good	Good-natured	Guilty	Happy	Interested
Active													
Adventurous	0.808												
*Aggressive	-	-											
*Bored	-0.236	-0.318	0.320										
Calm	0.443	0.470	-	-									
*Disgusted	-0.230	-0.272	0.269	0.559	-0.295								
Enthusiastic	0.700	0.702	-	-0.293	0.564	-0.286							
Free	0.621	0.673	-	-	0.598	-0.229	0.757						
Good	0.616	0.668	-	-0.386	0.692	-0.369	0.740	0.765					
Good-natured	0.561	0.602	-	-	0.632	-0.259	0.616	0.779	0.758				
Guilty	-	-	-	-	-	-	-	-	-	-			
Happy	0.629	0.667	-	-0.413	0.654	-0.365	0.782	0.734	0.864	0.675	-		
Interested	0.611	0.671	-	-0.342	0.557	-0.445	0.789	0.745	0.777	0.707	-	0.791	
Joyful	0.614	0.681	-	-0.355	0.604	-0.441	0.784	0.791	0.807	0.744	-	0.824	0.852
Loving	0.587	0.622	-	-0.262	0.584	-0.341	0.723	0.776	0.736	0.710	-	0.768	0.771
Mild	0.313	0.331	-	-	0.319	-	0.350	0.422	0.346	0.441	-	0.376	0.390
Nostalgic	0.400	0.488	-	-	0.447	-	0.482	0.434	0.485	0.417	-	0.424	0.474
Pleasant	0.624	0.659	-	-0.397	0.600	-0.496	0.690	0.734	0.821	0.737	-	0.823	0.797
Satisfied	0.637	0.682	-	-0.432	0.614	-0.516	0.721	0.672	0.757	0.566	-	0.765	0.787
Secure	0.633	0.671	-	-0.245	0.570	-0.264	0.717	0.775	0.725	0.755	-	0.755	0.731
Tame	0.419	0.390	-	-	0.431	-	0.396	0.501	0.431	0.569	-	0.426	0.432
Understanding	0.633	0.557	-	-	0.527	-0.271	0.670	0.689	0.648	0.705	-	0.627	0.670
Warm	0.596	0.638	-	-0.351	0.551	-0.379	0.689	0.739	0.737	0.685	-	0.755	0.732
Wild	0.432	0.474	-	-	0.240	-	0.376	0.389	0.370	0.383	-	0.403	0.352
*Worried	-	-	0.515	0.270	-	0.312	-	-	-	-	0.295	-	-

Table 5.9 continued												
	Joyful	Loving	Mild	Nostalgic	Pleasant	Satisfied	Secure	Tame	Understanding	Warm	Wild	*Worried
Active												
Adventurous												
*Aggressive												
*Bored												
Calm												
**Disgusted												
Enthusiastic												
Free												
Good												
Good-natured												
Guilty												
Happy												
Interested												
Joyful												
Loving	0.856											
Mild	0.390	0.424										
Nostalgic	0.515	0.449	0.291									
Pleasant	0.823	0.774	0.514	0.488								
Satisfied	0.778	0.684	0.369	0.563	0.830							
Secure	0.781	0.792	0.395	0.482	0.782	0.697						
Tame	0.463	0.518	0.484	0.331	0.510	0.386	0.650					
Understanding	0.700	0.666	0.403	0.446	0.706	0.617	0.806	0.655				
Warm	0.781	0.813	0.448	0.455	0.797	0.717	0.791	0.509	0.741			
Wild	0.363	0.385	0.263	0.422	0.345	0.363	0.380	0.278	0.343	0.406		
*Worried	-	-	-	-	-	-0.232	-	-	-	-	-	

Notes: Only correlations are reported which are significant at $P \leq 0.01$ level (2-tailed). *Attributes from the negative factor. Negative correlations are indicated in red and positive correlations in green; Interpretation of Spearman's rank order correlation values (r): $r \geq 0.3$ =Moderate correlation, $r \geq 0.5$ =Strong correlation; Strong correlations are indicated in bold.

Various emotion attributes related to Canderel had large Spearman's rank order correlations ($r \geq 0.8$), and only these large correlations are captured in Figure 5.1 to indicate which emotions are highly related. In addition to those included in the figure, active and adventurous were highly correlated ($r=0.808$), and so was secure and understanding ($r=0.806$). Correlated emotions are liked-valenced. Joyful was the emotion with the highest number of large correlations with other emotion attributes, indicating redundancy of the emotions loving, interested, happy, good and pleasant for this chocolate. It could also indicate that this individual emotion captured a lot of the positive emotional experience of this chocolate. All large correlations were between positive emotion factors.

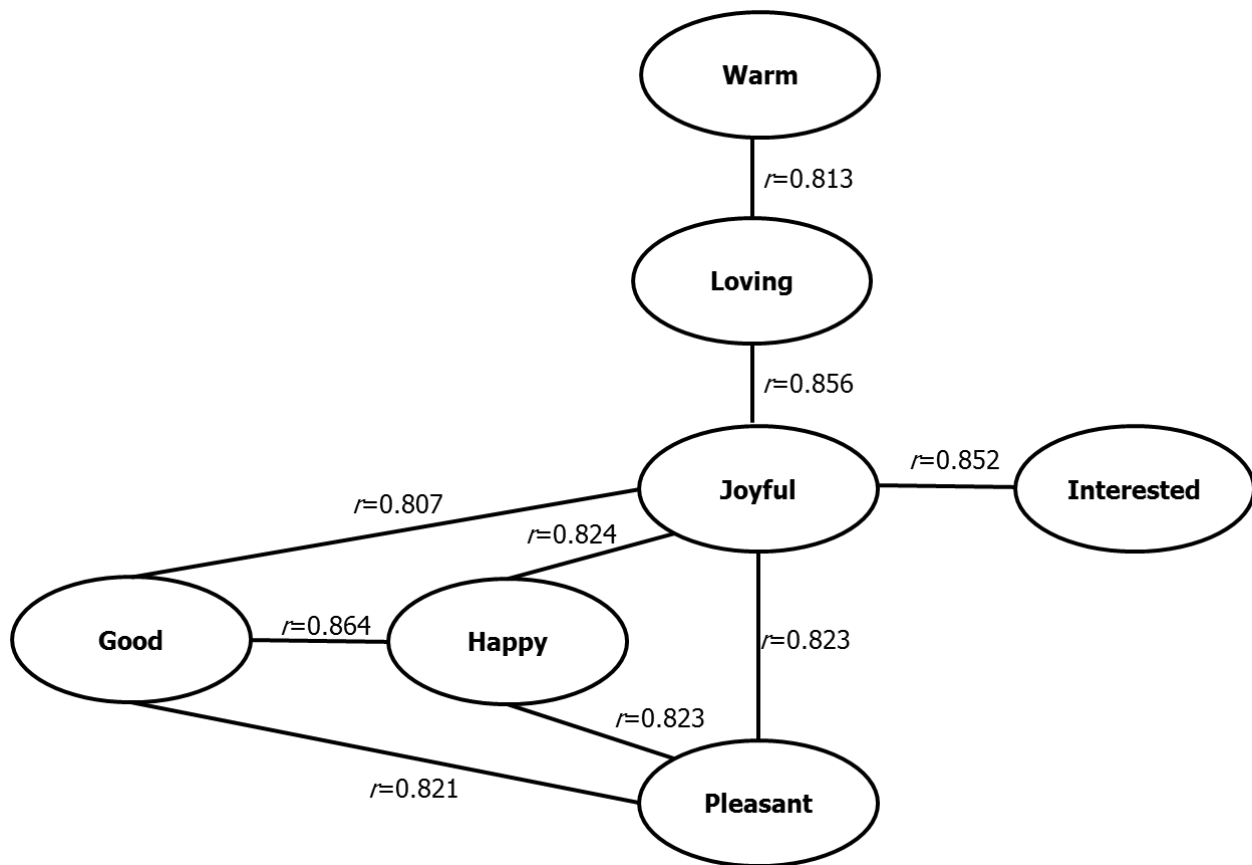


Figure 5.1: Canderel's large inter-item emotion correlations

Note: Only large correlations ($r \geq 0.8$) are indicated

5.5.2 Individual emotion correlations of Lindt

Findings regarding correlations for Lindt are summarised in Table 5.10 and were all in line with the conclusions for Canderel.

Table 5.10: Spearman's rank order correlations (r) between emotional attributes of Lindt

	Active	Adventurous	*Aggressive	*Bored	Calm	*Disgusted	Enthusiastic	Free	Good	Good-natured	Guilty	Happy	Interested
Active													
Adventurous	0.824												
*Aggressive	-	-											
*Bored	-0.312	-0.321											
Calm	0.452	0.508	-	-									
*Disgusted	-0.379	-0.287	0.328	0.518	-0.290								
Enthusiastic	0.742	0.704	-	-0.286	0.556	-0.354							
Free	0.642	0.668	-	-0.245	0.585	-0.277	0.781						
Good	0.653	0.665	-	-0.341	0.663	-0.383	0.788	0.727					
Good-natured	0.608	0.609	-	-0.251	0.633	-0.308	0.747	0.771	0.789				
Guilty	-	-	-	-	-	0.274	-	-	-	-			
Happy	0.640	0.656	-	-0.349	0.663	-0.375	0.775	0.756	0.839	0.800	-		
Interested	0.642	0.638	-	-0.371	0.550	-0.403	0.740	0.721	0.738	0.743	-	0.840	
Joyful	0.599	0.618	-	-0.306	0.639	-0.378	0.724	0.750	0.756	0.754	-	0.877	0.894
Loving	0.649	0.667	-	-0.311	0.636	-0.385	0.776	0.784	0.756	0.786	-	0.821	0.876
Mild	0.442	0.420	-	-	0.522	-	0.521	0.533	0.514	0.545	-	0.590	0.577
Nostalgic	0.415	0.487	-	-	0.387	-	0.494	0.516	0.483	0.488	-	0.531	0.565
Pleasant	0.617	0.670	-	-	0.672	-0.315	0.693	0.677	0.728	0.770	-	0.810	0.760
Satisfied	0.673	0.687	-	-0.424	0.615	-0.471	0.725	0.671	0.814	0.764	-	0.815	0.788
Secure	0.642	0.694	-	-0.262	0.589	-0.363	0.730	0.722	0.679	0.743	-	0.728	0.778
Tame	0.482	0.512	-	-	0.556	-0.248	0.507	0.502	0.513	0.564	-	0.567	0.547
Understanding	0.592	0.628	-	-0.250	0.599	-0.337	0.634	0.699	0.666	0.695	-	0.716	0.725
Warm	0.650	0.614	-	-0.241	0.550	-0.342	0.682	0.684	0.731	0.707	-	0.723	0.741
Wild	0.386	0.465	0.263		0.239		0.384	0.387	0.355	0.305	-	0.398	0.476
*Worried	-	-	0.411	0.277	-	0.364	-	-	-	-	0.336	-	-

Table 5.10 continued												
	Joyful	Loving	Mild	Nostalgic	Pleasant	Satisfied	Secure	Tame	Understanding	Warm	Wild	*Worried
Active												
Adventurous												
*Aggressive												
*Bored												
Calm												
*Disgusted												
Enthusiastic												
Free												
Good												
Good-natured												
Guilty												
Happy												
Interested												
Joyful												
Loving	0.895											
Mild	0.620	0.620										
Nostalgic	0.562	0.557	0.487									
Pleasant	0.787	0.761	0.621	0.605								
Satisfied	0.790	0.755	0.519	0.516	0.777							
Secure	0.763	0.823	0.552	0.573	0.770	0.762						
Tame	0.572	0.638	0.546	0.432	0.645	0.536	0.698					
Understanding	0.759	0.797	0.608	0.527	0.743	0.709	0.876	0.723				
Warm	0.762	0.769	0.557	0.472	0.657	0.737	0.761	0.567	0.770			
Wild	0.447	0.412	0.297	0.400	0.402	0.347	0.430	0.393	0.411	0.433		
*Worried	-	-	-	-	-	-0.224	-	-	-	-	-	

Notes: Only correlations are reported which are significant at $P \leq 0.01$ level (2-tailed). *Attributes from the negative factor. Negative correlations are indicated in red and positive correlations in green; Interpretation of Spearman's rank order correlation values (r): $r \geq 0.3$ =Moderate correlation, $r \geq 0.5$ =Strong correlation; Strong correlations are indicated in bold.

Figure 5.2 captures the various emotion attributes which had large Spearman's rank order correlations for Lindt ($r \geq 0.8$), and in addition to the figure below, active and adventurous ($r=0.811$) were also highly correlated, in line with the findings for Canderel. Lindt, however, has a higher number of large inter-item correlations compared to Canderel, and thus more interchangeable and less differentiated emotions. Happy was the emotion most correlated to other emotion attributes, and thus the emotions good-natured, good, satisfied, pleasant, interested, joyful and loving were redundant. Happy thus captured a large portion of the emotional experience with the chocolate.

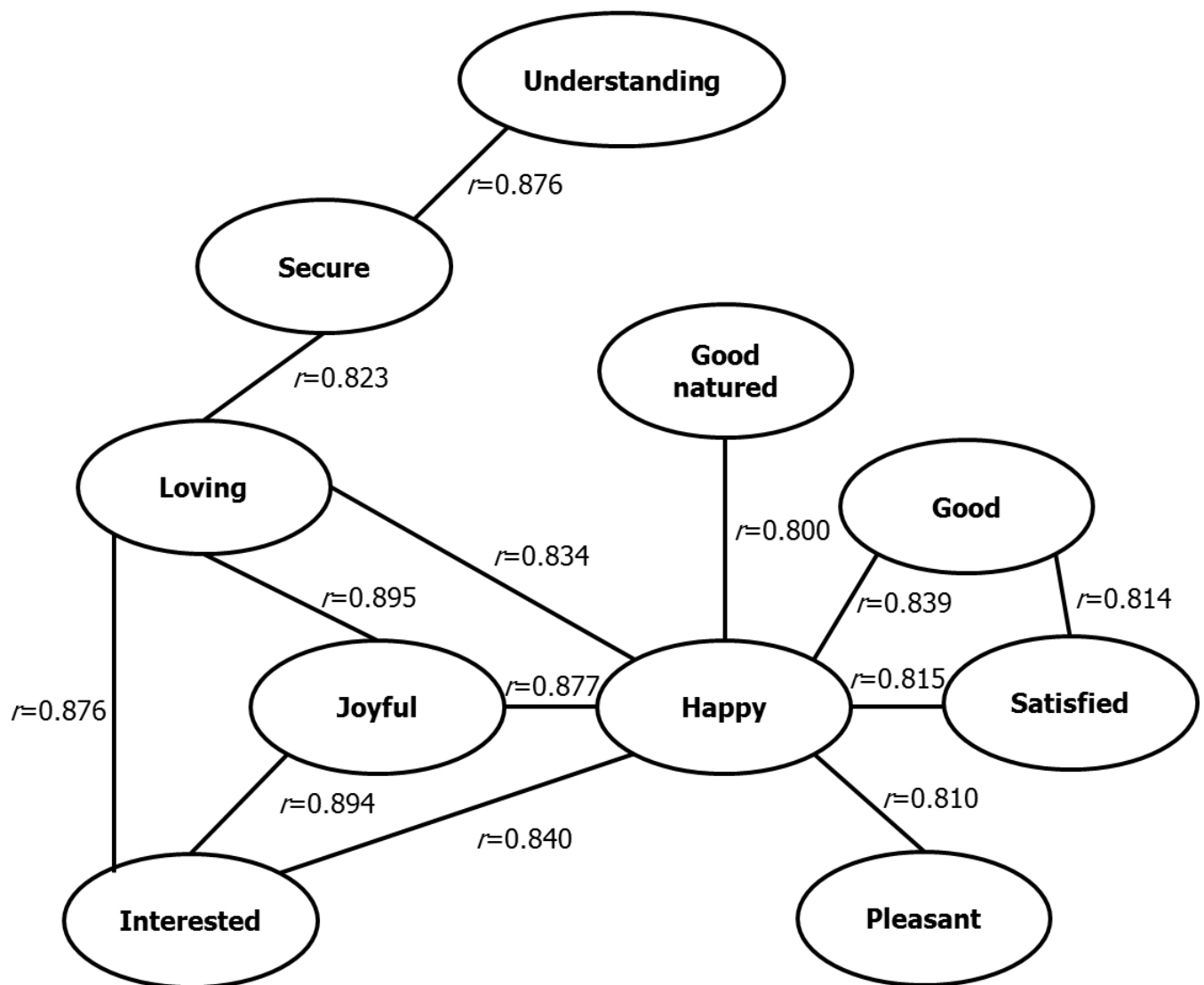


Figure 5.2: Lindt's large inter-item emotion correlations

Note: Only large correlations ($r \geq 0.8$) are indicated

5.5.3 Individual emotion correlations of Nestlé

Findings regarding correlations for Nestlé were in line with Canderel and Lindt (as indicated in Table 5.11), except for guilty, which did not correlate with any emotion attributes from the negative factor. For Nestlé, though, only the negative emotions bored and disgusted correlated negatively with various positive emotions, and guilty showed no correlations, which could indicate that the experience of Nestlé was more positive than the other two chocolates.

Table 5.11: Spearman's rank order correlations (r) between emotional attributes of Nestlé

	Active	Adventurous	*Aggressive	*Bored	Calm	*Disgusted	Enthusiastic	Free	Good	Good-natured	Guilty	Happy	Interested
Active													
Adventurous	0.811												
*Aggressive	-	-											
*Bored	-	-	0.267										
Calm	0.318	0.401	-	-									
*Disgusted	-	-0.302	0.279	0.482	-								
Enthusiastic	0.664	0.717	-	-0.246	0.521	-0.260							
Free	0.623	0.711	-	-0.241	0.526	-0.303	0.815						
Good	0.517	0.618	-	-0.288	0.625	-0.350	0.716	0.733					
Good-natured	0.596	0.647	-	-0.243	0.556	-0.281	0.740	0.796	0.813				
Guilty	-	-	-	-	-	-	-	-	-	-			
Happy	0.465	0.561	-	-0.359	0.630	-0.384	0.737	0.753	0.806	0.725	-		
Interested	0.517	0.635	-	-0.336	0.536	-0.358	0.715	0.772	0.749	0.729	-	0.793	
Joyful	0.527	0.644	-	-0.277	0.561	-0.326	0.796	0.814	0.775	0.765	-	0.861	0.836
Loving	0.606	0.662	-	-0.221	0.593	-0.279	0.766	0.788	0.794	0.780	-	0.834	0.839
Mild	0.340	0.311	-	-	0.464	-	0.435	0.451	0.417	0.511	-	0.409	0.423
Nostalgic	0.354	0.425	-	-0.242	0.412	-	0.511	0.512	0.579	0.470	-	0.561	0.528
Pleasant	0.437	0.547	-	-0.234	0.599	-0.369	0.667	0.708	0.768	0.740	-	0.730	0.702
Satisfied	0.444	0.506	-	-0.325	0.589	-0.415	0.628	0.658	0.753	0.669	-	0.795	0.679
Secure	0.572	0.651	-	-	0.592	-0.262	0.723	0.786	0.685	0.675	-	0.723	0.688
Tame	0.471	0.424	-	-	0.452	-	0.567	0.553	0.478	0.529	-	0.462	0.493
Understanding	0.536	0.590	-	-	0.613	-	0.717	0.711	0.618	0.664	-	0.635	0.623
Warm	0.553	0.642	-	-0.246	0.624	-0.312	0.736	0.772	0.741	0.711	-	0.798	0.695
Wild	0.364	0.466	-	-	0.286	-	0.510	0.491	0.358	0.364	-	0.375	0.407
*Worried	-	-	0.291	0.295	-	0.469	-	--	-	-	-	-	-

Table 5.11 continued												
	Joyful	Loving	Mild	Nostalgic	Pleasant	Satisfied	Secure	Tame	Understanding	Warm	Wild	*Worried
Active												
Adventurous												
*Aggressive												
*Bored												
Calm												
*Disgusted												
Enthusiastic												
Free												
Good												
Good-natured												
Guilty												
Happy												
Interested												
Joyful												
Loving	0.890											
Mild	0.444	0.476										
Nostalgic	0.525	0.584	0.422									
Pleasant	0.726	0.721	0.602	0.602								
Satisfied	0.737	0.742	0.523	0.603	0.784							
Secure	0.791	0.765	0.478	0.635	0.698	0.684						
Tame	0.513	0.566	0.614	0.507	0.599	0.503	0.658					
Understanding	0.691	0.692	0.546	0.540	0.705	0.581	0.825	0.698				
Warm	0.810	0.776	0.516	0.625	0.749	0.764	0.836	0.613	0.775			
Wild	0.409	0.367	0.302	0.371	0.354	0.309	0.432	0.410	0.431	0.406		
*Worried	-	-	-	-	-	-	-	-	-	-	-	

Notes: Only correlations are reported which are significant at $P \leq 0.01$ level (2-tailed). *Attributes from the negative factor. Negative correlations are indicated in red and positive correlations in green; Interpretation of Spearman's rank order correlation values (r): $r \geq 0.3$ =Moderate correlation, $r \geq 0.5$ =Strong correlation; Strong correlations are indicated in bold.

Figure 5.3 captures the various attributes which had large correlations ($r \geq 0.8$). These are thus liked-valenced. Joyful was also the emotion with the highest number of large correlations with other emotion attributes (as for Canderel), indicating redundancy of the emotions free, happy, loving, interested and warm for this chocolate. This emotion captured a lot of the positive emotional experience with this chocolate.

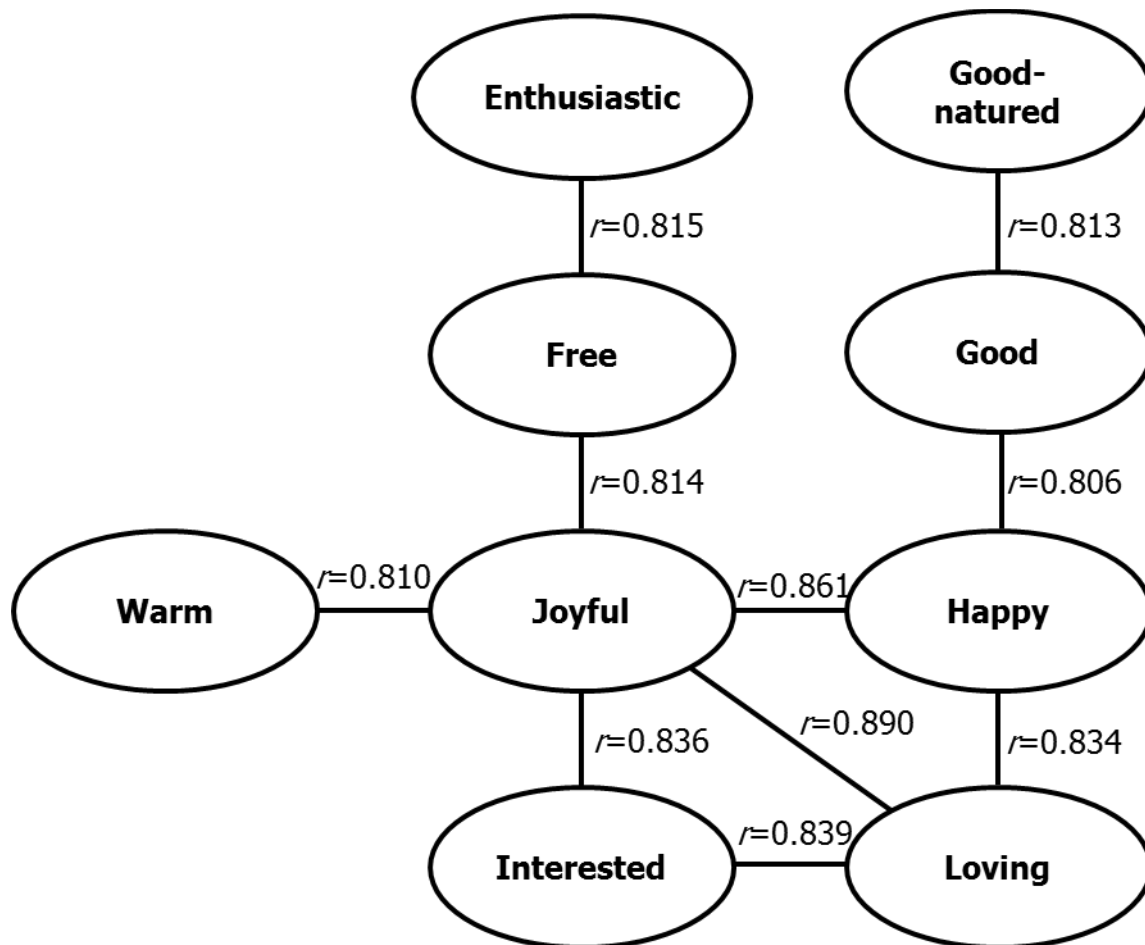


Figure 5.3: Nestlé's large inter-item emotion correlations

Note: Only large correlations ($r \geq 0.8$) are indicated

5.5.4 Redundancy and interchangeability of emotional attributes

Some similar emotion attribute correlations were noted across all three chocolates, and from this, it can be concluded that there are some like-valenced (and thus interchangeable) emotion attributes which are not product but rather category related. Jaeger *et al.* (2018) reported that the EsSense profile (King & Meiselman, 2010) has proven to be restricted in its application due to it containing a list of verbal labels with subtle differences. Table 5.12 provides a summary of

highly correlated emotions for the three chocolates ($r \geq 0.8$), which are all positive emotions. For all three chocolates, it was found that happy and good are interchangeable, as well as happy and joyful, and joyful and loving. There was thus redundancy in the list of sensory attributes.

Table 5.12: Large Spearman's rank order correlation (*r*) emotion comparison between chocolates

	Canderel: Diabetic chocolate	Lindt: Imported indulgent chocolate	Nestlé: Mainstream chocolate
<i>r</i>≥0.8 across all three chocolates	Happy – Good (Canderel=0.864, Lindt=0.839, Nestlé=0.806) Happy – Joyful (Canderel=0.824, Lindt=0.877, Nestlé=0.861) Joyful – Loving (Canderel=0.856, Lindt=0.895, Nestlé=0.890)		
<i>r</i>≥0.8 across two chocolates	Happy – Pleasant (Canderel=0.823, Lindt=0.810) Secure – Understanding (Canderel=0.806, Lindt=0.876)		-
	-	Happy – Loving (Lindt=0.834, Nestlé=0.834) Loving – Interested (Lindt=0.876, Nestlé=0.839)	
<i>r</i>≥0.8 in only one chocolate	Active – Adventurous (0.808) Good – Joyful (0.807) Good – Pleasant (0.821) Joyful – Interested (0.852) Loving – Warm (0.813) Pleasant – Joyful (0.823)	Active – Adventurous (0.811) Good – Satisfied (0.814) Happy – Good-natured (0.839) Happy – Interested (0.840) Happy – Satisfied (0.815) Interested – Joyful (0.894) Loving – Secure (0.823)	Enthusiastic – Free (0.815) Free – Joyful (0.814) Good - Good-natured (0.813) Joyful – Interested (0.836) Joyful – Warm (0.810)

Note: Only *r*≥0.8 is indicated

5.5.5 Variations in relationships of emotional attributes between chocolates

Table 5.13 captures the variations in the correlations of the various emotional attributes between chocolates; and only the correlations which are different between the chocolates are summarised, as this could further indicate the variance in emotional experience. For Canderel, bored and disgusted did not have a large correlation with any other emotional attribute, but a large positive correlation relationship was noted between guilty, worried, wild and aggressive. This could indicate that while bored and disgusted were experienced, these did not impact other emotions experienced; however, negative emotions which were experienced were closely correlated. For Lindt, no large positive correlation was noted between bored and the various negative attributes. Various large positive correlations were, however, noted between the various negative attributes, indicating that bored is possibly less relevant to the overall emotional experience of Lindt and that the incidence of negative emotion is closely related for this chocolate. For Nestlé, there were fewer large correlations noted between the negative emotion attributes, indicating that the incidence of negative emotion is not closely related and potentially purely incidental.

Table 5.13: Variations in correlations between the three chocolates

	Canderel variations	Lindt variations	Nestlé variations
No correlation	Bored - Free Bored - Good-natured Disgusted - Tame	Bored - Aggressive Bored - Pleasant Bored - Active Bored - Adventurous	Aggressive - Wild Bored - Active Bored - Secure Bored - Adventurous Disgusted - Active Disgusted - Calm Disgusted - Understanding Worried - Satisfied Worried - Secure Worried - Guilty
Positive correlation	Guilty - Worried ($r=0.336$)	Disgusted - Guilty ($r=0.274$)	-
Negative correlation	-	Bored - Understanding ($r=-0.250$) Disgusted - Tame ($r=-0.248$)	Bored - Nostalgic ($r=-0.242$)

5.6 VISUALISATION OF THE RELATIONSHIPS BETWEEN EMOTIONS

Another way of better understanding emotional similarities or differences between products is to analyse emotions in clusters (Jiang *et al.*, 2014) in order to visualise the variance of emotion terms (Ng, 2013). This has pointed to two underlying dimensions: a degree of pleasantness (valence) and activation (arousal) (Watson *et al.*, 1999; Barrett, 2006; Ferrarini *et al.*, 2010), which are the two qualities which most emotion theorists agree upon. These two dimensions have been found to be associated with an automatic physiological reaction in response to stimuli (Bensafi *et al.*, 2002). It is usually visualised by mapping emotions in an affective space comprised of two orthonormal axes, in four quadrants divided by these two dimensions (Jiang *et al.*, 2014), ranging from unpleasant to pleasant and from calm to excitement, for valence and arousal respectively (Dalenberg *et al.*, 2014a).

Figure 5.4 is the result of PCA of the emotional attributes under investigation and visualises various underlying relationships, weak relationships and redundancies of emotions. It also visualises the intensity of the emotions experienced based on the length of the lines linking the emotional attributes to the centre of the map. The naming of the quadrants indicated in Figure 5.4 was based on a report by Jaeger *et al.* (2018) who interpreted emotional response feedback from consumers from five different food categories including chocolate (namely cashew nuts, peanuts, chocolate, fruit and processed tomatoes) through a circumplex emotion model, spanning the dimensions of valence and arousal. Emotional valence (a feeling of pleasure or displeasure) has been indicated to be the primary dimension of emotional meaning (Barrett, 2006) and has been consistently related to product acceptability (Ng *et al.*, 2013; Kuesten *et al.*, 2014; Gutjar *et al.*, 2015; Spinelli *et al.*, 2015; Jaeger *et al.*, 2017). Emotional arousal (the feeling of activation or deactivation) is the second main dimension which structures emotional experiences (Barrett, 2006). The circumplex model of core affect originates from Yik *et al.* (2011) and was based on foundational work conducted to interpret emotion words. This model defines 12 segments which represent: a) The poles of the two core dimensions (“pleasure”/“displeasure” and “activation”/“deactivation”); and b) Eight emotional domains defined by a combination of both core dimensions. For example, “activated pleasure” captures pleasure and some activation. In comparison, “pleasant activation” is located higher on the pole of activation, while still being associated with positive valence. While the model originated from the above study, it was applied in the current study due to the validation by Jaeger *et al.* (2018)

reported above. The emotions associated with chocolate in this study can thus be mapped based on the eight emotional domains.

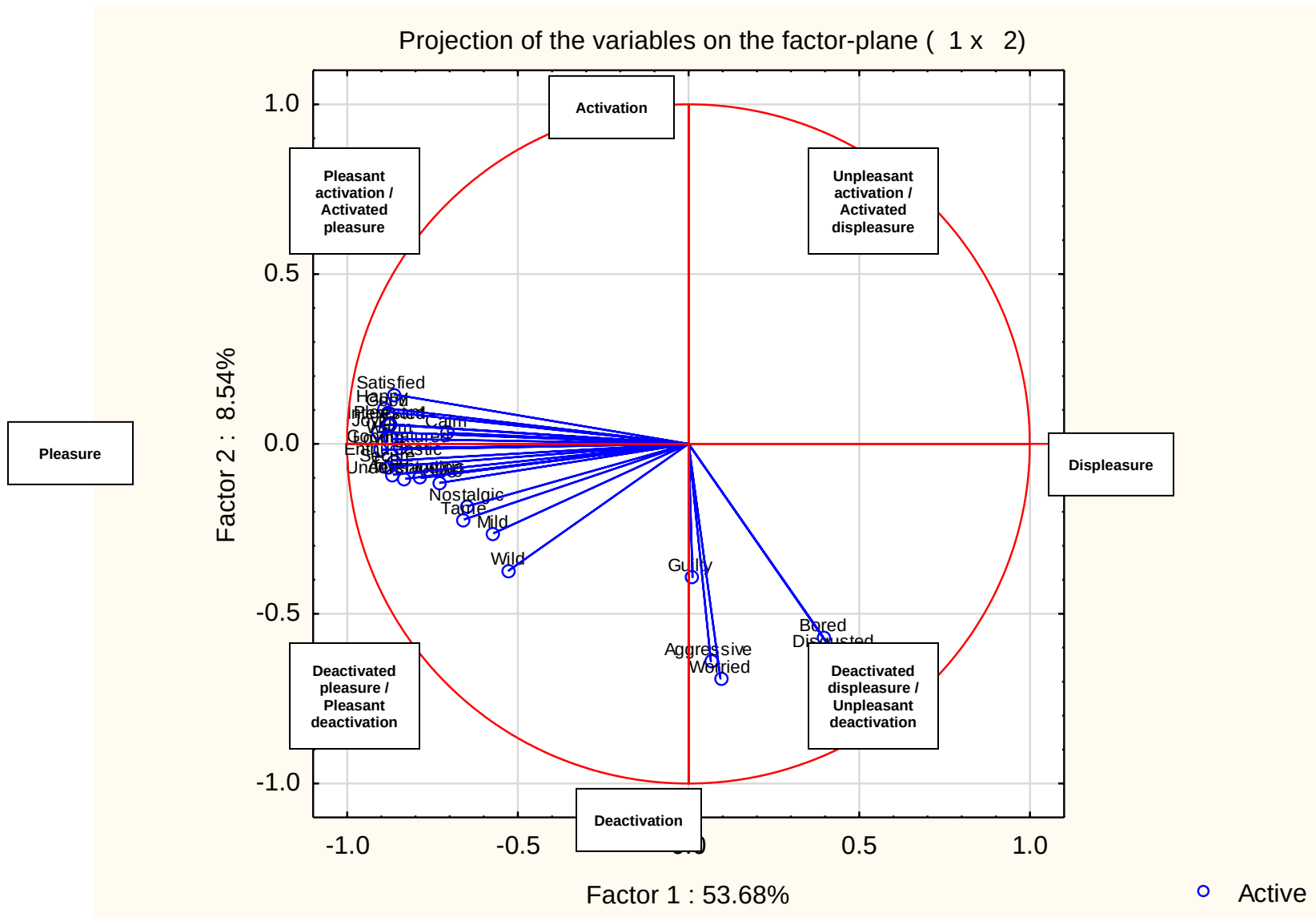


Figure 5.4: Map of emotions associated with the three chocolate samples

Positive emotions (based on the output of factor analysis) are located on or around the pleasure pole. Negative emotions are located closer to the displeasure pole than the pleasure pole. However, they were rather located close to the deactivation pole, indicating that these emotions were not necessarily related due to displeasure of the chocolate experience but rather to lower levels of arousal. Some positive emotions are activated emotions (thus high arousal), while others are deactivated (low arousal). High arousal positive emotions include satisfied, happy, pleasant and joyful, while low arousal positive emotions include wild, mild, tame and nostalgic. All negative emotions are, however, deactivated emotions (thus low arousal), but guilty is mapped the closest to deactivation of all the negative emotions. Bored and disgusted are located closer to the displeasure pole which indicates a greater tendency to deliver an unpleasant emotional experience (Figure 5.4). The location of emotional attributes on the maps further indicates that positive emotions are generally more closely related and likely to be experienced together, while negative emotions are less likely to coincide as their relationships are weaker. Within the group of positive emotions, there are, however, some emotions which are more closely related than others (Figure 5.4).

This map was found to be very similar to a map generated by Dalenberg et al. (2014) who mapped the emotions from the EsSense tool into a multi-dimensional space, and although it was based on breakfast drinks, the layout of the map and location of emotions in the PCA map of that study and this study was very similar. Their map also showcased close relationships between positive or unclassified emotions, while negative emotions were widely spaced. Negative emotions were also located on the opposite side of the map to positive emotions. Guilty was also located in the centre of this map, showing a weak relationship with other emotions. The emotions wild, mild, nostalgic and tame were also further located from the centre of the map and further from the other positive or unclassified emotions. There may thus be commonality in underlying emotion relationships across categories.

5.7 THE EMOTIONAL PROFILE OF CHOCOLATE

The sensory data revealed that the three chocolates varied greatly regarding the experience of the sensory properties. Despite this variance, the emotional profiles of the three chocolates (based on presence of emotion attributes) are very similar in terms of emotions experienced during consumption of yoghurt, which was also the conclusion of Schouteten *et al.* (2015), who reported that a limited number of emotion terms differed between yoghurt samples studied,

although sensory profiles were clearly defined. Furthermore, the mean values of the various emotions were very similar for Canderel and Lindt, even though these chocolates are very different in sensory profile, ingredients and proposition. Although the basic emotional footprint of the chocolates is similar, the emotional profile of the three products does, however, differ regarding the intensity of the emotions experienced for various emotion attributes.

This is in line with the findings of Kim *et al.* (2017), who reported that the emotional profiles of beverage and biscuit samples evaluated were similar but varied in intensity. The emotional profiles evoked by various products have shown that emotional responses predominantly differed in intensity between products, irrespective of the type of emotion (Jaeger *et al.*, 2018), and this was thus expected to be a finding of this study as it concerns products in the same product category. Köster and Mojet (2015) reported similar findings, adding that emotions raised by the tasting of different products in the same food category hardly differ, while emotions evoked by the product names are much stronger for a category such as chocolate. Thus emotional conceptualisations of products could be connected more to the product category instead of the individual products, which leads to few discriminatory emotional terms (Schouteten *et al.*, 2017).

However, in a study by King and Meiselman (2010) with a self-designed emotion questionnaire, the visual emotion profiles of products from different categories, namely pizza, mashed potatoes and gravy, vanilla ice cream, fried chicken and chocolate were very similar for most emotion attributes (variations in intensity were noted), with the exception of the emotions active, adventurous, affectionate and calm. It is, however, interesting to note that they reported that these emotion attributes where differences were indicated were placed first on the alphabetic emotion list, while the ratings of terms later in the list such as wild, worried, whole and understanding showed very little difference, and thus there may be an element of fatigue in the rating of emotions as well. This finding does not appear to have impacted this current study as no such pattern was found in respondent responses. Cardello *et al.* (2012), who also studied chocolate and potato chips, however, found that these two products had very different emotional profiles. Another school of thought is that emotions are more related to the eating situation than the actual food. This may explain why the emotions related to chocolate which is mostly eaten alone and often as consolation during negative mood moments, are much stronger than the

emotions evoked by potato chips which are usually consumed rather inattentively as a side dish to drinks in larger gatherings of people (Köster & Mojet, 2015).

Lastly, the similarity in the emotional profiles, despite the varying sensory profiles, could be explained by the theory of cognitive dissonance. When consumers find that a newly acquired product does not live up to expectations (in this case potentially Canderel and Lindt which were probably less familiar to the respondents), through cognitive dissonance reduction will they try to reduce the discomfort experienced by bringing their perceptions more in line with the original expectations (Festinger, 1962). If a product, however, elicits mixed emotions, a possible strategy for cognitive dissonance reduction could be to focus more on the positive than on the negative aspects of the overall emotional experience (Schifferstein & Desmet, 2010). A positive association with products that are liked and a negative association with products that are disliked are seen as the “easy way out” for consumers and often prevent researchers from accessing the true but often hidden conceptualisations associated with the object.

5.7.1 The emotional profile of Canderel

Canderel, the sugar-free chocolate aimed at people with diabetes, was rated the lowest in sweetness and the highest in bitterness. While it evoked a similar emotional profile to that of Lindt, Canderel evoked the lowest mean emotional response compared to the other two chocolates and the lowest rating incidence of RATA scores between 1 and 4 (1=slightly present, 2=moderately present, 3=very present, 4=extremely present), which its profile in Figure 5.5 reflects. Although not significantly higher than that of Lindt, respondents did assign a higher mean score to the negative emotions of aggression, boredom and disgust for this chocolate. Respondents also rated it lowest (but not significantly lower) on various positive emotions, including the top five emotions associated with all three chocolates, namely calm, good, happy, pleasant and satisfied.

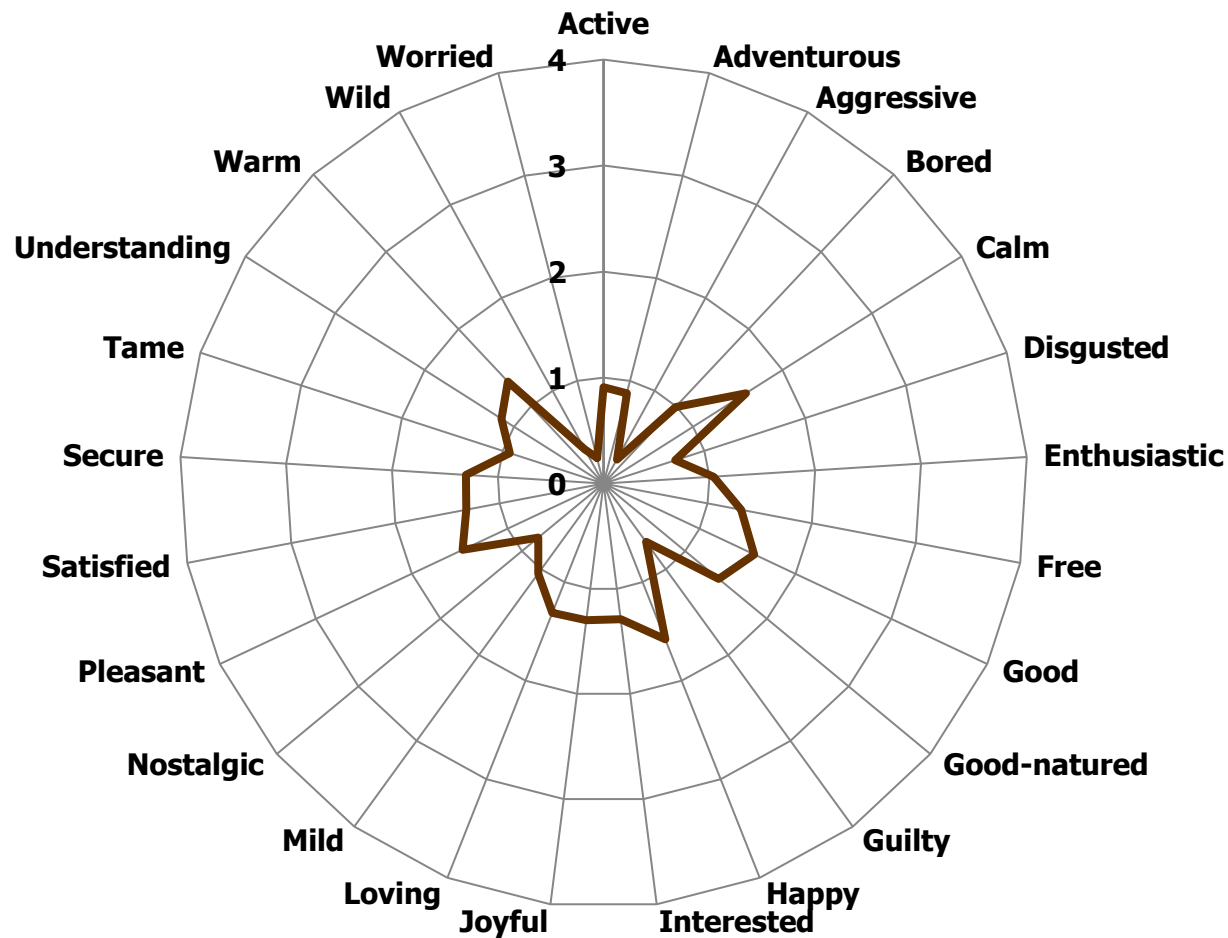


Figure 5.5: Emotional profile of Canderel

Notes: *Likert scale: 0=Not at all, 1=Slightly, 2=Moderately, 3=Very, 4=Extremely*; Mean values: Active=0.91, Adventurous=0.88, Aggressive=0.26, Bored=0.99, Calm=1.59, Disgusted=0.71, Enthusiastic=1.04, Free=1.32, Good=1.57, Good-natured=1.4, Guilty=0.68, Happy=1.58, Interested=1.29, Joyful=1.30, Loving=1.31, Mild=1.05, Nostalgic=0.80, Pleasant=1.47, Satisfied=1.32, Secure=1.30, Tame=0.93, Understanding=1.14, Warm=1.32, Wild=0.3, Worried=0.25.

5.7.2 The emotional profile of Lindt

Lindt, which is a luxury imported indulgent chocolate brand, was found to be the sweetest and the chocolate with the most intense mouthfeel. It was, however, found to be comparable to Canderel in emotional response (which is reflected in the profile in Figure 5.6) (no significant ($P \leq 0.05$) differences were identified between the mean scores of the emotional attributes for these chocolates). However, the majority of the mean ratings of Lindt falls in-between that of Canderel and Nestlé. Although not significant, it was rated lower than Canderel on the emotions free (mean=1.31) and secure (mean=1.19), and higher than Canderel and Nestlé on guilty (mean=0.75).

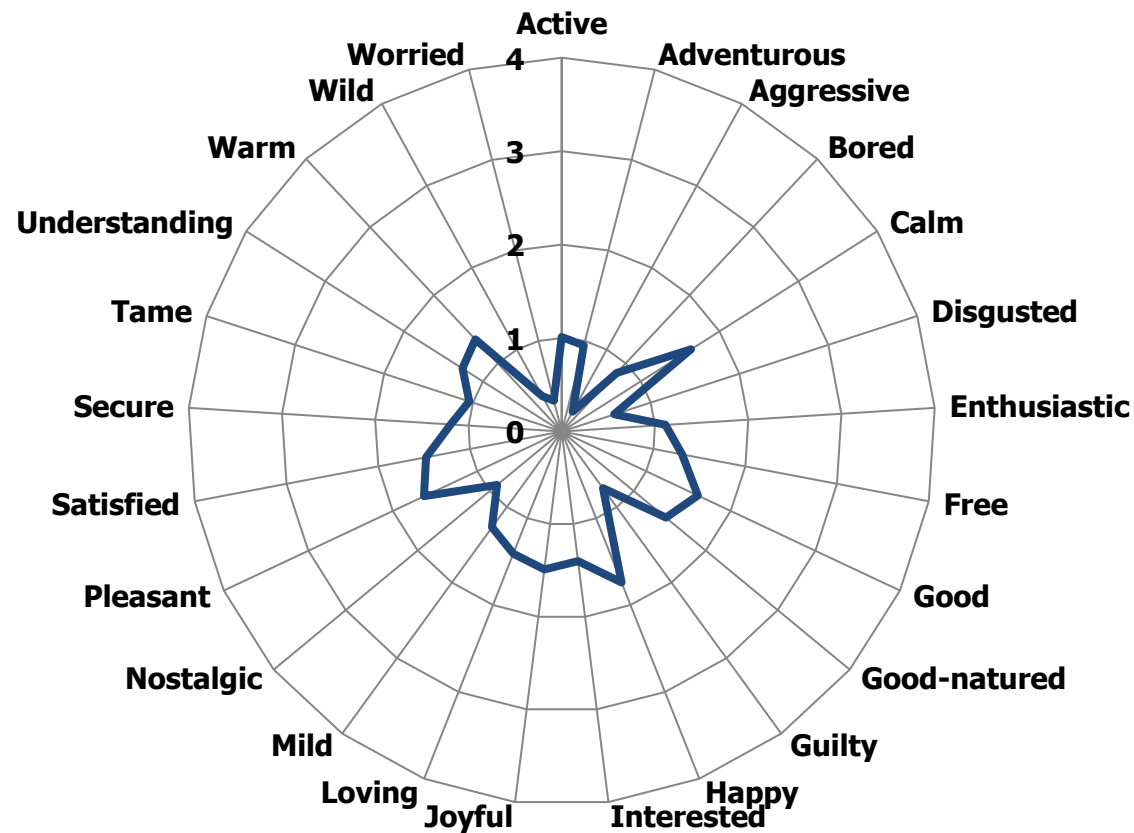


Figure 5.6: Emotional profile of Lindt

Notes: *Likert scale: 0=Not at all, 1=Slightly, 2=Moderately, 3=Very, 4=Extremely*; Mean values: Active=1.01, Adventurous=0.95, Aggressive=0.24, Bored=0.86, Calm=1.64, Disgusted=0.59, Enthusiastic=1.11, Free=1.31, Good=1.61, Good-natured=1.45, Guilty=0.75, Happy=1.74, Interested=1.40, Joyful=1.49, Loving=1.41, Mild=1.27, Nostalgic=0.90, Pleasant=1.63, Satisfied=1.48, Secure=1.19, Tame=1.04, Understanding=1.26, Warm=1.35, Wild=0.43, Worried=0.34.

5.7.3 The emotional profile of Nestlé

Nestlé is a mainstream chocolate and is thus likely to have been consumed by many respondents participating in the study. It was rated average for most sensory attributes compared to the sensory profile of Canderel and Lindt. From an emotional response perspective, however, it was rated highest on all positive or uncategorised emotions (significantly ($P \leq 0.05$) higher than Canderel and Lindt), and lowest on all negative emotions, except for worried where it was rated on par with Canderel. Its profile captured in Figure 5.7 is different from that of Canderel and Lindt.

Therefore, the emotional profiles of each chocolate could be prepared that visualise the unique emotional experience of respondents evoked by the consumption of these products.

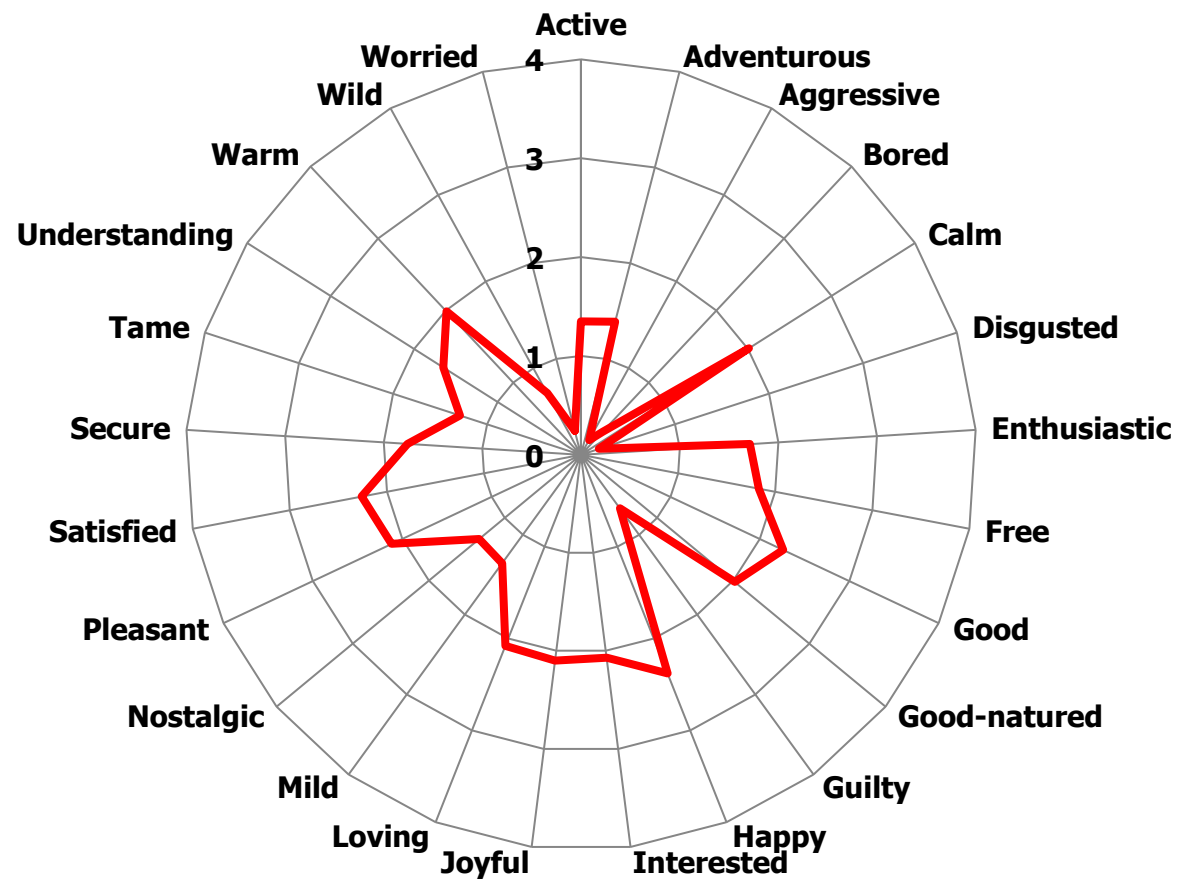


Figure 5.7: Emotional profile of Nestlé

Notes: *Likert scale: 0=Not at all, 1=Slightly, 2=Moderately, 3=Very, 4=Extremely*; Mean values: Active=1.35, Adventurous=1.39, Aggressive=0.17, Bored=0.32, Calm=2.01, Disgusted=0.19, Enthusiastic=1.71, Free=1.83, Good=2.26, Good-natured=2.02, Guilty=0.67, Happy=2.38, Interested=2.07, Joyful=2.10, Loving=2.08, Mild=1.36, Nostalgic=1.34, Pleasant=2.12, Satisfied=2.26, Secure=1.76, Tame=1.29, Understanding=1.65, Warm=1.99, Wild=0.71, Worried=0.25.

5.8 VALIDITY OF THE EMOTION QUESTIONNAIRE

The Cronbach's Alpha's for each of the extracted factors (Canderel $\alpha=0.968$, Lindt $\alpha=0.972$, Nestlé $\alpha=0.970$ for the positive factor; and Canderel $\alpha=0.613$, Lindt $\alpha=0.654$, Nestlé $\alpha=0.466$ for the negative factor) indicates that the emotion questionnaire and scale applied captured positive emotions accurately, but did not optimally capture and report on negative emotions. The negative emotion factor, however, had both a low mean score and low inter-item correlation, and the low Cronbach's Alpha may thus be related to low incidence of emotions experienced rather than an inability to capture the negative emotional experience by the tool and scale employed.

5.9 CONCLUSION

Chocolate consumption is an emotional experience as all emotions in the EsSense25 profile were found to be associated with chocolate. The chocolate eating experience is, however, predominantly positive, with a low incidence of negative or uncategorised emotions evoked during consumption. Some emotions, specifically aggressive, wild and worried, have a very low association with chocolate. No individual emotion was, however, able to discriminate between the three chocolates (to indicate significant ($P \leq 0.05$) differences between all three).

Two main emotion factors exist, positive and negative, and all "uncategorised" emotions were incorporated into either the positive or negative factor, except for the emotion guilt. Correlational analysis shows that various significant relationships exist between positive emotions, but negative emotions have limited correlations amongst each other. PCA also indicates the presence of two factors or dimensions, a valence and arousal factor, and that positive emotions are all closely related and are related to pleasure, however, both activated and deactivated pleasure. Negative emotions are not related to positive (pleasure) emotions, but are not located around displeasure, and are instead related to deactivation. It furthermore indicates redundancy of emotion terms, specifically positive emotion terms.

Respondents responded in a similar emotional manner to Canderel and Lindt, even though these two products are olfactively (sensorily) very different. The mean value of only one emotional attribute, that of guilt, was found to be significantly different ($P \leq 0.05$) between these two chocolates and the frequency of emotion attribute selection to describe these products was also similar. Nestlé, on the other hand, was found to be significantly ($P \leq 0.05$) different to both

Canderel and Lindt for most emotions based on mean values, and there was a higher frequency of selection of emotion terms to describe the emotional experience of Nestlé. Canderel and Lindt are not regularly purchased chocolates (due to their positioning as a product for people with diabetes and as luxury chocolate respectively), however, respondents responded in a similar emotional manner to these, which could indicate that familiarity plays a role in emotional response. Nestlé, the mainstream chocolate, however, delivered a positive emotional experience, and based on its marketing positioning, it is more likely to be regularly consumed than the other two chocolates.

The emotions evoked by the consumption of chocolate were similar for the three studied chocolates despite varying sensory properties, however, the intensity to which the emotions were experienced, varied. This resulted in very similar visual emotional profiles, with Canderel and Lindt appearing almost identical, and Nestlé also similar but less constricted due to a higher intensity of experienced emotion. Therefore, it does appear to be an effect of product on emotional response.

CHAPTER 6

THE RELATIONSHIP BETWEEN THE SENSORY PROPERTIES OF AND THE EMOTIONAL RESPONSE TO CHOCOLATE

6.1 INTRODUCTION

Sensory diversity and foods with different sensory properties have been associated with differences in emotional profiles (Jiang *et al.*, 2014; Gutjar *et al.*, 2015). Even different food varieties or product types from the same category can provide individuals with a broad range of sensory stimulations that could arouse different emotions (Bhumiratana *et al.*, 2014). Such results support the growing body of literature indicating that emotional conceptualisations are mainly sensory driven (Gibson, 2006; King *et al.*, 2010; Thomson *et al.*, 2010; Ng *et al.*, 2013; Gutjar *et al.*, 2015; Schouteten *et al.*, 2015; Spinelli *et al.*, 2015). In fact, it has been indicated that sensory and emotion attributes are so closely related that the sensory identity of an object and its associated emotional conceptualisations merge and become one in an individual's mind. Thus, when a product is experienced, the reaction towards it is both towards the actual product as well as these conceptualisations, and via this, sensory properties or attributes which are intrinsic to the product (and as a result part of its identity) become linked with these emotional conceptualisations (Thomson & Crocker, 2015).

Both sensory and emotional profiles were generated for the three chocolates included in this study, based on the respondents tasting the chocolates and rating the sensory and emotion attributes, and these were reported in the preceding chapters (sensory profiles in Chapter 4, and emotion profiles in Chapter 5). Determining the unique sensory and emotional profiles of each chocolate were of importance as the aim was not to measure emotional response to the category or product name, but to create individual profiles for each of the evaluated chocolates. Tasting was thus crucial to measure not only the intensity of the sensory attributes for each chocolate, but also to generate, reinforce, or alter emotions that may have already existed towards the chocolate category based on the specific experience of each chocolate. Jiang *et al.* (2014) reported that emotion toward specific food concepts is generated and/or reinforced by the emotion evoked during a food tasting experience, but can also be eliminated or weakened

during product tasting based on a consumer's point of view or reference related to the product category, but Köster and Mojet (2015) reported that sensorily evoked emotions vs. the remembered ones and also prospective ones based on expectation are all of importance.

The sensory and emotion profiles which were generated indicated that the three chocolates are sensorily diverse; however, there is less differentiation in the emotional profiles. Heterogeneity in the sensory attributes of the chocolate products was regarded as fundamental to the favourable outcome of this study where one of the objectives is to indicate relationships through establishing statistical linkages between sensory and emotional attributes, and this criterion guided sample selection. Heterogeneity in sensory attributes was assumed to also deliver heterogeneous emotional profiles, as sensory diversity is associated with variations in emotional profiles (Jaeger *et al.*, 2018). Chocolate samples were thus selected based on differences in sensory profiles to increase the likelihood to deliver variations in emotional profiles. A considerable variation in sensory attributes was thus intentionally sought and was expected to be associated with emotional differences between the samples included, in line with the selection objective of various similar studies (King & Meiselman, 2010; Ng *et al.*, 2013; Gutjar *et al.*, 2015; Spinelli *et al.*, 2015; Thomson & Crocker, 2015). However, sensorily extreme samples were avoided as they were expected to have a less distinct emotional profile and instead to be dominated by strong positive or negative valence (Jaeger *et al.*, 2017).

To increase the applied relevance of the statistical results, all chocolate samples included in the study were commercially available to consumers. Selection from the product category thus considered products diverse in sensory attributes, but also more and less familiar products, and a varied range of products from a marketing point of view. The chocolates included in the study were a) A mainstream chocolate, namely Nestlé; b) A sugar-free chocolate aimed at diabetic and health-conscious consumers, namely Canderel; and c) An indulgent imported luxury chocolate, namely Lindt.

In this chapter, the findings regarding the relationship between the sensory attributes of chocolates and the emotional responses to these attributes are reported, which addresses three objectives of the study. It will determine whether a relationship exists between the sensory attributes of and the emotional response to chocolate, whether specific sensory attributes can be linked to positive and negative emotions and whether the data will allow the compilation of a

model to illustrate the relationship between the sensory attributes of and emotional response to chocolate.

6.2 STATISTICAL ANALYSIS

Firstly, to investigate the relationship and thus a possibility of correlations between individual sensory and emotion attributes for each of the three chocolates and to identify whether specific sensory attributes can be linked to positive or negative emotion, Spearman's rank order correlation coefficients were calculated (r). Interpretation of the Spearman's rank order coefficients is based on Cohen's guidelines (1977) where $r=0$ - $r<0.3$ is viewed as small, $r\geq 0.3$ - $r<0.5$ as moderate, and $r\geq 0.5$ as strong. $r\geq 0.3$ was viewed as a tendency to correlate.

This was followed by multiple regression analysis of the sensory and emotion factors (reported on in Chapter 4 and 5) to also determine if a relationship exists on a factor level to further investigate the relationship between sensory and emotion attributes. In this section, the R^2 , R^2 adjusted, β -coefficients and P -values are reported. The R-squared (R^2), as the square of the R coefficient, quantifies the percentage (%) of the variance of emotion factors which is explained by sensory factors (Rights & Sterba, 2019). At 0%, the R^2 indicates that the model explains none of the variability of the response data around its mean, and at 100%, it indicates that the model explains all the variability of the response data around its mean, and thus the higher the R^2 , the better the model fits with the data (Goss-Sampson, 2019). As the R^2 value tends to increase as additional predictors are included in the model, one can get artificially higher R^2 , and to penalise this effect, adjusted R^2 was used and reported. The standardised β coefficient represents the importance of the independent variable (sensory attributes) in relation to the dependent variable (emotion attribute) (Schneider *et al.*, 2010). $\beta\geq 0.2$ indicates a small effect or tendency, while $\beta\geq 0.5$ indicates a moderate influence. In this study $\beta\geq 0.4$ was viewed as a practically significant contribution. The P -value identified where the variables (sensory factors) had a statistically significant impact on the other variable (emotion factors), which would be if $P\leq 0.05$. Multiple regression analysis was next performed on the total set of sensory attributes (the independent variable) in relation to the individual emotion attributes (the dependent variable) to determine which emotions are most influenced by the collection of sensory attributes, and here R^2 , R^2 adjusted and P -values are reported.

Subsequently, to determine the unique contribution of each sensory attribute to the emotion attributes, multiple regression analysis was performed between individual emotion and individual sensory attributes. The Beta (β) coefficients extracted from this analysis were used to construct a model for each chocolate visualising these contributions. To construct these models, $\beta \geq 0.25$ and $P \leq 0.05$ were selected for inclusion to represent where sensory attributes made unique and statistically significant ($P \leq 0.05$) contributions to emotional attributes, thus visualising those relationships that are of importance, while not incorporating too many unique contributions which will make the model visually complex to interpret. This cut-off point was selected as there were many β -coefficients noted with values between 0.2 and 0.3 and selecting only those which were $\beta \geq 0.25$ vs. $\beta \geq 0.20$ would reduce the number of variables in each model by half.

Lastly, a PCA was performed combining all the sensory and emotion data of the three chocolates, and information was extracted from a multivariate data table and expressed in a new set of variables or principal components. Through this extraction of data related to the sensory and emotional attributes of all three chocolates, two components were identified, as well as the attributes linked to these components. All the preceding statistical analysis was performed on the data of the individual chocolates as it was expected that, since the chocolates had unique sensory and similar yet individual emotion profiles, that analysis performed on the average values of the chocolates for all the attributes would obscure the specific relationships which were present. The PCA map was, however, prepared with the data of the three chocolates to visualise and describe the overall relationship between sensory and emotion attributes. It was also prepared to present the relationships within a circumplex model, a circular representation of a set of data that shows the correlation of data points to one another, which allows for the interpretation of sensory attributes mapped to emotion attributes.

6.3 RESULTS AND DISCUSSION

6.3.1 The relationship between individual attributes: sensory and emotion correlation analysis

Tables 6.1 and 6.2 indicate the Spearman's rank order correlation (r) analysis between individual sensory and positive and negative emotion attributes of the three chocolate samples, respectively.

Table 6.1: Spearman's rank order correlations (*r*) between individual sensory and positive emotion attributes

Emotion attribute	Canderel		Lindt		Nestlé	
	Sensory attribute	Spearman's rank order correlations (<i>r</i>)	Sensory attribute	Spearman's rank order correlations (<i>r</i>)	Sensory attribute	Spearman's rank order correlations (<i>r</i>)
Active	Sweet aroma	0.245**	Sweet aroma	0.201*	Gloss	-0.226**
	Creaminess	0.285**	Cocoa powder flavour	0.250**	Bitter flavour	0.201*
			Coffee flavour	0.259**	Bitter aftertaste	0.236**
Adventurous	Sweet aroma	0.257**	Burnt flavour	0.203*	Mouth-coating	0.203*
	Creaminess	0.327**	Coffee flavour	0.230**	Bitter aftertaste	0.299**
Calm	Sweet aroma	0.204*	Gloss	0.252**		
	Melting	0.209*				-
	Bitter	0.210*				
	aftertaste					
Enthusiastic	Sweet aroma	0.240**	Sweet aroma	0.215*		-
	Burnt flavour	-0.220**				
Free	Sweet aroma	0.281**	-		Bitter aftertaste	0.224**
Good	Sweet aroma	0.302**	Gloss	0.280**		
	Burnt flavour	-0.245**				-
	Creaminess	0.295**				
	Melting	0.233**				
Good-natured	Sweet aroma	0.220*	Gloss	0.204*		-
	Melting	0.230**				
Happy	Gloss	0.215*	Gloss	0.270**		
	Sweet aroma	0.296**	Sweet aroma	0.207*		-

Table 6.1 continued

Emotion attribute	Canderel		Lindt		Nestlé	
	Sensory attribute	Spearman's rank order correlations (<i>r</i>)	Sensory attribute	Spearman's rank order correlations (<i>r</i>)	Sensory attribute	Spearman's rank order correlations (<i>r</i>)
Happy	Burnt flavour	-0.292**	Cocoa powder flavour	0.205*		
	Vanilla flavour	0.243**			-	
	Creaminess	0.284**				
Happy	Melting	0.248**				
	Bitter aftertaste	-0.239**			-	
Interested	Sweet aroma	0.261**	Burnt flavour	0.212*		
	Burnt flavour	-0.281**			-	
	Creaminess	0.261**				
	Bitter aftertaste	-0.208*				
Joyful	Sweet aroma	0.240**	Gloss	0.245**		
	Burnt flavour	-0.248**			-	
	Creaminess	0.246**				
	Melting	0.261**				
Loving	Sweet Aroma	0.253**				
	Burnt Flavour	-0.233*				
	Creaminess	0.251**		-		-
	Melting	0.251**				
	Bitter aftertaste	-0.243**				
Mild		-	Gloss	0.250**		
			Bitter aftertaste	0.200*		-

Table 6.1 continued

Emotion attribute	Canderel		Lindt		Nestlé	
	Sensory attribute	Spearman's rank order correlations (<i>r</i>)	Sensory attribute	Spearman's rank order correlations (<i>r</i>)	Sensory attribute	Spearman's rank order correlations (<i>r</i>)
Nostalgic	Creaminess	0.251**	Burnt flavour	0.308**	-	
			Bitter aftertaste	0.265**		
Pleasant	Sweet aroma	0.319**	Gloss	0.263**	Sweet aroma	0.206*
	Burnt flavour	-0.266**	Burnt flavour	0.208*		
	Vanilla flavour	0.216*				
	Creaminess	0.307**				
Pleasant	Melting	0.301*				
	Bitter aftertaste	-0.197*				
Satisfied	Sweet aroma	0.341**	Gloss	0.222*	-	
	Burnt flavour	-0.264**				
	Vanilla flavour	0.302**				
	Creaminess	0.341**				
	Bitter aftertaste	-0.247**				
Secure	Sweet aroma	0.232**	-		-	
Tame	-		-		Bitter flavour	0.204*
Understanding	-		-		-	
Warm	Sweet aroma	0.249**	Gloss	0.246**	Sweet aroma	0.313**
	Burnt flavour	-0.203*			Bitter aftertaste	0.246*
	Creaminess	-0.241**				
Wild	-		Gloss	0.245**	Burnt flavour	-0.377**
			Cocoa powder flavour	0.227**	Bitter aftertaste	0.283*

Notes: Interpretation of Spearman's rank order correlations based on Cohen's guidelines (1977) (r): $r=0$ - $r<0.3$ =Small, $r\geq 0.3$ - $r<0.5$ =Moderate, $r\geq 0.5$ =Strong; Tendencies to correlate ($r\geq 0.3$) are indicated in bold; *Correlation is significant at the $P\leq 0.05$ level (2-tailed), **Correlation is significant at the $P\leq 0.01$ level (2-tailed); Only $r\geq 0.2$ and $P\leq 0.05$ are reported.

Table 6.2: Spearman's rank order correlations (*r*) between individual sensory and negative emotion attributes

Emotion attribute	Canderel		Lindt		Nestlé	
	Sensory attribute	Spearman's rank order correlations (<i>r</i>)	Sensory attribute	Spearman's rank order correlations (<i>r</i>)	Sensory attribute	Spearman's rank order correlations (<i>r</i>)
Aggressive	Sweet aroma	-0.203*	-		-	
	Bitter flavour	0.292**				
	Burnt flavour	0.257**				
Bored	Sweet aroma	-0.211*	-		-	
	Burnt flavour	0.274**				
	Cocoa powder flavour	0.205*				
	Milky flavour	-0.253**				
	Creaminess	-0.358**				
	Bitter aftertaste	0.211*				
Disgusted	Sweet aroma	-0.302**	-		-	
	Burnt flavour	0.328**				
	Cocoa powder flavour	0.210*				
	Milky flavour	-0.267**				
	Vanilla flavour	-0.208*				
	Creaminess	-0.311**				
	Melting	-0.294**				
	Bitter aftertaste	0.247**				
Guilty	-		-		-	
Worried	Sweet aroma	-0.293**	-		-	
	Bitter aftertaste	0.206*				

Notes: Interpretation of Spearman's rank order correlations based on Cohen's guidelines (1977) (r): $r=0$ - $r<0.3$ =Small; $r\geq 0.3$ - $r<0.5$ =Moderate; $r\geq 0.5$ =Strong; Tendencies to correlate ($r\geq 0.3$) are indicated in bold; *Correlation is significant at the $P\leq 0.05$ level (2-tailed), **Correlation is significant at the $P\leq 0.01$ level (2-tailed); Only $r\geq 0.2$ and $P\leq 0.05$ are reported.

6.3.1.1 Canderel

For Canderel, all positive emotions had significant ($P \leq 0.05$) small ($r = 0 - r < 0.3$) and moderate ($r \geq 0.3 - r < 0.5$) correlations with sensory attributes except for the emotions mild, tame and understanding, which are all unclassified emotions based on the EsSense25 classification (however, in this study, these were loaded to the positive emotion factor) (Table 6.1). It also had significant ($P \leq 0.05$) small ($r = 0 - r < 0.3$) and moderate ($r \geq 0.3 - r < 0.5$) correlations with all negative emotions except for guilty, also an unclassified emotion based on EsSense25 and the results of factor analysis in this study (Table 6.2).

The 20 positive emotions had small and moderate correlations to sensory attributes in 52 instances, while the five negative emotions were correlated to sensory attributes in 19 instances, and thus the number of correlations noted per negative emotion was far greater than per positive emotion. Of the 71 significant ($P \leq 0.05$) correlations, only 11 were moderate ($r \geq 0.3 - r < 0.5$) and the remainder were small ($r = 0 - r < 0.3$). Ten of the 19 significant ($P \leq 0.05$) correlations of sensory attributes with negative emotions were negative, while the significant ($P \leq 0.05$) correlations with positive emotions were predominantly positive (37 positive correlations vs. 15 negative correlations). The largest r values noted were related to the emotion satisfied, which was positively correlated to sweet aroma ($r = 0.341$) and creaminess ($r = 0.341$). The emotions pleasant, satisfied and disgusted all had three moderate ($r \geq 0.3 - r < 0.5$) correlations with sensory attributes. The emotion disgusted showed the most (eight) significant ($P \leq 0.05$) correlations with sensory attributes, followed by happy which had seven correlations, and bored and pleasant with six each. Sweet aroma was the sensory attribute which had the most (19) significant ($P \leq 0.05$) correlations with emotions, specifically with the majority of positive emotions.

6.3.1.2 Lindt

For Lindt, most of the positive emotions had significant ($P \leq 0.05$) correlations with at least one sensory attribute except for the emotions free, loving, secure, tame and understanding. There were no significant ($P \leq 0.05$) correlations of sensory attributes with negative emotion attributes. All correlations between the sensory attributes of Lindt with positive emotions were positive. Only one moderate ($r \geq 0.3 - r < 0.5$) correlation was noted between the positive emotion nostalgic

and the burnt flavour sensory attribute ($r=0.308$). The emotions active and happy had the most significant ($P\leq 0.05$) correlations with sensory attributes with three each. The sensory attribute gloss had the most significant ($P\leq 0.05$) correlations with emotions (10 significant correlations) and was in all cases positively correlated to positive emotions.

6.3.1.3 Nestlé

For Nestlé the positive emotions active, adventurous, free, pleasant, tame, warm and wild were significantly ($P\leq 0.05$) correlated with various sensory attributes, while there were no significant ($P\leq 0.05$) correlations between negative emotions and sensory attributes. There were only two moderate ($r\geq 0.3$ - $r<0.5$) correlations between the emotion wild and burnt flavour ($r=-0.377$) and warm and sweet aroma ($r=0.313$). The emotion active had the most (three) significant ($P\leq 0.05$) correlations with sensory attributes. Almost all the correlations between emotion and sensory attributes were related to the attribute bitter aftertaste.

6.3.1.4 Positive emotional attributes

Significant ($P\leq 0.05$) correlations were noted between sensory attributes and all positive emotion attributes (Table 6.1), except for the emotion understanding. A total number of 89 correlations were noted between the three chocolates, 52 of these correlations were between the sensory attributes and emotional attributes of Canderel, 25 for Lindt and 12 for Nestlé, indicating that the positive emotional attributes experienced during the consumption of Canderel were more significantly related to the sensory attributes of the product than Lindt and Nestlé. The majority of Spearman's rank order correlations between sensory attributes and positive emotions were small ($r=0$ - $r<0.3$); however, some moderate or tendencies to correlate ($r=0.3$ - $r\leq 0.5$) were noted, most of which were related to sweet aroma (four moderate correlations), creaminess (three moderate correlations) and burnt flavour (two moderate correlations), indicating that these sensory attributes are more likely to influence positive emotional attributes. For Canderel, the emotional attribute adventurous and sensory attribute creaminess were moderately correlated ($r=0.327$, $P\leq 0.01$); also pleasant and creaminess ($r=0.307$, $P\leq 0.01$); satisfied and creaminess ($r=0.341$, $P\leq 0.01$); good and sweet aroma ($r=0.302$, $P\leq 0.01$); pleasant and sweet aroma ($r=0.319$, $P\leq 0.01$); satisfied and sweet aroma ($r=0.341$, $P\leq 0.01$), as well as satisfied and vanilla

flavour ($r=0.302$, $P\leq 0.01$). For Lindt, nostalgic and burnt flavour was moderately correlated ($r=0.308$, $P\leq 0.051$). For Nestlé, the emotional attribute warm and the sensory attribute sweet aroma were moderately correlated ($r=0.313$, $P\leq 0.01$), and so was wild and burnt flavour ($r=-0.377$, $P\leq 0.01$). All these moderate correlations were positive except for wild and burnt flavour for Nestlé. This indicates that the different sensory profiles of the chocolates result in different and unique relationships with emotion attributes.

The emotional attributes which had small ($r=0-r<0.3$) or moderate ($r=0.3-r\leq 0.5$) correlations with sensory attributes for Canderel, were happy with seven correlations, pleasant with six, and loving and satisfied with five each. For Lindt, active had four correlations, and happy and wild three, and for Nestlé active had three correlations while adventurous, warm and wild had two each, indicating that the sensory profile of Canderel resulted in a happy emotional experience, while the profiles of Lindt and Nestlé resulted in an active emotional experience.

6.3.1.5 Negative emotional attributes

Significant ($P\leq 0.05$) correlations were noted between sensory attributes and all negative emotion (Table 6.2) attributes, except for the emotion guilty, which was unclassified in this study. A total number of 19 significant ($P\leq 0.05$) correlations were noted; however, all of these were between the sensory attributes and emotional attributes of Canderel, indicating again that the negative emotional attributes experienced during the consumption of this chocolate were more significantly related to the sensory attributes of the product than Lindt and Nestlé. Most of the Spearman's rank order correlations were small ($r=0-r<0.3$), however, some moderate or tendencies to correlate ($r=0.3-r\leq 0.5$) were noted, once again related to sweet aroma, creaminess and burnt flavour with one moderate correlation each, indicating that these sensory attributes are more likely to influence emotional attributes. For Canderel, the emotional attribute disgusted and sensory attribute sweet aroma were moderately correlated ($r=-0.302$, $P\leq 0.01$), also disgusted and burnt flavour ($r=0.328$, $P\leq 0.01$) and disgusted and creaminess ($r=-0.311$, $P\leq 0.01$). The moderate correlations between disgusted and sweet aroma and creaminess were negative, and between disgusted and burnt flavour were positive. The sensory profile of Canderel thus resulted in a disgusted emotional experience.

6.3.2 The relationship between factors: sensory and emotion

The relationship between sensory and emotion attributes was also reviewed on a factor level. As summarised in Chapter 4 and 5, two factors were extracted for each chocolate for both the sensory and emotion attributes, namely “sweet” and “bitter” sensory factors, and “positive” and “negative” emotion factors. Multiple regression analyses were conducted with the above factors to identify and describe these relationships, as this analysis can predict the outcome of a dependent variable (Schneider *et al.*, 2010), in this case, emotional response based on the interaction with explanatory or independent variables, in this study the sensory attributes of chocolates. A separate multiple regression analysis was performed for each single chocolate with only one of the emotion factors (either positive or negative) along with the two sensory factors (both bitter and sweet). Table 6.3 contains the results from this multiple regression analysis, and the R^2 , R^2 adjusted, β -coefficients and P -values are reported.

Table 6.3: Summary statistics from multiple regression analysis between emotion and sensory factors

Dependent variable		R^2	R^2 adj.	Independent variable	
				Sensory Sweet	Sensory Bitter
				Beta (β) coefficient	Beta (β) coefficient
Canderel	Positive emotion	10.8%	9.5%	0.481**	-0.183
	Negative emotion	25.2%	24.1%	-0.378**	0.330**
Lindt	Positive emotion	7.7%	6.4%	0.132	0.427**
	Negative emotion	1.6%	0.0%	0.040	0.123
Nestlé	Positive emotion	2.7%	1.3%	0.032	0.213
	Negative emotion	3.5%	2.0%	0.098	0.061

Notes: R^2 adj= R^2 adjusted; Beta (β) coefficient: $\beta \geq 0.2$ =Small effect or tendency; $\beta \geq 0.5$ =Moderate influence; $\beta \geq 0.4$ =Practically significant; *Relationship is significant at the $P \leq 0.05$ level (2-tailed), **Relationship is significant at the $P \leq 0.01$ level (2-tailed).

The results indicate that for Canderel, only 9.5% of the variance of the positive emotion factor is explained by the sensory factors while the sensory factors explain 24.1% of the variance of the

negative emotion factor. The sweet sensory factor made a unique statistically significant positive contribution ($\beta=0.481$; $P\leq 0.05$) to the positive emotion factor, and a unique negative contribution to the negative emotion factor ($\beta=-0.378$; $P\leq 0.05$), while the bitter sensory factor made a unique positive contribution to the negative emotion factor ($\beta=0.330$; $P\leq 0.05$), and no contribution to the positive emotion factor. Only the contribution of the sweet sensory factor to the positive emotion factor is viewed as practically significant ($\beta\geq 0.4$).

For Lindt, only 6.4% of the variance of the positive emotion factor is explained by the sensory factors, while 0.0% of the variance of the negative emotion factor is explained by sensory factors. Only the bitter sensory factor made a unique statistically significant positive contribution ($\beta=0.427$; $P\leq 0.05$) to positive emotion. For Nestlé, only 1.3% of the variance of the positive emotion factor is explained by the sensory factors, while sensory factors explain 2.0% of the variance of the negative emotion factor. Neither of the sensory factors made a unique contribution to either the positive or negative emotion factors.

The above results indicate that the variation in the percentage of the emotion factors, which is explained by the sensory factors, is based on the unique profile of the chocolates. As the three chocolates were found to be sensorily different, this resulted in the sensory attributes of Canderel having a large (24.1%) influence on negative emotion and a smaller influence on positive emotion (9.5%), while the sensory attributes of Lindt had a small (6.4%) influence on positive emotion only, and for Nestlé the sensory attributes had a negligible influence on both positive and negative emotion.

6.3.3 The contribution of the set (collective) of sensory attributes to individual emotions

The relationships between sensory and emotion attributes were next reviewed as a collective of the sensory attributes in relation to individual emotion attributes. Multiple regression analyses were again conducted to identify and describe these relationships, to predict the outcome of the dependent variable (in this case the individual emotion attributes) based on the interaction with explanatory or independent variables (in this case the set of sensory attributes of each chocolate). A separate multiple regression analysis was performed for each chocolate for each

individual emotion attribute along with the set of 14 sensory attributes included in the study. The output is summarised in Table 6.4, including the R^2 , R^2 adjusted and P -values.

Table 6.4: Summary statistics from multiple regression analysis between individual emotions and the set of sensory attributes

Emotion attribute set	Canderel			Lindt			Nestlé		
	R ²	R ² Adj.	Sign.	R ²	R ² Adj.	Sign.	R ²	R ² Adj.	Sign.
Active	20.1%	10.8%	$P \leq 0.05^*$	16.5%	6.8%	0.640	15.2%	5.4%	0.102
Adventurous	21.0%	11.8%	$P \leq 0.01^{**}$	15.7%	5.9%	0.870	16.9%	7.2%	0.054
Aggressive	20.5%	11.3%	$P \leq 0.01^{**}$	9.1%	-1.4%	0.595	21.5%	12.4%	$P \leq 0.01^{**}$
Bored	26.0%	17.4%	$P \leq 0.01^{**}$	14.4%	4.4%	0.141	8.0%	-2.7%	0.721
Calm	23.7%	14.9%	$P \leq 0.01^{**}$	13.7%	3.7%	0.177	11.4%	1.2%	0.352
Disgusted	33.2%	25.5%	$P \leq 0.01^{**}$	8.0%	-2.6%	0.719	5.6%	-5.3%	0.920
Enthusiastic	17.2%	7.6%	$P \leq 0.05^*$	13.0%	2.9%	0.222	13.4%	3.4%	0.194
Free	19.2%	9.8%	$P \leq 0.05^*$	10.6%	2.0%	0.437	16.6%	7.0%	0.060
Good	30.2%	22.2%	$P \leq 0.01^{**}$	16.6%	6.9%	0.060	12.9%	2.8%	0.232
Good-natured	15.4%	5.6%	0.097	17.5%	8.0%	$P \leq 0.05^*$	12.4%	2.3%	0.266
Guilty	18.8%	9.4%	$P \leq 0.05^*$	13.2%	3.1%	0.211	13.9%	4.0%	0.163
Happy	32.1%	24.3%	$P \leq 0.01^{**}$	22.3%	13.3%	$P \leq 0.01^{**}$	12.6%	2.5%	0.251
Interested	23.0%	14.1%	$P \leq 0.01^{**}$	15.2%	5.4%	0.104	14.3%	4.4%	0.144
Joyful	23.0%	14.0%	$P \leq 0.01^{**}$	15.7%	5.9%	0.086	17.8%	8.3%	$P \leq 0.05^*$
Loving	24.0%	15.2%	$P \leq 0.01^{**}$	14.3%	4.4%	0.143	13.6%	3.6%	0.185
Mild	11.9%	1.7%	0.313	17.8%	8.3%	$P \leq 0.05^*$	14.2%	4.3%	0.147
Nostalgic	15.5%	5.7%	0.093	20.1%	10.8%	$P \leq 0.05^*$	13.3%	3.3%	0.199
Pleasant	29.7%	21.6%	$P \leq 0.01^{**}$	19.9%	10.6%	$P \leq 0.05^*$	13.7%	3.7%	0.179
Satisfied	28.3%	20.0%	$P \leq 0.01^{**}$	16.9%	7.2%	0.054	12.0%	1.9%	0.296
Secure	17.0%	7.4%	$P \leq 0.05^*$	10.4%	0.0%	0.460	15.5%	5.8%	0.092

Table 6.4 continued

Emotion attributes	Canderel			Lindt			Nestlé		
	R ²	R ² Adj.	Sign.	R ²	R ² Adj.	Sign.	R ²	R ² Adj.	Sign.
Tame	8.9%	-1.6%	0.616	8.7%	-1.9%	0.643	11.5%	1.3%	0.341
Understanding	13.6%	3.6%	0.182	8.7%	-1.8%	0.637	13.6%	3.6%	0.181
Warm	17.0%	7.4%	<i>P</i> ≤0.05*	11.1%	8.0%	0.381	17.5%	7.9%	<i>P</i> ≤0.05*
Wild	13.3%	3.3%	0.201	13.4%	3.4%	0.193	17.9%	8.4%	<i>P</i> ≤0.05*
Worried	14.0%	4.0%	0.162	15.1%	5.3%	0.108	16.8%	7.1%	0.056

Notes: R² adj = R² adjusted. *Correlation is significant at the *P*≤0.05 level (2-tailed), **Correlation is significant at the *P*≤0.01 level (2-tailed).

The R^2 -adjusted values were firstly reviewed to determine the contributions of the set of sensory attributes to each individual emotion attribute experienced. To interpret these values, a cut-off point or frame for interpretation had to be determined in order to compare the values between emotion attributes and based on the same emotion attribute between chocolates. According to Halcoussis (2005), there is no standard for R^2 interpretation, and interpreting results based on only the absolute values of R^2 is not ideal as in many fields, especially those dealing with human behaviour; it is entirely expected that R^2 values will be low. Hair *et al.* (2013) and Hair and Ringle (2011) suggested in research which focused on marketing challenges, that R^2 values of 0.75, 0.50, or 0.25 for endogenous latent variables can, as a basic rule of thumb, be described as substantial, moderate or weak, respectively. However, a low R^2 can still be a statistically significant predictor (if $P \leq 0.05$) as a change in the independent variable will have an impact on the dependent variable. Another approach is to review R^2 values in intervals, which in this study can be useful to be able to compare emotions with higher R^2 values to those with lower R^2 values, as this would indicate for which emotional attributes sensory attributes are a more significant predictor. Similarly, the overall impact of sensory attributes on the emotional response to each chocolate can also be compared. Considering that very few R^2 values in this study exceeded 20%, the intervals of below 10%, between 10% and 20%, and above 20% were selected for interpretation.

The intervals of the R^2 -adjusted results indicate that the set of sensory attributes had the greatest influence on the emotional response to Canderel, with five of the R^2 adjusted values explaining the variability in excess of 20% (disgusted=25.5%, happy=24.3%, good=22.2%, pleasant=21.6% and satisfied=20.0%), with a further eight explaining the variability above 10% but below 20% (bored=17.4%, loving=15.2%, calm=14.9%, interested=14.1%, joyful=14.0%, adventurous=11.8%, aggressive=11.3% and active=10.8%). For eighteen of the emotion attributes, however, despite some R^2 adjusted values falling below 10%, the set of sensory attributes still made statistically significant ($P \leq 0.05$) contributions to the emotions experienced. The influence of the set of sensory attributes on the emotion attributes was positive for all emotions except for the emotion tame.

For the emotions associated with Lindt, the R^2 -adjusted values were above 10% but below 20% for only three emotions (nostalgic=10.8%, happy=13.3% and pleasant=10.6%), with remaining R^2 adjusted values below 10% for the remaining 22 emotions. It was noted that the influence of the set of sensory attributes on emotion was negative for four emotion attributes (aggressive=-

1.4%, disgusted=-2.6%, tame=-1.9% and understanding=-1.8%). For only five of the emotions (good-natured, happy, mild, nostalgic and pleasant) did the set of sensory attributes make statistically significant ($P \leq 0.05$) contributions to the emotions experienced.

For Nestlé, only one emotion had an R^2 -adjusted value of above 10% but below 20% (aggressive=12.4%), while for the other 24 emotions the R^2 -adjusted values indicate the contribution of the set of sensory attributes to explaining the variation to be below 10%. It was noted that the influence of the set of sensory attributes on emotion was negative for two emotion attributes (bored=-2.7% and disgusted=-5.3%). For only four of the emotions (aggressive, joyful, warm and wild) did the set of sensory attributes make statistically significant ($P \leq 0.05$) contributions to the emotions experienced.

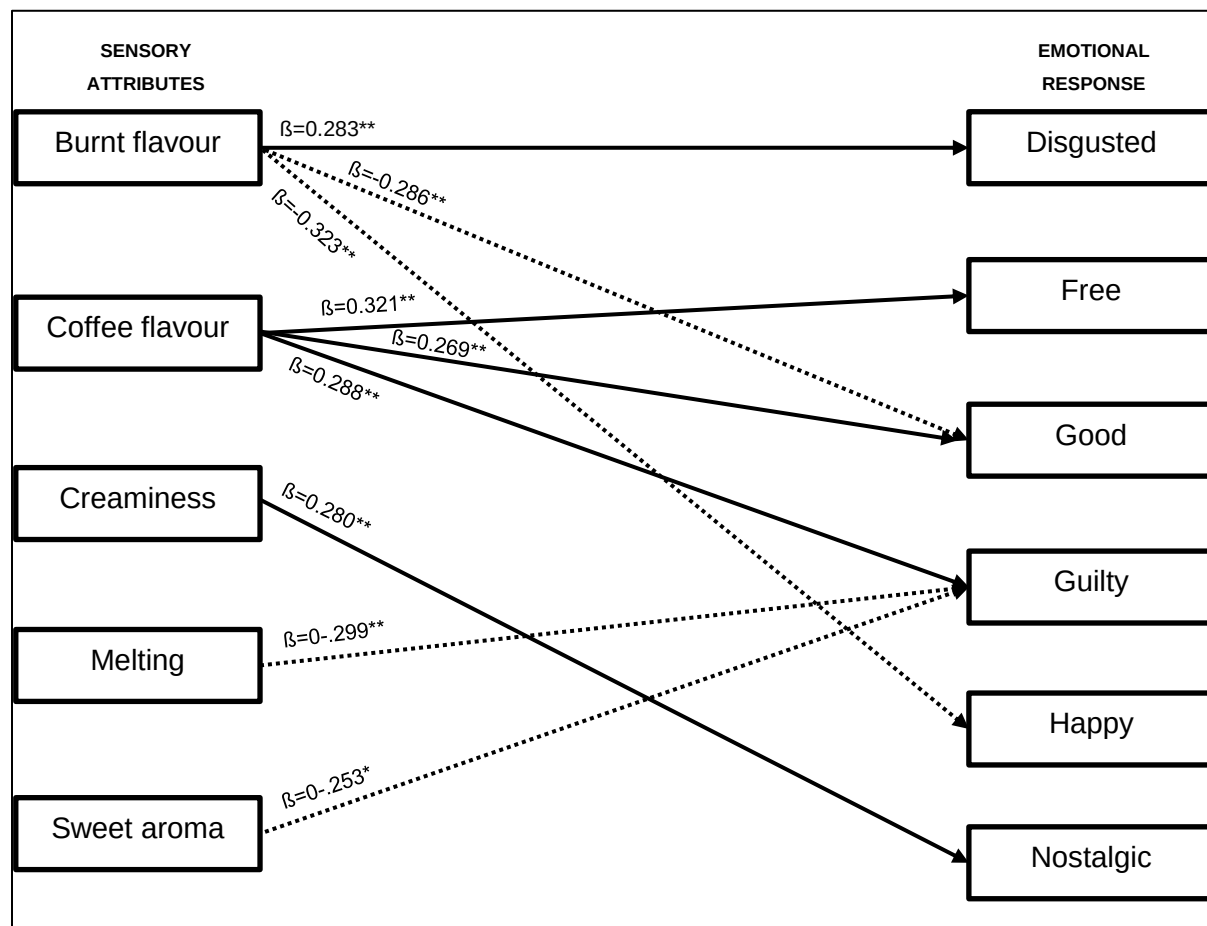
The emotions to which the set of sensory attributes of Canderel contributed most (based on the ranking of the R^2 adjusted values) included disgusted, happy, good, pleasant and satisfied. For Lindt, the sensory attributes most contributed to the emotions of happy, nostalgic, pleasant, mild and good-natured. For Nestlé the emotions aggressive, wild, joyful, warm and adventurous were influenced most.

No individual emotion attribute achieved an R^2 -adjusted value higher than 10% for all three chocolates, and between the top five emotions influenced most by the set of sensory attributes, there were no similarities between the chocolates. The influence of the set of sensory attributes on the emotions experienced during chocolate consumption was thus inconsistent between the chocolates, indicating that each of the unique products evoked a unique emotional experience, influenced by the set of sensory attributes to different extents. To further investigate and illustrate these unique relationships in models, the unique contribution of the individual sensory attributes to each emotional attribute will be addressed in the following section.

6.3.4 The unique contribution of individual sensory attributes to individual emotions

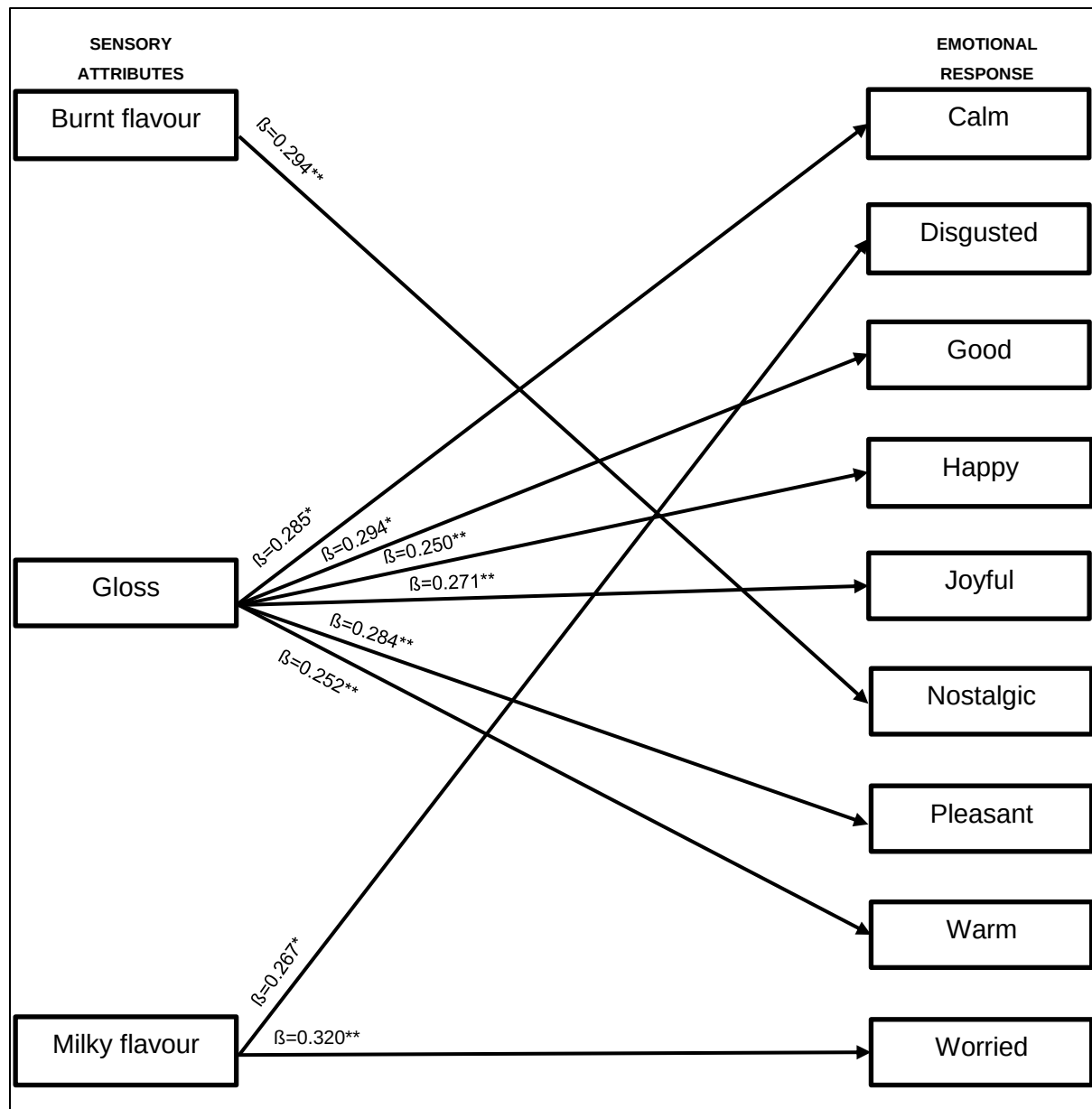
The empirical-related objective d was to compile a model indicating the relationship between the sensory properties (attributes) of and the emotional response to chocolate. To construct these models, multiple regression analysis was performed between individual emotion and sensory attributes generating Beta coefficients (β), which indicate the strength of the effect of the sensory attribute on the emotional response, and P -values which indicate if the relationship is of statistical significance. As indicated in Section 6.2, to construct the models for the three

chocolates, $\beta \geq 0.25$ and $P \leq 0.05$ were selected as the cut-off points in order to represent where sensory attributes made unique statistically significant ($P \leq 0.05$) contributions to emotional attributes, thus visualising those relationships that are of importance, while not incorporating too many relationships which will make the model visually complex to interpret. The models (Figures 6.1, 6.2 and 6.3) thus captured these β -coefficients indicating the strength of the relationship between variables and the P -values indicating the level of statistical significance of these relationships (both $P \leq 0.05$ and $P \leq 0.01$ are indicated).



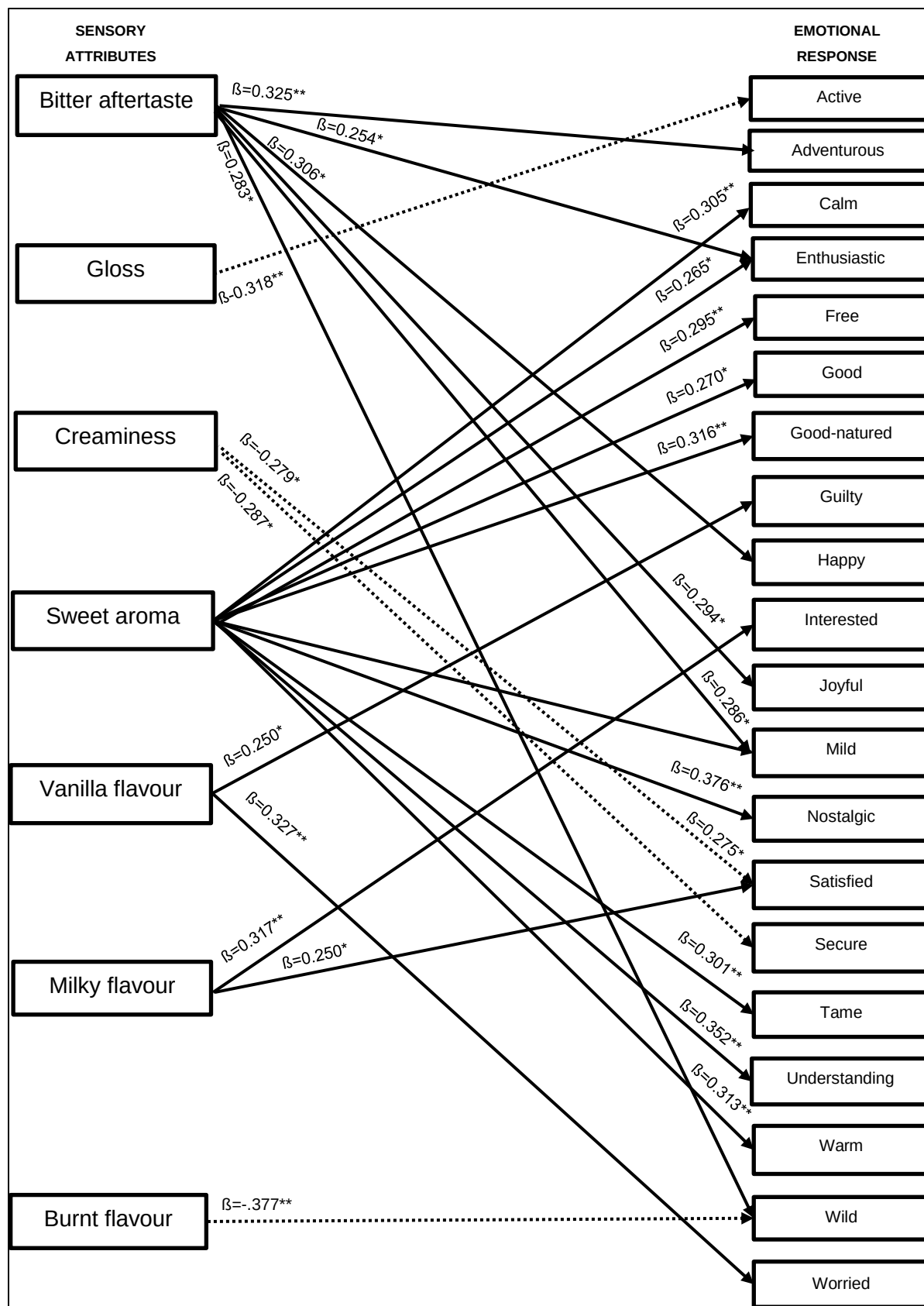
Notes: Beta (β) coefficient: $\beta \geq 0.2$ =Small effect or tendency; $\beta \geq 0.5$ =Moderate influence; $\beta \geq 0.4$ =Practically significant; Only $\beta \geq 0.25$ with significant influence is indicated, *Influence is significant at the $P \leq 0.05$ level (2-tailed), **Influence is significant at the $P \leq 0.01$ level (2-tailed); Positive correlations are indicated with solid lines, negative correlations are indicated with dashed lines.

Figure 6.1: Constructed model of the relationship between sensory attributes and emotional response of Canderel



Notes: Beta (β) coefficient: $\beta \geq 0.2$ =Small effect or tendency; $\beta \geq 0.5$ =Moderate influence; $\beta \geq 0.4$ =Practically significant; Only $\beta \geq 0.25$ with significant influence is indicated, *Influence is significant at the $P \leq 0.05$ level (2-tailed), **Influence is significant at the $P \leq 0.01$ level (2-tailed); Positive correlations are indicated with solid lines, negative correlations are indicated with dashed lines.

Figure 6.2: Constructed model of the relationship between sensory attributes and emotional response of Lindt



Notes: Beta (β) coefficient: $\beta \geq 0.2$ =Small effect or tendency; $\beta \geq 0.5$ =Moderate influence; $\beta \geq 0.4$ =Practically significant; Only $\beta \geq 0.25$ with significant influence is indicated, *Influence is significant at the $P \leq 0.05$ level (2-tailed), **Influence is significant at the $P \leq 0.01$ level (2-tailed); Positive correlations are indicated with solid lines, negative correlations are indicated with dashed lines.

Figure 6.3: Constructed model of the relationship between sensory attributes and emotional response of Nestlé

6.3.4.1 Canderel

In Figure 6.1, a constructed model is presented of the contribution of the sensory attributes of Canderel to the emotions experienced during consumption and indicates the importance of the burnt flavour and coffee flavour to the emotional experience. Five sensory attributes (burnt flavour, coffee flavour, creaminess, melting and sweet aroma) had a statistically significant ($P \leq 0.05$) contribution to both positive (free, good, happy and nostalgic) and negative or unclassified (disgusted and guilty) emotions, and made small unique contributions ($\beta \geq 0.25$ - $\beta < 0.4$) to the emotional experience of Canderel. Burnt flavour and coffee flavour alone contributed to five of the six emotions indicated in the model. Three sensory attributes (coffee flavour, melting and sweet aroma) contributed to the experience of the emotion of guilt, while two attributes (burnt flavour and coffee flavour) impacted the emotion namely good. Sensory attributes made both positive and negative contributions to emotions. While burnt flavour contributed positively to the emotion disgusted, it had a negative contribution to good and happy, indicating that the presence of the sensory attribute was likely to suppress the experience of the two latter emotions. Melting and sweet aroma contributed negatively to the emotion of guilt and was thus likely to reduce the experience of this emotion during consumption. The highest β values and thus unique contributions were noted for the influence of burnt flavour on happy ($\beta = -0.323$; $P \leq 0.01$) and coffee flavour on free ($\beta = 0.321$; $P \leq 0.01$).

6.3.4.2 Lindt

In Figure 6.2, a constructed model is presented of the contribution of the sensory attributes of Lindt to the emotions experienced during consumption and indicates the importance of gloss in the emotional experience. Three sensory attributes (burnt flavour, gloss and milky flavour) had a statistically significant ($P \leq 0.05$) contribution to both positive (free, good, happy and nostalgic) and negative or unclassified (disgusted and guilty) emotions and made small unique contributions ($\beta \geq 0.25$ - $\beta < 0.4$) to the emotional experience of Lindt. Gloss alone contributed to

seven of the nine emotions indicated in the model. All emotions included in the model had a small unique ($\beta \geq 0.25$ - $\beta < 0.4$) contribution from only a single sensory attribute. Sensory attributes made only positive contributions to these emotions. The highest β values and thus unique contributions were noted for the influence of milky flavour on worried ($\beta = -0.320$; $P \leq 0.01$), burnt flavour on nostalgic ($\beta = 0.294$; $P \leq 0.01$) and gloss on good ($\beta = 0.294$; $P \leq 0.01$).

6.3.4.3 Nestlé

In Figure 6.3, a constructed model is presented of the contribution of the sensory attributes of Nestlé to the emotions experienced during consumption and indicates the importance of sweet aroma and bitter aftertaste in the emotional experience. Seven sensory attributes (bitter aftertaste, gloss, creaminess, sweet aroma, vanilla flavour, milky flavour and burnt flavour) made statistically significant ($P \leq 0.05$) small ($\beta \geq 0.25$ - $\beta < 0.4$) contributions to both positive (active, adventurous, calm, enthusiastic, free, good, good-natured, guilty, happy, interested, joyful, mild, nostalgic, satisfied, secure, tame, understanding, warm and wild) and negative and unclassified (worried and guilty) emotions. Bitter aftertaste and sweet aroma alone contributed to 14 of the 20 emotions included in the model. In three cases did two sensory attributes contribute to the same emotion, namely bitter aftertaste and sweet aroma to enthusiastic; creaminess and milky flavour to satisfied; and bitter aftertaste and burnt flavour to wild, while for the other 17 emotions, only individual sensory attributes made contributions. Sensory attributes made mostly positive contributions to emotions; however, four negative contributions were noted between gloss and active ($\beta = -0.318$), creaminess and satisfied ($\beta = -0.297$), creaminess and secure ($\beta = -0.287$) and burnt flavour and wild ($\beta = -0.377$). The highest β values and thus unique contributions were noted for the influence of burnt flavour on wild ($\beta = -0.377$; $P \leq 0.01$) sweet aroma on mild ($\beta = 0.376$; $P \leq 0.01$), sweet aroma on understanding ($\beta = 0.352$; $P \leq 0.01$), and vanilla flavour on worried ($\beta = 0.327$; $P \leq 0.01$).

6.3.4.4 Comparison of the models of the three chocolates

The contributions by sensory attributes to emotional attributes were unique for each of the three chocolates, as there was no single common unique contribution of a sensory attribute to an emotion identified for all three chocolates. For each chocolate the sensory attributes which contributed to the most emotion attributes or the strength of the various contributions of sensory attributes to emotional responses differed, indicating that the unique sensory attributes of the chocolate contributed uniquely to the emotional experience. Between the models of the three chocolates, the sensory attributes which had the highest significant ($P \leq 0.05$), yet small unique

($\beta \geq 0.25$ - $\beta < 0.4$) contribution to an emotion (in descending order) were all related to Nestlé (for the influence of burnt flavour on wild ($\beta = -0.377$; $P \leq 0.01$) sweet aroma on mild ($\beta = 0.376$; $P \leq 0.01$), sweet aroma on understanding ($\beta = 0.352$; $P \leq 0.01$), and vanilla flavour on worried ($\beta = 0.327$; $P \leq 0.01$). Thus, the contribution of sensory attributes to emotion attributes was generally of greater influence for Nestlé than for Canderel or Lindt.

Of the noted sensory attributes which had the highest contribution (β -values) to emotion attributes for the three chocolates, it was noted that in most of these cases, either the sensory or emotion attribute had the highest or lowest mean rating between the three chocolates (as summarised in Chapter 4 and 5), except for the emotional attributes nostalgic and good experienced during the consumption of Lindt, the emotional attribute free experienced during the consumption of Canderel, and the sensory attribute burnt flavour associated with Canderel. This indicates that the intensity of the sensory or emotional experience could be what results in these contributions, but as not all attributes were always highest or lowest in mean rating, it also alludes to the possibility that underlying relationships between the sensory attributes of a product may influence emotional response, more so than the intensity of the individual sensory attributes (captured as mean value).

6.3.4.5 The contribution of aroma sensory attributes to emotion

As indicated in Figure 6.1 and 6.3, sweet aroma made 11 small ($\beta \geq 0.25$ - $\beta < 0.4$) unique significant ($P \leq 0.05$) contributions to various emotion attributes for Canderel (guilty: $\beta = -0.253$, $P \leq 0.05$) and for Nestlé (calm: $\beta = 0.305$, $P \leq 0.01$; enthusiastic: $\beta = 0.265$, $P \leq 0.05$; free: $\beta = 0.295$, $P \leq 0.01$; good: $\beta = 0.270$, $P \leq 0.05$; good-natured: $\beta = 0.316$, $P \leq 0.01$; mild: $\beta = 0.376$, $P \leq 0.01$; nostalgic: $\beta = 0.275$, $P \leq 0.05$; tame: $\beta = 0.301$, $P \leq 0.01$; understanding: $\beta = 0.352$, $P \leq 0.01$; and warm: $\beta = 0.313$, $P \leq 0.01$). It was in fact the sensory attribute which made the most unique contributions to emotional attributes across the three models, although it was not indicated as a unique contributor in the model for Lindt. This is in line with findings of Lindstrom (2005), who reported that 75% of emotions are triggered by smell. The relationship between smell or aroma and emotion appears to be greater than its relationship with the other senses such as vision and audition (Lindstrom, 2005).

All β -coefficients and thus contributions by sweet aroma to positive emotions were positive and were all for Nestlé (calm: $\beta = 0.305$, $P \leq 0.01$; enthusiastic: $\beta = 0.265$, $P \leq 0.05$; free: $\beta = 0.295$, $P \leq 0.01$; good: $\beta = 0.270$, $P \leq 0.05$; good-natured: $\beta = 0.316$, $P \leq 0.01$; mild: $\beta = 0.376$, $P \leq 0.01$;

nostalgic: $\beta=0.275$, $P\leq 0.05$; tame: $\beta=0.301$, $P\leq 0.01$; understanding: $\beta=0.352$, $P\leq 0.01$; and warm: $\beta=0.313$, $P\leq 0.01$). Sweet aroma, however, was assigned an average mean value for Nestlé (mean=1.80) for this sensory attribute as reported in Table 4.1 Chapter 4, and despite this, it still made multiple contributions to emotional attributes. The β -coefficient between sweet aroma and the negative or unclassified emotion namely guilty ($\beta=-0.253$, $P\leq 0.05$) was, however, negative for Canderel, and in Table 4.1 in Chapter 4 it is reported that Canderel had the lowest mean value for this attribute (mean=1.39) which resulted in this negative contribution.

It was also noted that all emotional attributes to which sweet aroma made unique contributions for Nestlé achieved the highest mean ratings as indicated in Chapter 5, Table 5.3 (calm mean=2.02, enthusiastic mean=1.71, free mean=1.83, good mean=2.26, good-natured mean=2.02, mild mean=1.36, nostalgic mean=1.34, tame mean=1.29, understanding mean=1.65, warm mean=1.99). The emotional attribute to which sweet aroma made unique contributions for Canderel, namely guilty, however, achieved the lowest mean rating (mean=0.68).

Aroma is known to have an emotional component, as olfaction has been associated with both emotion and mood (Mykytowycz, 1985; Miltner *et al.*, 1994; Bensafi *et al.*, 2002; Bensafi *et al.*, 2003; Royet *et al.*, 2003; Herz *et al.*, 2004), and in this study, a higher sweet aroma contributed to the more intense (based on mean scores) experience of positive emotions. Smell or aroma, therefore, is a critical sense in evoking emotions.

6.3.4.6 The contribution of appearance sensory attributes to emotion

As indicated in Figure 6.2 and 6.3, gloss was the sensory attribute which made the second highest number (seven) of unique small ($\beta\geq 0.25$ - $\beta<0.4$) contributions to emotions for Nestlé (active: $\beta=-0.318$, $P\leq 0.01$) and Lindt (calm: $\beta=0.285$, $P\leq 0.05$; good: $\beta=0.294$, $P\leq 0.05$; happy: $\beta=0.250$, $P\leq 0.05$; joyful: $\beta=0.271$, $P\leq 0.01$; pleasant: $\beta=0.284$, $P\leq 0.01$; and warm: $\beta=0.252$, $P\leq 0.01$), and while all the contributions (β -coefficients) were positive and were related to positive emotions for Lindt, for Nestlé the contribution (β -coefficients) was negative to a positive emotion (active). As reported in Table 4.1 in Chapter 4, Lindt achieved the highest mean rating for the gloss sensory attribute (mean=1.70) while Nestlé achieved the lowest mean score (mean=0.91), which resulted in these specific contributions.

As summarised in Chapter 5, Table 5.3, the emotional attributes to which gloss made unique contributions for Lindt had an average mean rating (calm mean=1.64, good mean=1.61, happy mean=1.74, joyful mean=1.49, pleasant mean=1.63, warm mean=1.35). The emotional attribute to which sweet aroma made unique contributions for Nestlé achieved the highest mean rating (active mean=1.35). The gloss of chocolate thus contributed to an overall positive emotional experience. Despite the findings that a large percentage of emotions are smell evoked, the mentioned study by Lindstrom (2005) also reported that 37% of respondents believed that sight is the most important sense followed by smell (23%), hearing (20%), taste (15%), and touch (5%), and in this study, the visual appearance of the chocolate did influence emotional attributes.

6.3.4.7 The contribution of mouthfeel sensory attributes to emotion

As indicated in Figure 6.1 and 6.3, the mouthfeel attributes creaminess and melting made only four small unique ($\beta \geq 0.25$ - $\beta < 0.4$) contributions to emotion attributes (for Canderel melting to guilty: $\beta = 0.299$, $P \leq 0.01$; and creaminess to nostalgic: $\beta = 0.280$, $P \leq 0.01$; for Nestlé creaminess to satisfied: $\beta = -0.279$, $P \leq 0.05$ and to secure: $\beta = 0.287$, $P \leq 0.05$). These contributions (β -coefficients) were both positive and negative in nature. Creaminess made a small positive contribution to the emotion attribute nostalgic for Canderel which, as indicated in Chapter 4, Table 4.1, had a low mean value for this attribute (mean=1.38), and creaminess made two small negative contributions to satisfied and secure for Nestlé, which had an average mean value (mean=1.66). Melting made a small negative contribution to the emotion attribute guilty for Canderel, which had an average mean value (mean=1.94).

As summarised in Chapter 5, Table 5.3, the emotional attributes to which creaminess and melting made unique contributions for Canderel achieved the lowest mean ratings (guilty mean=0.68, nostalgic mean=0.80) and for Nestlé achieved the highest mean ratings (satisfied mean=2.27, secure mean=1.76). While for the aroma and appearance attributes which contributed to emotion attributes, the absolute mean values of the sensory and emotion attributes appear to correlate, for the above-mentioned mouthfeel attributes, the ranking of the mean values of both the sensory mouthfeel and emotion attributes between the three chocolates (low, average or high) does not seem to correlate and thus do not provide similar evidence for intensity being the driver behind the unique contributions identified for the other sensory attribute categories. For example, the average mean value for the creaminess of Nestlé (mean=1.66) contributed negatively to high mean values for the emotion attributes

satisfied (mean=2.27) and secure (mean=1.76), while the average melting mean value of Canderel (mean=1.94) contributed negatively to low mean values for the emotion attribute guilty (mean=0.68), and the low creaminess values (mean=1.38) contributed positively to low mean values for the emotion nostalgic (mean=0.80).

It was noted that creaminess and melting were the mouthfeel attributes with the most considerable variation between the lowest and highest mean ratings assigned to the three chocolates (1.62 points difference for creaminess and 0.77 for melting), indicating that respondents may have found it easier to convey their experience with these sensory attributes and rated them accordingly, while they could not accurately convey it for the other mouthfeel attributes as they were all rated similarly. These large variations in mean values may have resulted in the contributions to emotions appearing to be inconsistent with what was noted for the other sensory attribute sub-segments. Texture or mouthfeel attributes have been mentioned as being difficult to isolate (Jiang *et al.*, 2014). This is as Kravchuk *et al.* (2012) reported that food texture is a multidimensional sensory attribute as it is influenced by the food's structure, rheology as well as surface properties, which often makes it complex to evaluate. This differentiation between the three samples may thus have resulted in incidental contributions or contributions which may not reflect the true impact of the mouthfeel sensory attributes on emotion. Grohmann *et al.* (2007), however, reported that while consumers partly evaluate a product based on how it feels (or texture in the case of food), each consumer reacts differently to the sense of touch, and this may be the reason why contributions were inconsistent.

6.3.4.8 The contribution of flavour sensory attributes to emotion

As indicated in Figure 6.1, 6.2 and 6.3, four flavour attributes (two bitter factor sensory attributes, namely burnt flavour and coffee flavour, and two sweet factor sensory attributes, namely milky flavour and vanilla flavour) made small unique ($\beta \geq 0.25$ - $\beta < 0.4$) significant ($P \leq 0.05$) contributions to ten different emotion attributes across the models of the three chocolates (for Canderel burnt flavour to disgusted: $\beta = 0.283$, $P \leq 0.01$, good: $\beta = -0.286$, $P \leq 0.01$, and happy: $\beta = 0.323$, $P \leq 0.01$; coffee flavour to free: $\beta = 0.321$, $P \leq 0.01$, good: $\beta = 0.269$, $P \leq 0.01$; and guilty: $\beta = 0.388$, $P \leq 0.01$; for Lindt burnt flavour to nostalgic: $\beta = 0.294$, $P \leq 0.01$, and milky flavour to disgusted: $\beta = 0.267$, $P \leq 0.05$ and worried: $\beta = 0.320$, $P \leq 0.01$; and for Nestlé vanilla flavour to guilty: $\beta = 0.250$, $P \leq 0.05$ and worried: $\beta = 0.327$, $P \leq 0.01$; milky flavour to interested: $\beta = 0.317$, $P \leq 0.01$ and satisfied: $\beta = 0.250$, $P \leq 0.05$; and burnt flavour to wild: $\beta = -0.377$, $P \leq 0.01$). Of all the flavour attributes, burnt flavour thus made the most (five) unique contributions to emotional

attributes across the three chocolates, followed by milky flavour with four contributions, coffee flavour with three contributions, and vanilla flavour with two contributions.

For Canderel, as summarised in Section 4.3.3, two bitter factor sensory attributes (burnt flavour and coffee flavour) contributed to emotional attributes. The β -coefficients and thus contributions by burnt flavour to positive emotions were negative (good: $\beta=-0.286$, $P\leq 0.01$, happy: $\beta=-0.323$, $P\leq 0.01$) but the contribution was positive to the negative emotion (disgusted: $\beta=0.283$, $P\leq 0.01$), while the contribution of coffee flavour was positive to two positive emotions (free: $\beta=0.321$, $P\leq 0.01$, good: $\beta=0.269$, $P\leq 0.01$), and negative to the negative or unclassified emotion guilty (guilty: $\beta=0.288$, $P\leq 0.01$). Canderel was assigned high mean scores for both burnt flavour (the second highest mean rating after Nestlé) and coffee flavour (the highest mean rating between the three chocolates) (burnt flavour mean=0.80 and coffee flavour mean=1.00). These high mean values resulted in the negative contribution to the positive emotions good and happy, which was assigned the lowest mean scores for these emotion attributes (good mean=1.57, happy mean=1.58), and the positive contribution to the negative emotion disgusted which was assigned the highest mean score for this emotion attribute (mean=0.71).

For Lindt, the burnt flavour from the bitter sensory factor and milky flavour from the sweet sensory factor contributed to both positive (burnt flavour to pleasant) and negative (milky flavour to disgusted and worried) emotional attributes. The β -coefficient and thus contribution by burnt flavour to the positive emotion pleasant was positive ($\beta=0.294$, $P\leq 0.01$), while the contribution by milky flavour to the negative emotions was also positive (disgusted: $\beta=0.267$, $P\leq 0.05$ and worried: $\beta=0.320$, $P\leq 0.01$). Lindt was assigned the lowest mean values for both burnt flavour and milky flavour (burnt flavour mean=0.30 and milky flavour mean=1.46). The low mean value of burnt flavour resulted in the positive contribution to the positive emotion nostalgic which was assigned an average mean value (mean=0.90), and the positive contribution of burnt flavour to the negative emotions disgusted which was assigned an average mean rating (mean=0.59) and worried which was assigned the highest mean rating for this emotion attribute (mean=0.34). The low mean value of milky flavour resulted in a positive contribution to the negative emotions disgusted and worried, which were assigned an average mean score (disgusted mean=0.59) and a high mean score (worried mean=0.34) between the three chocolates.

For Nestlé, the burnt flavour from the bitter sensory factor and vanilla flavour and milky flavour from the sweet sensory factor contributed to emotional attributes. The β -coefficients and thus

contributions by burnt flavour to the positive emotion wild was negative ($\beta=-0.377$, $P\leq 0.01$). Vanilla flavour contributed positively to two negative emotions (guilty: $\beta=0.250$, $P\leq 0.05$ and worried: $\beta=0.327$, $P\leq 0.01$), and milky flavour contributed positively to two positive emotions (interested: $\beta=0.317$, $P\leq 0.01$ and satisfied: $\beta=0.250$, $P\leq 0.05$). Nestlé was assigned the highest mean values for burnt flavour (mean=0.83), which resulted in a negative contribution to the positive emotion wild which was assigned the highest mean value (mean=0.71). It was further assigned average mean values for vanilla flavour (mean=0.82) and milky flavour (mean=1.73). Vanilla flavour contributed positively to the negative emotions guilty and worried which was assigned an average and lowest mean score respectively (guilty mean=0.70, worried mean=0.25). Milky flavour contributed positively to the positive emotions interested and satisfied, which was assigned the highest mean rating (interested mean=2.07, satisfied mean=2.27).

It was noted for Canderel (as captured in Table 5.3) that the remaining two sensory attributes from the bitter sensory factor which were not indicated to contribute to emotion, namely bitter flavour and cocoa powder flavour, were also assigned the highest mean scores (bitter flavour mean=1.30 and cocoa powder flavour mean=1.93), while the three sensory attributes from the sweet factor which did not contribute to the emotional attributes (namely milky flavour, sweet flavour and vanilla flavour) were also assigned the lowest mean values (milky flavour mean=1.46 and sweet flavour mean=1.00, vanilla flavour mean=0.65). Thus, the experience with Canderel was predominantly bitter although not all bitter attributes contributed to the emotional experience; however, no sweet sensory attributes contributed either. Of the six emotions to which the specific sensory attributes contributed, four were negative or unclassified (disgusted or guilty).

For Lindt, however, the remaining three sensory attributes from the bitter sensory factor were not indicated to contribute to emotion, namely, bitter flavour, cocoa powder flavour and coffee flavour as they were assigned the lowest mean values (bitter flavour mean=0.39, cocoa powder flavour mean=1.39 and coffee flavour mean=0.50), while the remaining two sensory attributes from the sweet factor (sweet flavour and vanilla flavour) were assigned the highest mean values (sweet flavour mean=1.29 and vanilla flavour mean=1.29). As for Canderel, the sensory experience of Lindt was predominantly sweet; however, not all sensory attributes from the sweet sensory factor contributed to the emotional experience, and an attribute from the bitter sensory factor (burnt flavour) made a unique contribution.

For Nestlé the remaining sensory attributes from the bitter sensory factor which did not make any contributions to emotional attributes (bitter flavour, cocoa powder flavour, coffee flavour) were assigned average mean scores (bitter flavour mean=0.74, cocoa powder flavour mean=1.59, coffee flavour mean=0.76). The remaining sensory attribute from the sweet factor (sweet flavour) which did not make a unique contribution to any emotional attributes was assigned the second highest mean rating (mean=2.39). The experience with Nestlé was thus somewhat balanced between sweet and bitter, and as a result, the sensory attributes made unique contributions to 20 emotion attributes, of which only two were negative or unclassified (guilty and worried).

According to Leite *et al.* (2013), sweetness presents a high negative correlation with bitterness, and chocolate samples with a higher intensity of bitterness obtained lower sweetness ratings. Respondents in sensory research studies have, however, indicated that they found the balance between the sweet and bitter taste to be of importance (De Pelsmaecker *et al.*, 2017), and thus the extent of sweetness or bitterness may not be as relevant as the overall sensory experience based on this relationship. Thus, while sweet and bitter are opposing sensory experiences, they could culminate in one single flavour experience. Based on the mean ratings of the bitter and sweet sensory attributes and the relationship between these, it can be concluded that the experience with Canderel was predominantly bitter (resulting in the limited contribution of sensory attributes to emotion), the experience with Lindt was predominantly sweet (resulting in more contributions by sensory attributes to emotion than Canderel), and the experience of Nestlé appears to have been more balanced (resulting in the most contributions). The perception of sweetness and not absolute sweetness is thus the important component of the consumption experience (Drewnowski *et al.*, 2012), and may likely be what affects emotional associations (Wardy *et al.*, 2017).

Perceived sugar content decreases with increasing perceived bitter content (Thamke *et al.*, 2009), and sweetness perception is thus related to the intensity of bitter flavour attributes as outlined in Section 4.3.3, where the ratio of the sweet mean factor score to the bitter mean factor score was reported, with a ratio of 1.2 for Canderel, 3.5 for Lindt and 1.7 for Nestlé. Furthermore, as discussed above, the sweet perception of Canderel, Lindt and Nestlé differed based on the intensity to which the various sweet and bitter flavour attributes were experienced individually and collectively. Sweetness and bitterness have been reported to be opposing or contrasting flavours, and sweet solutions tend to evoke feelings of happiness and surprise,

while bitter solutions tend to result in anger and disgust (Rousmans *et al.*, 2000). This balance between sweet and bitter sensory attributes is thus of importance to interpret the emotional experience. Dubovski *et al.* (2017), however, reported that while a bitter taste (such as quinine) enhances negative emotions, sweet taste does not necessarily enhance or increase positive emotions, which is the case in this study as the sweet chocolate, Lindt, did not deliver more positive emotion contributions than the more balanced chocolate, Nestlé. Ng *et al.* (2013) stated that it may specifically be the sweet taste of natural sugar rather than artificial sweetness that contributes to positive emotions, and the source of the sweetness in Canderel thus possibly resulted in not many positive emotions being experienced during consumption of this chocolate.

Irrespective of the source of sweetness, in this study, bitter sensory attributes seem to lead the contribution to emotional attributes while there is less of a contribution of sweet factor flavour attributes to emotions (five contributions from burnt flavour and three contributions from coffee flavour vs. four contributions from milky flavour and two contributions from vanilla flavour). Furthermore, bitterness and sweetness in products are also more complex than just those explicit attributes, as Thamke *et al.* (2009) reported that attributes such as bitter/harsh aftertaste, tart, cocoa, coffee, and nutty are associated with the bitter attribute and cluster, while vanilla and chocolate are associated with the sweet attribute and cluster. Sweet-like flavours (such as milky or vanilla flavour) have, however, also been found to deliver a positive experience, as Mojet *et al.* (2015), for example, reported that vanilla flavour in yogurt was related to positive emotions. It was also noted that while bitter sensory factor attributes made more unique contributions to emotion attributes than sweet sensory factor attributes, the sensory attributes sweet flavour and bitter flavour did not make a unique contribution to the emotional attributes experienced, and it was rather related flavours which had the greatest contribution.

6.3.4.9 The contribution of aftertaste sensory attributes to emotion

As indicated in Figure 6.3, bitter aftertaste made six small unique ($\beta \geq 0.25$ - $\beta < 0.4$) contributions to emotion attributes for only Nestlé (adventurous: $\beta = 0.325$, $P \leq 0.01$; enthusiastic: $\beta = 0.254$, $P \leq 0.05$; happy: $\beta = 0.306$, $P \leq 0.05$; joyful: $\beta = 0.294$, $P \leq 0.05$, mild: $\beta = 0.286$, $P \leq 0.05$ and wild: $\beta = 0.283$, $P \leq 0.05$). These contributions (β -coefficients) were all positive contributions to positive emotions. Nestlé was indicated to have an average bitter aftertaste based on the mean sensory attribute rating as indicated in Table 4.1 (mean=0.94), which made unique contributions to emotions which were assigned the highest mean values between the three chocolates

(adventurous mean=1.35, enthusiastic mean=1.71, happy mean=2.38, joyful mean=2.10, mild mean=1.36 and wild mean=0.71). For this attribute, it thus appears that an aftertaste that is not particularly weak or intense contributed to the experience of these emotions during the consumption of Nestlé.

6.4 PRINCIPAL COMPONENT ANALYSIS OF SENSORY AND EMOTIONAL ATTRIBUTES

PCA was performed with the sensory and emotion data of all three chocolates combined to prepare a PCA map within which overarching relationships could be presented and sensory terms could be mapped to multiple emotions (and vice versa) as a circumplex model as reported in Chapter 5.

It has been reported that in some studies the relationships between sensory characteristics and emotional associations were not interpretable because the same characteristic was both positively and negatively mapped to the same area within the model (Jaeger *et al.*, 2018). This could point to the need for segmentation of how consumers emotionally react to the sensory attributes of products, as in a circumplex model, sensory terms with significant linkages to one or more emotion words can be mapped or linked to between one and four segments or domains based on the interpretation of the pattern of linkages.

Through this analysis, the dimensionality of the multivariate data was reduced to two principal components, and these were visualised graphically as a map. The two components explained a large proportion of the variation (with component 1 explaining 34.62% and component 2 explaining 9.26% of the variation, thus cumulatively 43.8%). The resulting Eigenvalues were 13.50 and 3.60 for component 1 and 2 respectively, and thus a large amount of variance was retained by these two components. This map further visualises the relationships between the sensory attribute and emotion attribute variables, as positively correlated variables are grouped together, negatively correlated variables are positioned on opposite sides of the map (or opposed quadrants), and the distance between variables and the origin indicates the quality (contribution) of these variables on the factor map. The plot in Figure 6.4 indicates that the emotion and sensory terms each locate mainly along with an individual component, which shows that there is a low overall correlation between emotion and sensory attributes for all three chocolates combined.

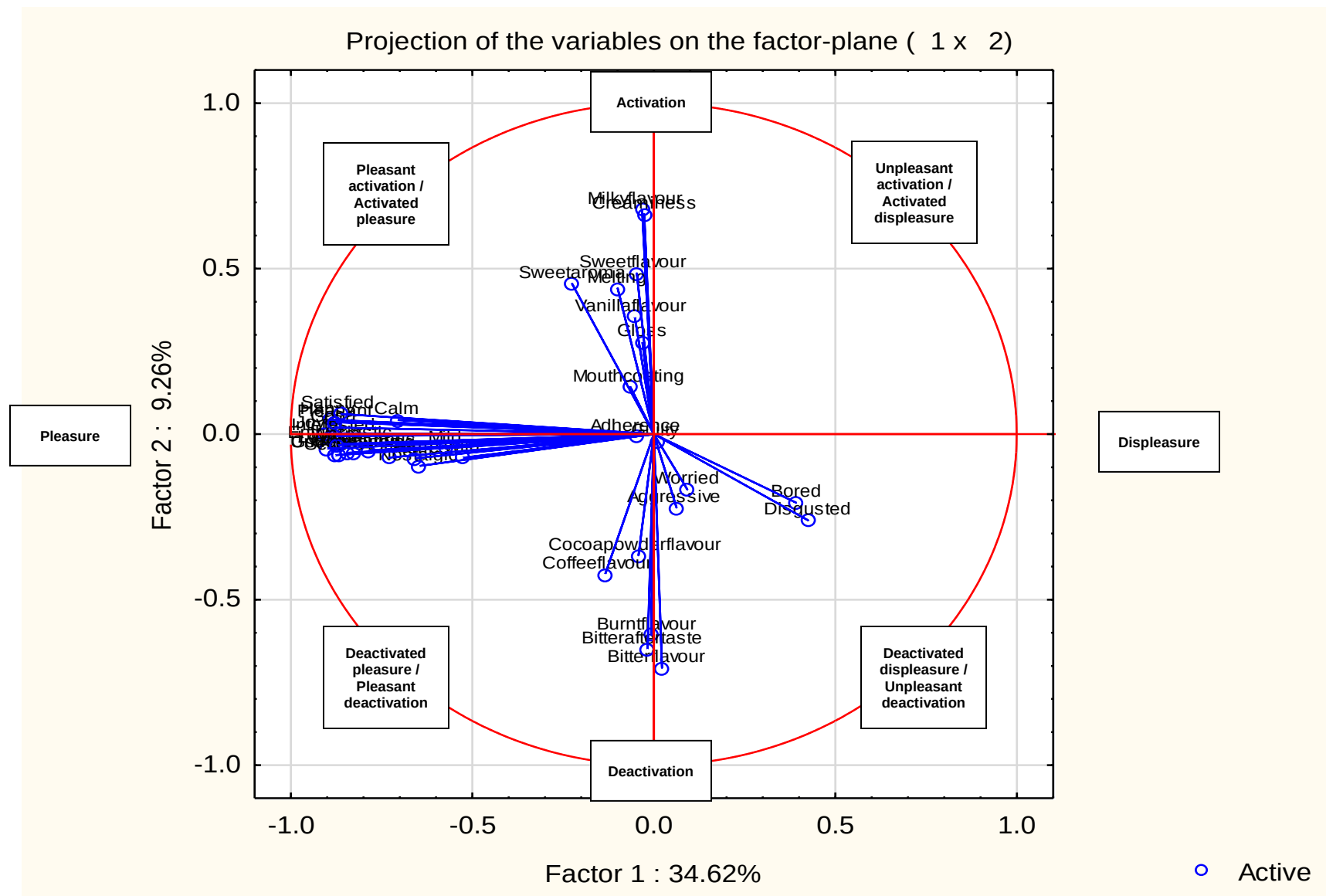


Figure 6.4: Principal component analysis of sensory and emotion attributes

The bulk of the emotional attributes are located along the plane of the first component, which explains a smaller portion of the variance as compared to the second component where the bulk of the variance is explained, and around which most of the sensory attributes are positioned. Sensory attributes thus contribute more significantly to explaining the variance between products than emotional attributes. The majority of emotional attributes are also not closely correlated with sensory attributes as they are positioned well away from all sensory attributes. Burnt flavour, bitter aftertaste and bitter flavour, as well as milky flavour, creaminess and sweet flavour specifically are located along with component two but far from the centre of the map, which means they are most significantly ($P \leq 0.05$) correlated with emotion factors. The bitter attributes of burnt flavour, bitter aftertaste and bitter flavour are all positively correlated with one another and this relationship is well represented in this map, followed by the other two bitter attributes of cocoa powder flavour and coffee flavour which have a weaker relationship with the other bitter attributes due to distance from the other attributes indicated on the map. The negative emotions worried, aggressive, bored and disgusted are positioned on the same side of the map along with these bitter sensory attributes and thus, a relationship is visualised. Milky flavour, creaminess and sweet flavour are sensory attributes which are positioned on the opposite side of the map to the bitter attributes and showcase the existence of a negative correlation to the above-mentioned negative attributes. The sensory attribute adherence is positioned in the middle of the plot and thus has low overall representation and is thus of low importance to the study and low impact on the emotional experience.

There are no emotions located within the top half of the plot along with the sensory attributes located there (from top of the map: milky flavour, creaminess, sweet flavour, sweet aroma, melting, vanilla flavour, gloss and mouth-coating), which clearly shows a weak relationship, while the co-location of the sensory and emotion attributes mentioned in the paragraph above in the bottom half of the plot demonstrate the presence of a relationship. As mentioned earlier in this chapter, it appears that emotion attributes could be related to the bitter sensory attribute or to the bitter:sweet ratio, and in this map, the bitter factor sensory attributes and sweet factor sensory attributes are both located on the second component indicating a relationship between them. They are visually located on opposite sides of the map, indicating that they are also opposed. It is interesting to note that on the map, the bitter flavour attribute extends further out than the sweet flavour attribute and is thus of more significance in this map and study.

The location of the various sensory attributes within the emotion quadrants is also of interest, as the mapping of sensory attributes to the circumplex emotion model indicates the potential of specific sensory attributes to influence, for example, valence (pleasure or displeasure) and arousal (activation and deactivation). It was noted that while burnt flavour, bitter aftertaste, cocoa powder flavour and coffee flavour are considered deactivated pleasure, bitter flavour is deactivated displeasure. All other (sweet factor) sensory attributes are classified as activated pleasure. Table 6.5 captures the contribution of each individual sensory and emotion attribute to the components and has been ranked from largest contribution to smallest.

Table 6.5: The contribution of variables to the principal components

Attribute	Component 1	Attribute	Component 2
Bitter flavour	0.14	Joyful	0.06
Milky flavour	0.13	Loving	0.06
Creaminess	0.12	Happy	0.06
Bitter aftertaste	0.12	Good	0.06
Burnt flavour	0.10	Secure	0.06
Sweet flavour	0.07	Pleasant	0.06
Sweet aroma	0.06	Interested	0.06
Melting	0.05	Warm	0.06
Coffee flavour	0.05	Free	0.06
Cocoa powder flavour	0.04	Satisfied	0.06
Vanilla flavour	0.03	Enthusiastic	0.06
Gloss	0.02	Good-natured	0.05
Disgusted	0.02	Understanding	0.05
Aggressive	0.01	Adventurous	0.05
Bored	0.01	Active	0.04
Worried	0.01	Calm	0.04
Mouth-coating	0.01	Tame	0.03
		Nostalgic	0.03
		Mild	0.02
		Wild	0.02
		Disgusted	0.01
		Bored	0.01

Note: Only contributions of 0.01% and above are indicated.

It showcases that for the smaller component (component two) positive emotions such as joyful, loving, happy, good and secure most contribute to this component and thus most reflect the (positive) emotional experience with chocolate. However, as this component is smaller in variance retained, emotion attributes contribute less than sensory attributes to explaining the overall variance of the chocolate eating experience. No sensory attribute contributed to this component and thus indicates that the overall relationship between the majority of emotions and sensory attributes is weak on an overall level for chocolate. For the larger component (component one), both sensory and emotion attributes contribute to the factor; however, sensory attributes are highly ranked, specifically bitter flavour, milky flavour, creaminess, bitter aftertaste and burnt flavour, while the emotion attributes are ranked lower. Only negative emotions (disgusted, aggressive, bored and worried) contribute to this second factor which indicates a relationship with the sensory attributes. The contribution values of the top-ranked emotion attributes of this component are much lower than for component two. The importance of the bitter flavour contribution is also clear as the sweet flavour attribute contribution to the first component is half of that of the bitter flavour attribute.

6.5 CONCLUSION

Based on the correlation analysis, the emotional experience of Canderel was predominantly negative, highly influenced by a low sweet aroma. The consumption of Lindt evoked many positive emotions, largely related to the glossiness of the chocolate. The emotional experience of Nestlé was largely positive, influenced by the bitter aftertaste. More correlations were noted between sensory attributes and negative emotions than positive emotions. All positive emotions except for the emotion understanding were correlated to sensory attributes, while all negative emotions except for the unclassified emotion guilty were correlated to sensory attributes. No common correlations were identified across the three chocolates due to the unique sensory profile of each of the three chocolates.

The sensory aroma attribute appears to make the most contribution to emotion, followed by the visual attribute of gloss. The relationship between texture sensory attributes and aftertaste and emotions were found to be weak. The bitter sensory attributes burnt flavour and coffee flavour made the most unique contributions to emotions.

Bitter factor attributes made the largest contribution to the PCA map constructed for all three chocolates, and in this map, negative emotional attributes were closely related to the emotional

experience. The relationship between sweet and bitter flavours is however of importance, as, while the contribution of sweet flavour to emotion was less than that of bitterness, bitter flavour attributes had many positive correlations with positive emotions, which indicate that an underlying inverse relationship must exist. When bitterness ratings were higher, they were closely related to negative emotions. Thus, while the consumption of chocolate appears to be a positive emotional experience, it is indicated that an increase in bitterness or an adjustment in the bitter to sweet ratio could alter the emotional experience. The emotional experience is thus possibly attributable to the ratio between sweetness and bitterness and could indicate that the emotional experience is driven by the presence or absence of bitter flavour components in relation to the level of sweetness in a product. It is thus possible that sweetness plays a greater role in emotional response than the results of this study indicate, based on its relationship with bitterness sensory attributes.

The intensity of the experience of specific sensory attributes could also play a role in emotional response, as more and less intensely experienced sensory attributes often contributed to more or less intense emotional attributes.

CHAPTER 7

THE RELATIONSHIP BETWEEN VARIOUS INTERNAL CONSUMER BEHAVIOUR VARIABLES AND THE EMOTIONAL RESPONSE TO CHOCOLATE

7.1 INTRODUCTION

Product-focused emotion research provides deeper insight into consumers' product experiences (Spinelli & Niedziela, 2016; Spinelli & Monteleone, 2018), but in combination with other methodologies, it could even further enhance the value of consumer research. Emotion has been indicated to be influenced by various factors, some of which are related to consumer behaviour. Researchers have thus attempted to combine emotional and sometimes emotion-sensory research with other behavioural elements, and it has recently been demonstrated by Cardello and Jaeger (2016) and Jaeger *et al.* (2017) who combined emotional, situational and attitudinal measures in a product research study. In other such studies, food choice, for example, has been linked to sensory properties of products but was found to be best predicted by the combination of emotional response and liking rather than by liking scores only (Gutjar *et al.*, 2015). King *et al.* (2010) showed that as the frequency of product use increased, the intensity ratings of positive emotion also increased, but for negative emotion terms, intensity decreased with the frequency of use.

It has been reported that there are three factors which can impact emotional responses to food items, namely sensory properties, the type of food, and thirdly the characteristics of the individual which could include numerous variables (Jiang *et al.*, 2014). As foods and the sensory qualities thereof do not have invariant hedonic attributes but are instead dependent on context and the experience of the individual, these variables are all inter-related. If a combination of such variables is to be measured within a specific context, predictions about the reactions to different foods or tastes can be made to a certain extent, but even then there could still be variations due to differentials in experiences and attitudes amongst consumers (Gibson, 2006). Mora *et al.* (2018) thus, proposed that aside from the sensory differences between products, various factors linked to consumers and their behaviour could be included in an

emotional response study. However, such studies that simultaneously explored the impact of sensory experience on consumer emotions and behaviour are rare (Chen & Lin, 2018).

As discussed in Chapter 2, the consumer behaviour variables included in this study (namely mood, familiarity, acceptability and attitude) have all been indicated to have an emotional component. One of the objectives of this study was aimed at not only identifying the existence of relationships between sensory experience and emotional response but also between emotion and consumer behaviour in order to understand and describe what has been coined the “whole consumer experience” (Plaehn & Lundahl, 2006). This can only be done by looking beyond individual product attributes and towards this whole consumer experience to better understand the impact of consumer behaviour. This chapter thus reports the findings regarding the relationship between emotion and various internal consumer behaviour variables, namely mood, familiarity, acceptability and attitude.

7.2 STATISTICAL ANALYSIS

Each section in this chapter addresses one of the four individual consumer behaviour variables which were investigated, as well as its influence on emotion (Section 7.3.1: The relationship between mood and emotion, Section 7.3.2: The relationship between familiarity and emotion, Section 7.3.3: The relationship between acceptability and emotion and Section 7.3.4: The relationship between attitude and emotion). Through descriptive statistics, mean ratings were calculated and reported for the attributes of each consumer behaviour variable.

In sensory and consumer science, the primary way of managing multiple descriptive terms has been to investigate common variance in the use of these terms and search for underlying dimensions using PCA (Prescott, 2017). A factor analysis was thus performed using the Principal component method of extraction for the data of all chocolates, conducted with Oblimin rotation with Kaiser normalisation (Osborne, 2015). This was done in order to: 1) Extract and describe factors based on correlations between the consumer behaviour attributes; 2) Understand the relationship between individual consumer behaviour attributes, and 3) Determine the reliability of the applied tools to capture the consumer responses for each behaviour variable based on the Cronbach's Alpha's of the extracted factors (which is reported at the end of each section), where $\alpha \geq 0.5$ is accepted with caution, $\alpha \geq 0.7$ is acceptable, and $\alpha \geq 0.8$ is good. Factor analysis was, however, not conducted for the consumer behaviour variable namely acceptability, as this variable did not consist of attributes which could be

grouped into factors. This is followed by a correlation analysis where Spearman's rank order two-tailed correlation coefficients (r) were calculated between the consumer behaviour and the emotion factors (reported in Chapter 5), firstly based on the factors constructed of all three chocolates combined, followed by correlations based on the factors of the three individual chocolates.

To subsequently (after the variables had been classified based on the factor analysis) investigate the relationship and thus possibility of correlations between individual emotion attributes and the consumer behaviour variables, Spearman's rank order correlation coefficients (r) were calculated with the data of all chocolates combined, and subsequently with the data of the individual chocolates. Interpretation of the Spearman's rank order correlation coefficients is based on Cohen's guidelines (1977) where $r=0$ - $r<0.3$ is viewed as small, $r\geq 0.3$ - $r<0.5$ as moderate, and $r\geq 0.5$ as strong. Correlations larger than or equal to 0.3 ($r\geq 0.3$) were viewed as a tendency to correlate. Only $r\geq 0.2$, which are significant correlations, are reported, either significant at the $P\leq 0.05$ level (2-tailed) or at the $P\leq 0.01$ level (2-tailed).

Lastly, to visualise the relationship between the consumer behaviour variables and emotion variables for each chocolate, information was extracted from a multivariate data table and was expressed in a new set of variables or principal components. The derived PCA map reduced the dimensionality of the multivariate data to two principal components and visualised these graphically as a plot with four quadrants in order to illustrate the relationships between the various attributes.

7.3 RESULTS

7.3.1 The relationship between mood and emotion

7.3.1.1 Mood state of the respondents

Mood was the first consumer behaviour variable determined (included as the first section in the questionnaire) to establish a baseline understanding of how the respondents were feeling. It was based on a scale of zero to four where zero indicated that the mood attribute was not at all experienced while four indicated it was extremely experienced. As indicated in Figure 7.1, respondents were generally feeling alert as they reported moods of clear-headed (mean=3.01), well-coordinated (mean=2.99) and wide awake (mean=3.83), and they were also feeling relaxed (mean=2.85) and in a generally positive mood, reporting feeling friendly (mean=2.79) and cheerful (mean=2.51). A very limited number of respondents reported that they were

experiencing moods such as confusion (mean=0.09), aggression (mean=0.11) or depression (mean=0.19).

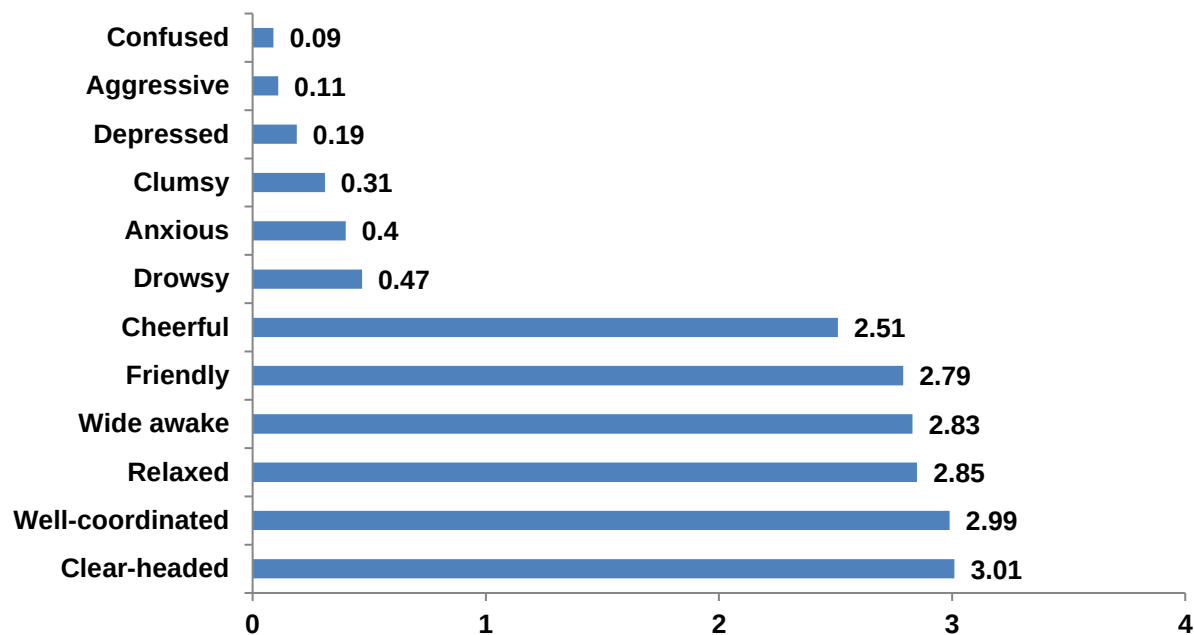


Figure 7.1: Mean score of mood of respondents at the start of the questionnaire

Note: Likert scale: 0=Not at all, 1=Slightly, 2=Moderately, 3=Very, 4=Extremely.

7.3.1.2 Factor analysis to group moods

A factor analysis was performed with the mood data which had been collected. Initially, four factors with eigenvalues greater than one were extracted. A series of factor analyses were conducted which indicated that three factors gave the most interpretable solution. On the bases of the three factors, the Bartlett's test of sphericity, which tests the overall significance of all the correlations within the correlation matrix, was significant ($\chi^2=577$, $P \leq 0.01$), indicating that it was appropriate to use the factor analytic model on this set of data. The Kaiser-Meyer-Olkin measure of sampling adequacy indicated that the strength of the relationships among variables was high (KMO=0.735). Thus it was acceptable to proceed with the analysis. An Oblimin rotation was performed since factors were expected to be correlated. The obtained pattern matrix is displayed in Table 7.1, and all factor loadings except for the mood relaxed were above 0.4 and are thus all displayed.

Table 7.1: Pattern matrix with factor extractions for moods

Item	Factors		
	Positive mood	Negative mood	Clumsy
	1	2	3
Wide awake	0.851		
Clear-headed	0.796		
Well-coordinated	0.760		
Friendly	0.711		
Cheerful	0.632		
Drowsy	-0.566		
Relaxed	0.358		
Depressed		0.809	
Anxious		0.654	
Confused		0.639	
Aggressive		0.580	
Clumsy			0.814
Inter-item correlation	0.417	0.247	-
Cronbach's Alpha	0.835	0.599	-
Mean factor score	2.220	1.200	-
Standard deviation	0.861	0.516	-

Notes: *Likert scale: 0=Not at all, 1=Slightly, 2=Moderately, 3=Very, 4=Extremely*; Cronbach's Alpha: $\alpha \geq 0.5$ =Accepted with caution, $\alpha \geq 0.7$ =Acceptable, $\alpha \geq 0.8$ =Good; Mean factor loading: <1.0 =Not present at all, ≥ 1.0 - <2.0 =Slightly present, ≥ 2.0 - <3.0 =Moderately present, ≥ 3.0 - <4.0 =Very present and 4.0 =Extremely present; Shaded loadings indicate items that loaded meaningful on one factor.

The three extracted factors together accounted for 47.35% of the variance. The internal consistency of both factors was high, with acceptable ($\alpha \geq 0.7$) Cronbach's Alphas, $\alpha = 0.835$ for positive mood and $\alpha = 0.599$ for negative mood which is accepted with caution. The three factors were thus sufficient to explain the underlying structure of the mood of the respondents. The pattern matrix revealed factor one to consist of seven items, and based on the moods included in each factor, and it was labelled "positive mood". The second factor consisted of four items and based on the moods included in each factor, and it was labelled "negative mood". The mood clumsy loaded as a unique factor. Factor loadings were higher for the positive mood

factor (2.220) than for the negative mood factor (1.200). Within the positive mood factor, the mood wide-awake had the highest inter-item correlation score (0.851) while relaxed had the lowest (0.358). The negative mood factor depressed had the highest inter-item correlation (0.809) score, with aggressive having the lowest (0.580) score. Drowsy was negatively correlated to this factor (-0.566) and was therefore reported separately.

A mood study conducted by Churchill and Behan (2010) grouped mood attributes into four clusters, namely 1) Stressful, irritated, miserable and depressed; 2) Invigorated, vibrant, stimulated, cooled and refreshed; 3) Carefree, happy, sexy and sensual; and 4) Warm, pampered reassured, relaxed and tranquil. This cluster analysis thus resulted in the creation of a negative factor (set 1 as outlined above), and three “positive” factors (set 2-4 as outlined above). The study of Churchill and Behan (2010), however, used a lengthier and possibly more descriptive mood list than the current study, which therefore most likely delivered more than the two basic factors of positive and negative mood of this study.

7.3.1.3 The relationship between mood and emotion factors

7.3.1.3.1 Mood and emotion factor correlations: Combination of the three chocolates

Spearman’s rank order correlations (r) were calculated to describe the relationship between the mood and emotion factors for all chocolates (emotion factors reported in Chapter 5) and are reported in Table 7.2.

Table 7.2: Spearman’s rank order correlations (r) between mood and emotion factors of all three chocolates

	Positive emotion	Negative emotion	Guilty
Positive mood	0.137**	-0.042	0.009
Negative mood	0.059	0.104*	0.226**
Clumsy	0.047	0.077	0.062

Notes: Interpretation of Spearman’s rank order correlations based on Cohen’s guidelines (1977) (r): $r=0$ - $r<0.3$ =Small, $r\geq 0.3$ - $r<0.5$ =Moderate, $r\geq 0.5$ =Strong; *Correlation is significant at the $P\leq 0.05$ level (2-tailed), **Correlation is significant at the $P\leq 0.01$ level (2-tailed).

All reported Spearman’s rank order correlations (r) were small ($r=0$ - $r<0.3$), indicating that on a factor level, the relationship between mood and emotion is small. The highest r value ($r=0.226$; $P\leq 0.01$) was noted between negative mood and guilty emotion, followed by the positive mood

and positive emotion ($r=0.137$; $P\leq 0.01$). This indicates that consumers who are in a positive mood state are more likely to experience positive emotion during consumption, while those in a negative mood state are likely to experience guilt.

The overall weak relationships between mood and emotion factors could be, as Gibson (2006) stated, that relationships between mood, emotions and physiological arousal are complex, as the emotional significance of a given level of arousal will depend on the person's current emotional state but also on their personality, which can interact with mood and influence response to emotional stimuli. The existence of some underlying relationship is, however, in line with the findings of Köster and Mojet (2015) who found that during a negative mood state, negative verbal information is retrieved more easily than positive information and conversely, positive information is retrieved more readily during positive mood.

7.3.1.3.2 Mood and emotion factor correlations: Individual chocolates

Spearman's rank order correlations (r) were also determined to describe the relationship between the mood and emotion factors for the individual chocolates as captured in Table 7.3. Only three significant ($P\leq 0.05$) positive relationships were noted, two with small r values ($r=0$ - $r<0.3$) namely between positive mood and positive emotion of Nestlé ($r=0.245$, $P\leq 0.05$), negative mood and guilty emotion also for Nestlé ($r=0.218$, $P\leq 0.05$), and one moderate tendency to correlate ($r\geq 0.3$ - <0.5) between the negative mood and guilty emotion for Lindt ($r=0.335$, $P\leq 0.05$).

Directionally, the positive mood factors had positive correlations with the positive emotion factors of all three chocolates, while the positive mood factor had negative correlations with the negative emotion factors of all three chocolates. A positive mood thus appears to result in a positive emotional experience with chocolate. The negative mood factors had a positive correlation with both the positive and the negative emotion factors, indicating that while a positive mood appears to result in a positive emotional experience, a negative mood could result in either a positive or negative emotional experience. It was, however, noted that the r values between the negative mood and negative emotion factors were higher than between the negative mood and positive emotion factors. It is thus more likely that a negative mood would result in a negative emotional experience. However, overall, it seems there is an inclination towards a positive emotional experience with chocolate, irrespective of whether the respondent was in a positive or negative mood, and even a possible suppression of negative emotions due

to a positive mood. The positive mood factors had a positive correlation with the emotion guilt for both Canderel and Nestlé, however a negative correlation with Lindt. The negative mood factors had a positive correlation with the emotion guilt for all three chocolates. A feeling of guilt is thus likely to be evoked if a consumer is in a negative mood.

Table 7.3: Spearman's rank order correlations (*r*) between mood and emotion factors for the mean of all three chocolates

	Canderel			Lindt			Nestlé		
	Positive emotion	Negative emotion	Guilty	Positive emotion	Negative emotion	Guilty	Positive emotion	Negative emotion	Guilty
Positive mood	0.081	-0.038	0.066	0.114	-0.011	-0.054	0.245**	-0.083	0.017
Negative mood	0.044	0.082	0.123	0.038	0.138	0.335**	0.106	0.114	0.218*
Clumsy	-0.011	0.161	0.009	0.076	0.016	0.108	0.087	0.074	0.068

Notes: Interpretation of Spearman's rank order correlations based on Cohen's guidelines (1977) (*r*): $r=0$ - $r<0.3$ =Small, $r\geq 0.3$ - $r<0.5$ =Moderate, $r\geq 0.5$ =Strong; Tendencies to correlate ($r\geq 0.3$) are indicated in bold; *Correlation is significant at the $P\leq 0.05$ level (2-tailed), **Correlation is significant at the $P\leq 0.01$ level (2-tailed).

7.3.1.4 The relationship between individual mood and emotion attributes

Based on the small correlations reported thus far between mood and emotion factors, the relationships were further investigated on an individual attribute level to conclude if further relationships can be uncovered.

7.3.1.4.1 Mood and emotion individual attribute correlations: Combined data of all chocolates

The relationship between individual mood and emotion attributes calculated with the data of all three chocolates combined are captured in Table 7.4.

Table 7.4: Spearman's rank order correlations (*r*) between individual mood and emotion attributes for all chocolates

Mood	Emotion	Spearman's rank order correlations (<i>r</i>)
Positive mood factor attributes		
Cheerful	Secure	0.167**
	Tame	0.163**
	Understanding	0.144*
Clear-headed	Good	0.186**
	Pleasant	0.174**
	Happy	0.172**
	Understanding	0.157**
	Secure	0.155*
	Free	0.147*
	Loving	0.143*
	Tame	0.143*
	Good-natured	0.142*
	Satisfied	0.139*
	Bored	-0.152*
Drowsy	Active	0.145*
Friendly	Active	0.184**
	Adventurous	0.146*
	Pleasant	0.144*

Table 7.4 continued

Mood	Emotion	Spearman's rank order correlations (<i>r</i>)
Friendly	Loving	0.140*
Relaxed	Tame	0.201**
	Calm	0.175**
	Mild	0.167**
	Understanding	0.147*
Well-coordinated	Tame	0.148*
Wide awake	Active	0.168**
	Adventurous	0.159**
	Pleasant	0.145*
Negative mood factor attributes		
Aggressive	Wild	0.151*
Anxious	-	
Confused	-	
Depressed	Disgusted	0.182**
	Wild	0.153*
Unclassified mood		
Clumsy	-	

Notes: Interpretation of Spearman's rank order correlations based on Cohen's guidelines (1977) (*r*): $r=0$ - $r<0.3$ =Small, $r\geq 0.3$ - $r<0.5$ =Moderate, $r\geq 0.5$ =Strong; *Correlation is significant at the $P\leq 0.05$ level (2-tailed), **Correlation is significant at the $P\leq 0.01$ level (2-tailed); All *r* values with $P\leq 0.05$ are reported.

All reported Spearman's rank order correlations (*r*) between individual mood and emotion attributes for all chocolates were small ($r=0$ - $r<0.3$), indicating that the relationship between mood and emotion is weak when the data of all three chocolates is combined. However, directionally, most of the positive mood attributes were positively correlated to various positive emotions, with only one positive mood attribute (clear-headed) negatively correlated to a negative emotion (bored), and one other positive attribute (drowsy) negatively correlated to a positive attribute (secure). If respondents were in a positive mood, it thus appears that they were more likely to experience positive emotions during the consumption of chocolate, and

those in a positive mood were less likely to experience negative emotions, as there was an absence of significant correlations between positive moods and negative emotions. Those in a positive mood also directionally had a more emotional experience, with 27 correlations noted between positive mood and emotion attributes, but only three between negative mood and emotion attributes.

7.3.1.4.2 Mood and emotion individual attribute correlations: Data of three individual chocolates

The relationship between individual mood and emotion attributes calculated for all three chocolates individually are captured in Table 7.5.

Table 7.5: Spearman's rank order correlations (*r*) between individual mood and emotion attributes of individual chocolates

Mood	Canderel	Lindt	Nestlé
Positive mood factor attributes			
Cheerful	-	-	-
Clear-headed	-	-	Good 0.236**
			Calm 0.217*
			Loving 0.212*
			Bored -0.204*
Drowsy	-	-	Secure -0.209*
Friendly	-	Adventurous 0.222**	-
		Active 0.200*	
Relaxed	-	Secure 0.237**	Mild 0.236**
		Tame 0.226**	Guilty -0.233**
		Guilty -0.215*	
Well-coordinated	-	-	Active 0.257**
			Good 0.203*
			Tame 0.211*
Wide awake	-	Active 0.203*	Good 0.261**
			Secure 0.246**
			Pleasant 0.233**
			Nostalgic 0.231**
			Understanding 0.222**
			Calm 0.217*
			Happy 0.209*

Table 7.5 continued

Mood	Canderel	Lindt	Nestlé
Wide awake			Joyful 0.209*
Negative mood factor attributes			
Aggressive	-	-	-
Anxious	-	Guilty 0.206*	Worried 0.246* Aggressive 0.214*
Confused	-	Disgusted 0.223**	-
Depressed	Disgusted 0.236**	Aggressive 0.227** Guilty 0.200*	-
Unclassified mood factor attributes			
Clumsy	Aggressive 0.204* Disgusted 0.202*	Nostalgic 0.233** Aggressive 0.211*	-

Notes: Interpretation of Spearman's rank order correlations based on Cohen's guidelines (1977) (r): $r=0$ - $r<0.3$ =Small, $r\geq 0.3$ - $r<0.5$ =Moderate, $r\geq 0.5$ =Strong; *Correlation is significant at the $P\leq 0.05$ level (2-tailed), **Correlation is significant at the $P\leq 0.01$ level (2-tailed); Only $r\geq 0.2$ and $P\leq 0.05$ are reported.

This approach yielded higher Spearman's rank order correlations (r) values than when the data of the three chocolates were combined, indicating that the combination of the data as reported in the previous section (data of all chocolates combined) masked some relationships. The Spearman's rank order correlations (r) were, however, all still small ($r=0-r<0.3$), indicating that the relationship between mood and emotion is still weak.

For Canderel, three small ($r=0-r<0.3$) significant ($P\leq 0.05$) positive correlations were identified between the mood clumsy and the emotions aggressive ($r=0.204$, $P\leq 0.05$) and disgusted ($r=0.236$, $P\leq 0.05$), and between the mood depressed and the emotion disgusted ($r=0.236$, $P\leq 0.01$). The influence of respondents' mood on the emotions experienced during the consumption of this chocolate seems to have been limited.

Twelve small ($r=0-r<0.3$), yet significant ($P\leq 0.05$) correlations were identified during mood and the emotions experienced during the consumption of Lindt. The mood relaxed had the most correlations (three) with emotion attributes, correlating positively with secure ($r=0.237$, $P\leq 0.01$) and tame ($r=0.226$, $P\leq 0.05$), and negatively with guilty ($r=-0.215$, $P\leq 0.05$). Clumsy, depressed and friendly both had two significant ($P\leq 0.05$) correlations with emotion attributes. Clumsy was positively correlated with nostalgic ($r=0.233$, $P\leq 0.01$) and aggressive ($r=0.211$, $P\leq 0.05$), depressed was positively correlated with aggressive ($r=0.227$, $P\leq 0.01$) and guilty ($r=0.200$, $P\leq 0.05$), while friendly was positively correlated with adventurous ($r=0.222$, $P\leq 0.01$) and active ($r=0.200$, $P\leq 0.05$). The moods anxious, confused and wide awake were correlated with one emotion each, anxious with guilty ($r=0.206$, $P\leq 0.05$), confused with disgusted ($r=0.223$, $P\leq 0.01$) and wide awake with active ($r=0.203$, $P\leq 0.05$).

Twenty small ($r=0-r<0.3$), yet significant ($P\leq 0.05$) correlations existed between mood and the emotions experienced during the consumption of Nestlé. The mood wide awake had the most correlations (eight) with emotion attributes, all of which were positive. Wide awake correlated with good ($r=0.261$, $P\leq 0.01$), secure ($r=0.246$, $P\leq 0.01$), pleasant ($r=0.233$, $P\leq 0.01$), nostalgic ($r=0.231$, $P\leq 0.01$), understanding ($r=0.222$, $P\leq 0.01$), calm ($r=0.217$, $P\leq 0.05$), happy ($r=0.209$, $P\leq 0.05$) and joyful ($r=0.209$, $P\leq 0.05$). The mood clear-headed was positively correlated with good ($r=0.236$, $P\leq 0.01$), calm ($r=0.217$, $P\leq 0.05$) and loving ($r=0.212$, $P\leq 0.05$), and negatively with bored ($r=-0.204$, $P\leq 0.05$). The mood anxious was positively correlated with two emotion attributes, namely worried ($r=0.246$, $P\leq 0.05$) and aggressive ($r=0.214$, $P\leq 0.05$), while the emotion relaxed was also correlated with two emotion attributes, positively correlated with mild

($r=0.236$, $P\leq 0.01$) and negatively correlated with guilty ($r=-0.233$, $P\leq 0.01$). Lastly, the mood drowsy was negatively correlated with the emotion secure ($r=-0.209$, $P\leq 0.05$).

Most correlations for the individual chocolates between mood and emotion attributes were positive except for clear-headed and bored, drowsy and secure and relaxed and guilty, indicating that respondents' mood and emotion were generally in the same direction even though the correlations were small. The emotions which had significant relationships with positive moods were all positive (or unclassified in the case of guilty), while the reverse was true for negative moods and related emotions, once again indicating that consumers in a positive mood are more likely to have a positive emotional experience. The mood wide-awake had the most number (nine) of significant ($P\leq 0.05$) correlations with emotions, followed by the mood relaxed (with five); these two mood states thus resulted in a more emotional experience.

7.3.1.5 Principal component analysis of mood and emotion attributes

7.3.1.5.1 Canderel

Through the extraction of data related to the mood and emotional attributes, two components were identified as well as the attributes linked to these components, which explains a large proportion of the variation (with component 1 explaining 35.00% and component 2 explaining 10.66% of the variation, thus cumulatively 45.66%). The resulting Eigenvalues were 12.94 and 3.94 for factor 1 and 2 respectively, and thus a large amount of variance was retained by these two components. The PCA map in Figure 7.2 demonstrates that there are very few significant ($P\leq 0.05$) relationships between mood and emotion attributes for Canderel, as mood attributes are all located on or close to the second component (related to activation or deactivation), while emotion attributes are located on or close to the first component (related to pleasure or displeasure). The mood attributes which are co-located are in line with the output of the factor analysis of the mood attributes of all three chocolates (as reported in Table 7.1). There is, however, a closer proximity between negative moods and negative emotions than between positive moods and positive emotions.

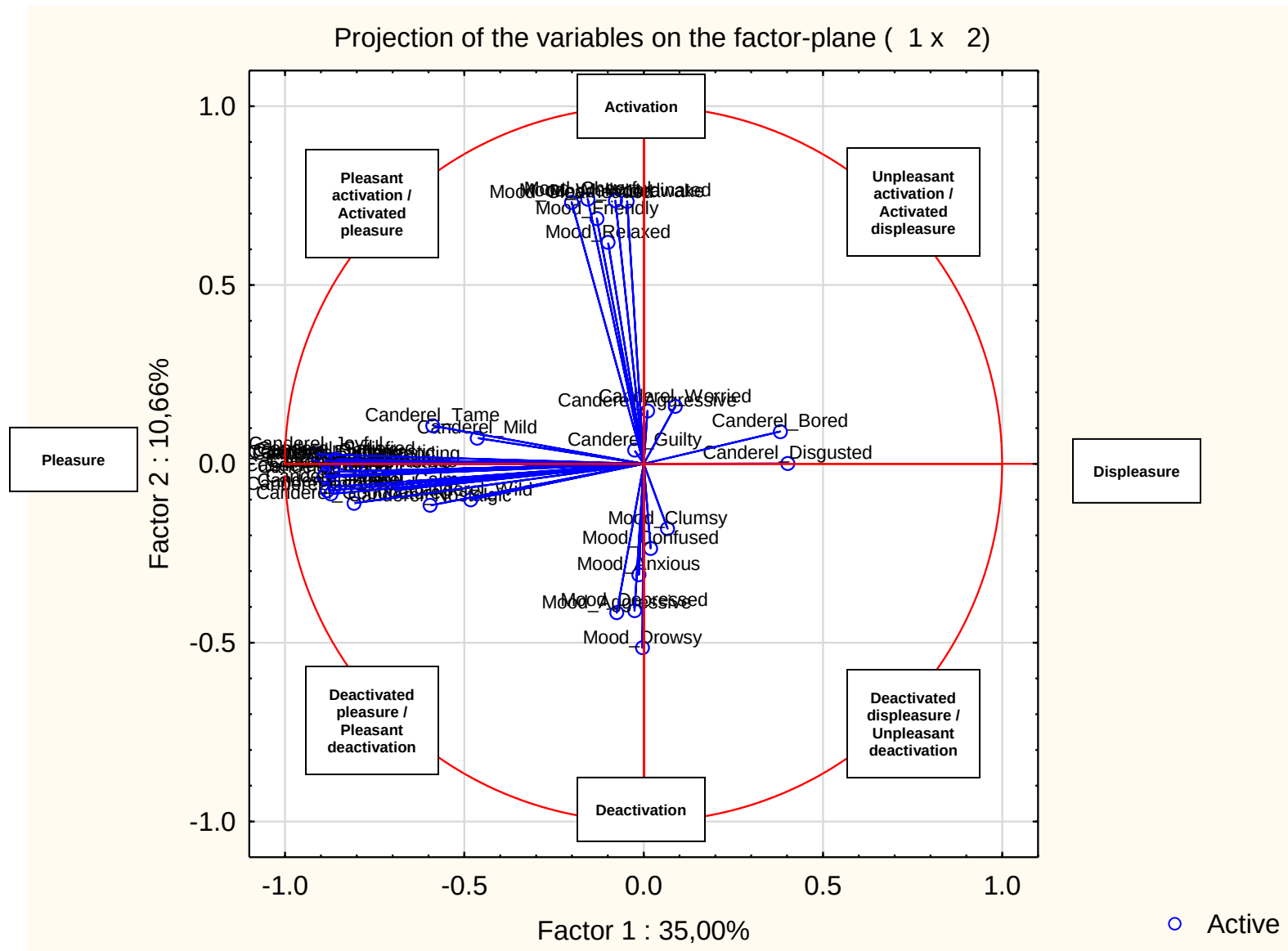


Figure 7.2: PCA map of mood and emotion attributes of Canderel

7.3.1.5.2 Lindt

Through the extraction of data related to the mood and emotional attributes of Lindt, two components were identified as well as the attributes linked to these components, as indicated in Figure 7.3, which explains a large proportion of the variation (with component 1 explaining 36.61% and component 2 explaining 10.58%, thus cumulatively 47.19%). The resulting Eigenvalues were 13.54 and 3.91 for factor 1 and 2 respectively, and thus a large amount of variance was retained by these two components. The PCA map also demonstrates, as with Canderel, that there are very few significant ($P \leq 0.05$) relationships between mood and emotion attributes for Lindt. Mood attributes are all located on or close to the second component, while emotion attributes are located on or close to the first component. Mood attributes which are co-located are also in line with the output of the factor analysis of all mood attributes. The PCA map layout of Lindt is very similar to that of Canderel. However, the emotion aggressive shows higher proximity to negative mood attributes.

7.3.1.5.3 Nestlé

Through the extraction of data related to the mood and emotional attributes of Nestlé, two components were identified as well as the attributes linked to these components, as indicated in Figure 7.4, which explains a large proportion of the variation (with component 1 explaining 36.33% and component 2 explaining 10.16%, thus cumulatively 46.49%). The resulting Eigenvalues were 13.44 and 3.76 for factor 1 and 2 respectively, and thus a large amount of variance was retained by these two components. The PCA map demonstrates that some significant ($P \leq 0.05$) yet small relationships exist between mood and emotion attributes for Nestlé. Similarly, to the PCA's of Canderel and Lindt, mood attributes are all located on or around the second component, while emotion attributes are located on or around the first component. Mood attributes which are co-located are in line with the output of the factor analysis of all mood attributes. However, the clusters of moods of the Nestlé PCA map are located on the opposite sides of the PCA map as compared to Canderel and Lindt, indicating an inverse relationship between moods and emotions for this chocolate. The negative emotions worried and disgusted are also located on the opposite side of the rest of the negative emotion variables on the PCA map, further away from the mood clusters. This indicates an overall weaker relationship between mood and specific negative emotional attributes for Nestlé in comparison to Lindt and Canderel, and for the emotion attribute disgusted, mood might have a greater impact on the emotional response to Nestlé than it had for Canderel and Lindt. It was also noted that some of the mood attributes were located further away from the centre of the map into the specific emotional quadrants (as compared to the PCA maps of Canderel and Lindt), further supporting the conclusion that there are more relationships between mood and emotion for the consumption of Nestlé.

7.3.1.6 Reliability of the mood questionnaire

The Cronbach's Alpha's for each of the extracted factors (0.835 for the positive factor and 0.599 for the negative factor) indicated that the mood questionnaire and scale applied captured positive moods accurately but did not optimally capture and report on negative moods. The negative mood factor, however, had both a low mean factor score (1.200) and low rank order correlation values (0.247), and the low Cronbach's Alpha may thus be related to low incidence of negative moods experienced rather than inability to capture the existing moods by the tool and scale employed (Table 7.1).

7.3.2 The relationship between familiarity and emotion

7.3.2.1 Familiarity of respondents with various chocolate types

Figure 7.5 captures the frequency to which different chocolate types were reported to be consumed by the respondents. It was based on a scale of zero to four where zero indicated that it was never consumed, while four indicated it was consumed daily. Chocolate (in general) was consumed on almost a weekly basis (overall consumption mean value=2.91). Countlines are the most frequently consumed chocolate format (mean=2.22), followed by Filled tablets (mean=2.09) and Plain milk tablets (mean=2.03). Dark tablets (mean=1.15), Seasonal chocolates (mean=0.97), and Chocolates with toys (mean=0.45) are not consumed very often.

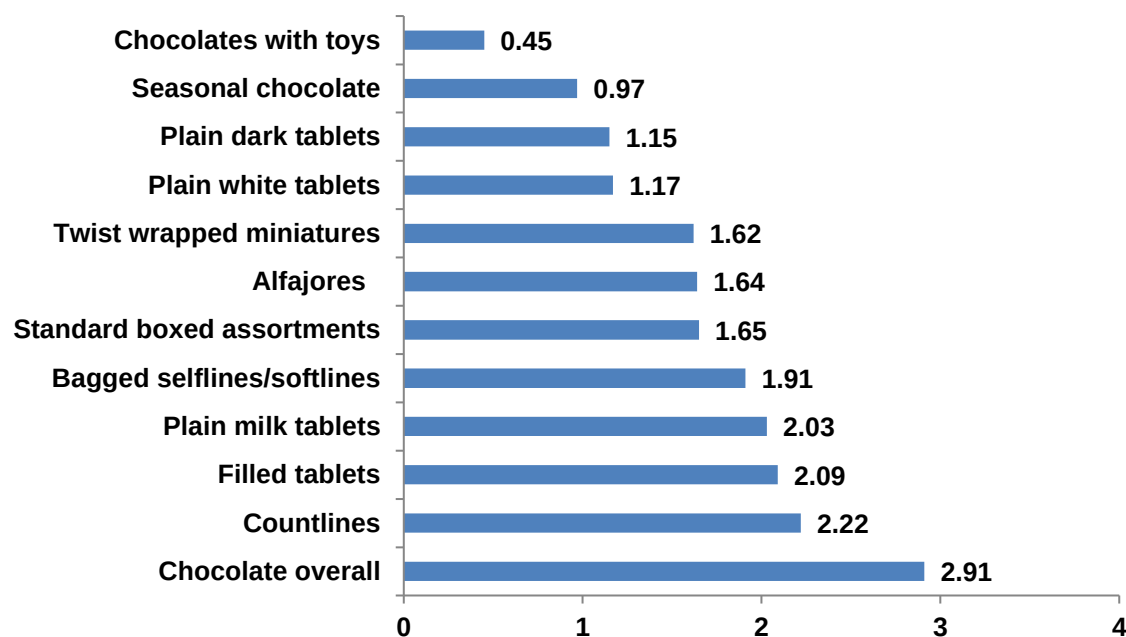


Figure 7.5: Frequency of consumption of various chocolate types

Note: Likert scale: Never =0; Once a year/rarely=1; Monthly=2; Weekly=3; Daily=4.

7.3.2.2 Factor analysis to group familiarity with the various chocolate types

A factor analysis was performed with the familiarity data which was collected. Initially, four factors with eigenvalues greater than one were extracted. A series of factor analyses were conducted which indicated that two factors gave the most interpretable solution. On the basis of the two factors, the Bartlett's test of sphericity, which tests the overall significance of all the correlations within the correlation matrix, was significant ($\chi^2=434$, $P\leq 0.01$), indicating that it was appropriate to use the factor analytic model on this set of data. The Kaiser-Meyer-Olkin measure of sampling adequacy indicated that the strength of the relationships among variables was high (KMO=0.819). Thus, it was acceptable to proceed with the analysis. An Oblimin rotation was performed since factors were expected to be correlated. The obtained pattern matrix is displayed in Table 7.6 and all factor loadings were above 0.4 and are thus all displayed.

Table 7.6: Pattern matrix with factor extractions for chocolate familiarity

	Factors	
	Small chocolates	Large chocolates
Items:	1	2
Alfajores	0.854	
Chocolates with toys	0.676	
Bagged	0.664	
selflines/softlines		
Standard boxed	0.657	
assortments		
Twist wrapped	0.509	
miniatures		
Seasonal chocolate	0.504	
Filled tablets		0.693
Plain dark tablets		0.681
Plain milk tablets		0.605
Countlines		0.451
Plain white tablets		0.424
Inter-item correlation	0.360	0.390
Cronbach's Alpha	0.772	0.718

Table 7.6 continued		
Factors		
	Small chocolates	Large chocolates
Items:	1	2
Mean factor score	1.380	1.730
Standard deviation	0.756	0.960

Notes: *Likert scale: Never=0; Once a year/rarely=1; Monthly=2; Weekly=3; Daily=4*; Cronbach's Alpha: $\alpha \geq 0.5$ =Accepted with caution, $\alpha \geq 0.7$ =Acceptable; $\alpha \geq 0.8$ =Good; Mean factor score: <1.0 =Never consumed, $\geq 1.0 < 2.0$ =Consumed once a year/rarely, $\geq 2.0 < 3.0$ =Consumed monthly, $\geq 3.0 < 4.0$ =Consumed weekly and 4.0 =Consumed daily; Shaded loadings indicate items that loaded meaningful on one factor.

The two extracted factors together accounted for 47.51% of the variance. The internal consistency of both factors was high, with acceptable ($\alpha \geq 0.7$) Cronbach's Alphas, $\alpha = 0.772$ for small chocolates and $\alpha = 0.718$ for large chocolates. Factor analysis in the current study thus revealed two factors which were sufficient to explain the underlying structure of the familiarity of the respondents with chocolate. The pattern matrix revealed factor one to consist of six items and based on the chocolate types included in each factor, and it was labelled "small chocolate" format. The second factor consisted of five terms and based on the chocolate types included in each factor, and it was labelled "large chocolate" format. All chocolate types loaded onto a factor. Factor loadings were higher for the large chocolate factor (1.730) than for the small chocolate factor (1.380). Within the small chocolate format factor, Alfajores had the highest correlation score (0.854) in the factor, while seasonal chocolates had the lowest (0.504). In the large chocolate format factor, filled tablets had the highest correlation score (0.693), and Plain white tablets the lowest (0.424).

7.3.2.3 Relationship between overall chocolate usage and familiarity attributes

As one of the objectives of the study was to understand the relationship between chocolate familiarity and emotional response, but insufficient respondents were recruited into each usage sub-segment (daily, weekly, monthly, yearly) (as outlined in Chapter 3), the relationship between overall familiarity and specific chocolate format familiarity was investigated in order to identify chocolate formats which can be considered as a secondary item to determine the relationship between emotion and familiarity. As captured in Table 7.7 through the calculation of Spearman's rank order correlations (r), it was found that overall chocolate usage is

significantly ($P \leq 0.05$) correlated to the usage of three different chocolate types, with tendencies to correlate ($r \geq 0.3$), namely Plain milk tablets ($r = 0.332$), Countlines ($r = 0.329$) and Filled tablets ($r = 0.320$). Thus, these three chocolates were considered in the subsequent calculations and correlations between familiarity and emotional response.

Table 7.7: Spearman's rank order (*r*) correlations between overall chocolate usage and familiarity with chocolate types

	Items	Spearman's rank order correlations (<i>r</i>)
Small chocolate format	Alfajores	0.018
	Chocolates with toys	0.127
	Bagged selflines/softlines	0.287**
	Standard boxed assortments	0.184*
	Twist wrapped miniatures	0.115
	Seasonal chocolate	0.160
Large chocolate format	Filled tablets	0.320**
	Plain dark tablets	0.231**
	Plain milk tablets	0.332**
	Countlines	0.329**
	Plain white tablets	0.066

Notes: Interpretation of Spearman's rank order correlations based on Cohen's guidelines (1977) (*r*): $r=0$ - $r<0.3$ =Small, $r\geq 0.3$ - $r<0.5$ =Moderate, $r\geq 0.5$ =Strong; Tendencies to correlate ($r\geq 0.3$) are indicated in bold; *Correlation is significant at the $P\leq 0.05$ level (2-tailed), **Correlation is significant at the $P\leq 0.01$ level (2-tailed).

7.3.2.4 Relationship between familiarity and emotion factors

7.3.2.4.1 Familiarity and emotion factor correlations: Combined data of all chocolates

Spearman's rank order correlations (*r*) were determined to describe the relationship between the familiarity and emotion factors for all chocolates and are summarised in Table 7.8.

Table 7.8: Spearman's rank order (*r*) correlations between emotions factors and familiarity factors

	Positive emotion	Negative emotion	Guilty
Small chocolate format	0.041	0.029	0.091
Large chocolate format	0.135	0.032	0.028

Notes: Interpretation of Spearman's rank order correlations based on Cohen's guidelines (1977) (*r*): $r=0$ - $r<0.3$ =Small, $r\geq 0.3$ - $r<0.5$ =Moderate, $r\geq 0.5$ =Strong; *Correlation is significant at the $P\leq 0.05$ level (2-tailed), **Correlation is significant at the $P\leq 0.01$ level (2-tailed).

All correlations (r) were small ($r=0-r<0.3$). Directionally, the r values between the positive emotion factor and both the small chocolate format factor ($r=0.042$; $P\geq 0.05$) and the large chocolate format factor ($r=0.135$; $P\geq 0.05$) are of a higher value than between the negative emotion factor and both the small chocolate format factor ($r=0.029$; $P\geq 0.05$) and the large chocolate factor ($r=0.032$; $P\geq 0.05$), and thus chocolate users, in general, are more likely to have a positive emotional experience. King *et al.* (2010) reported that product non-users provide a different emotional profile than users, and that product non-users are focused more on negative emotions (Tuorila, 2015). While only chocolate users were included in this study, there appear to be differences in the emotional experience between large format and small format chocolate users based on r values.

7.3.2.4.2 Familiarity and emotion factor correlations: Data of the three individual chocolates

Spearman's rank order correlations (r) were determined to describe the relationship between the familiarity and emotion factors for the individual chocolates and are summarised in Table 7.8. Significant ($P\leq 0.05$) positive correlations were identified between the positive emotion factor and both the small format ($r=0.209$, $P\leq 0.05$) and large format ($r=0.232$, $P\leq 0.01$) chocolate factor during the consumption of Lindt, as well as between the positive emotion factor and both the small format ($r=0.272$, $P\leq 0.01$) and large format ($r=0.2321$, $P\leq 0.01$) chocolate factor during the consumption of Nestlé.

Table 7.9: Spearman's rank order correlations between emotion factors and familiarity factors for individual chocolates

	Canderel			Lindt			Nestlé		
	Positive emotion	Negative emotion	Guilty	Positive emotion	Negative emotion	Guilty	Positive emotion	Negative emotion	Guilty
Small chocolate format	0.041	0.029	0.091	0.209*	-0.145	0.145	0.272**	-0.119	0.075
Large chocolate format	0.135	0.032	0.028	0.232**	-0.103	0.062	0.231**	-0.095	0.058

Notes: Interpretation of Spearman's rank order correlations based on Cohen's guidelines (1977) (r): $r=0$ - $r<0.3$ =Small, $r\geq 0.3$ - $r<0.5$ =Moderate, $r\geq 0.5$ =Strong; *Correlation is significant at the $P\leq 0.05$ level (2-tailed), **Correlation is significant at the $P\leq 0.01$ level (2-tailed).

7.3.2.5 The relationship between individual familiarity and emotion attributes

Based on the small correlations reported thus far between familiarity and emotion factors, the relationships were further investigated on an individual attribute level to conclude if further relationships can be uncovered.

7.3.2.5.1 Familiarity and emotion individual attribute correlations: Data of the three individual chocolates

a) Small chocolate format correlations with emotion attributes

Spearman's rank order correlations (r) were determined to describe the relationship between chocolates from the small factor and emotion attributes as summarised in Table 7.10. Only r values for Lindt and Nestlé are summarised as none were identified for Canderel.

Table 7.10: Spearman's rank order (r) correlations between emotion attributes and chocolates from the small factor

Chocolate format	Lindt		Nestlé	
	Emotion	Spearman's rank order correlations (r)	Emotion	Spearman's rank order correlations (r)
Alfajores	Active	0.319**	Active	0.237
	Adventurous	0.329**	Adventurous	0.313**
	Enthusiastic	0.271**	Enthusiastic	0.258*
	Good	0.260*	Free	0.291*
	Happy	0.231	Good	0.222
	Joyful	0.223	Good-natured	0.233
	Wild	0.247*	Happy	0.231
			Interested	0.287*
			Joyful	0.253*
			Loving	0.228
			Pleasant	0.227
			Secure	0.264*
			Understanding	0.301**
			Warm	0.232

Table 7.10 continued

Chocolate format	Lindt		Nestlé	
	Emotion	Spearman's rank order correlations (r)	Emotion	Spearman's rank order correlations (r)
Alfajores			Wild	0.252*
Chocolates with toys	Active	0.251*	-	
	Adventurous	0.236		
	Bored	-0.226		
	Warm	0.227		
Bagged selflines/ softlines	-		Active	0.298**
			Adventurous	0.298**
			Enthusiastic	0.268*
			Good	0.263*
			Good-natured	0.251*
			Happy	0.228
			Joyful	0.235
			Loving	0.305**
			Satisfied	0.227
			Understanding	0.237*
			Warm	0.222
Standard boxed assortments	Adventurous	0.222	Bored	-0.323**
	Enthusiastic	0.232	Interested	0.253*
Twist wrapped miniatures	-		-	
Seasonal chocolate	-		-	

Notes: Interpretation of Spearman's rank order correlations based on Cohen's guidelines (1977) (r): $r=0$ - $r<0.3$ =Small, $r\geq 0.3$ - $r<0.5$ =Moderate, $r\geq 0.5$ =Strong; Only $r\geq 0.2$ are reported; Tendencies to correlate ($r\geq 0.3$) are indicated in bold; *Correlation is significant at the $P\leq 0.05$ level (2-tailed), **Correlation is significant at the $P\leq 0.01$ level (2-tailed).

The majority of correlations (r) were small ($r=0-r<0.3$) and some were significant ($P\geq 0.05$), but six moderate ($r\geq 0.3-r<0.5$) significant ($P\leq 0.05$) correlations were noted, namely positive correlations between Alfajore familiarity and the emotions active ($r=0.319$, $P\leq 0.01$) and adventurous ($r=0.329$, $P\leq 0.01$) during the consumption of Lindt, and during the consumption of Nestlé; positive correlations between Alfajore familiarity and the emotions adventurous ($r=0.313$, $P\leq 0.01$) and understanding ($r=0.301$, $P\leq 0.01$); between Bagged selflines/softlines familiarity and the emotion loving ($r=0.305$, $P\leq 0.01$), and a negative correlation between Standard boxed assortment familiarity and the emotion bored ($r=-0.323$, $P\leq 0.01$). It thus appears that the consumers of these specific chocolate types had a more positive emotional experience during the consumption of Lindt and Nestlé. The highest number of correlations (28) was, however, noted between emotional attributes and small chocolate usage for Nestlé and between Alfajore familiarity and various emotions (18) during the consumption of both Lindt and Nestlé. Mainly positive emotions were evoked amongst small chocolate consumers by the consumption of Lindt and Nestlé. Two correlations were identified for the emotion bored which was negatively correlated with consumers of Chocolates with toys when consuming Lindt ($r=-0.226$, $P\leq 0.05$), and consumers of Standard boxed assortments when consuming Nestlé ($r=-0.323$, $P\leq 0.01$). The familiarity with small chocolates in general thus resulted in a more positive emotional experience.

b) Large chocolate correlations with emotion attributes

Spearman's rank order correlations (r) were determined to describe the relationship between chocolates from the large factor and emotion attributes for all the chocolates as in Table 7.11. Only r values for Lindt and Nestlé are summarised as none were identified for Canderel.

Table 7.11: Spearman's rank order (r) correlations between emotion attributes and chocolates from the large factor

Chocolate format	Lindt		Nestlé	
	Emotion	Spearman's rank order correlations (r)	Emotion	Spearman's rank order correlations (r)
Filled tablets	-		Good-natured	0.239**
Plain dark tablets	-		-	

Table 7.11 continued

Chocolate format	Lindt		Nestlé	
	Emotion	Spearman’s rank order correlations (r)	Emotion	Spearman’s rank order correlations (r)
Plain milk tablets	Enthusiastic	0.238*	-	
	Good	0.317**		
	Good-natured	0.234		
	Happy	0.252*		
	Interested	0.247*		
	Warm	0.261*		
Countlines	-		-	
Plain white tablets	Enthusiastic	0.251*	Active	0.253*
	Free	0.225	Bored	-0.239*
	Good	0.237	Enthusiastic	0.288**
	Interested	0.260*	Free	0.298**
	Joyful	0.254*	Good-natured	0.268*
	Loving	0.324**	Happy	0.243*
	Mild	0.236	Interested	0.345**
	Nostalgic	0.277**	Joyful	0.303**
	Satisfied	0.226	Loving	0.336**
	Understanding	0.244*	Mild	0.279**
	Warm	0.301**	Pleasant	0.240*
			Satisfied	0.279**
			Secure	0.250*
			Tame	0.312**
			Understanding	0.286**
			Warm	0.351**

Notes: Interpretation of Spearman's rank order correlations based on Cohen's guidelines (1977) (*r*): $r=0$ - $r<0.3$ =Small, $r\geq 0.3$ - $r<0.5$ =Moderate, $r\geq 0.5$ =Strong; Only $r\geq 0.2$ are reported; Tendencies to correlate ($r\geq 0.3$) are indicated in bold; *Correlation is significant at the $P\leq 0.05$ level (2-tailed), **Correlation is significant at the $P\leq 0.01$ level (2-tailed).

Most of the Spearman's rank order correlations between large chocolate familiarity and emotion attributes (as summarised in Table 7.11) were small ($r=0$ - $r<0.3$). Eight moderate or tendencies to correlate ($r\geq 0.3$ - $r<0.5$) positive significant ($P\leq 0.05$) correlations were noted, three of these between Plain milk tablet familiarity and the emotion good ($r=0.317$, $P\leq 0.01$), and Plain white tablet familiarity and the emotions loving ($r=0.324$, $P\leq 0.01$) and warm ($r=0.301$, $P\leq 0.01$) during the consumption of Lindt. Five of these were noted during the consumption of Nestlé, namely between Plain white tablet familiarity and interested ($r=0.345$, $P\leq 0.01$), joyful ($r=0.303$, $P\leq 0.01$), loving ($r=0.336$, $P\leq 0.01$), tame ($r=0.312$, $P\leq 0.01$) and warm ($r=0.351$, $P\leq 0.01$). It thus appears that the consumers of these specific chocolate types had a more positive emotional experience during the consumption of Lindt and Nestlé. The highest number of correlations was noted between emotional attributes and Plain White Tablet familiarity for Nestlé (16 correlations), and between emotional attributes and Plain white tablet familiarity for Lindt (11 correlations), followed by Plain milk tablet familiarity and Lindt with six correlations. It thus appears that amongst large chocolate consumers, Plain white tablet and Plain milk tablet users experienced the most emotion due to the number of correlations noted between consumption frequency and emotion, with Filled tablet, Plain dark tablet and Countline consumers reporting fewer emotions. This is possibly because the consumption of Plain milk tablets during this study was an emotional experience for Plain milk and White tablet consumers, while the experience was less emotional for consumers of the other large formats as they possibly often experience more emotion when consuming their "more complex" chocolates of choice. Plain milk tablet users, however, did not experience any significant emotions when consuming Nestlé, while various emotions were reported during the consumption of Lindt, as they are very likely to have experienced Nestlé in the past but Lindt to a lesser degree.

The highest number of correlations was, however, noted between emotional attributes and large chocolate usage for Nestlé. Mainly positive emotions were evoked amongst small chocolate consumers by the consumption of Lindt and Nestlé. One correlation was identified for the emotion bored which was negatively correlated with consumers of Plain white tablets when consuming Nestlé ($r=-0.239$, $P\leq 0.05$), and consumers of standard boxed assortments when consuming Nestlé ($r=-0.323$, $P\leq 0.01$). The usage of large chocolates in general thus also resulted in a positive emotional experience.

Mainly positive emotions were evoked amongst consumers of large chocolates which are in line with the findings of small chocolate consumers. Small chocolate consumers, however, appear

to have a more emotional experience with 28 small ($r=0-r<0.3$) and moderate ($r\geq 0.3-r<0.5$) correlations noted between small chocolate usage and emotion vs. 17 for large chocolate usage and emotion. Jaeger *et al.* (2013) reported that in a study of the emotional response to snack bars, participants who had consumed snack bars during the seven days before completing the survey had a more positive response than those who had not, while Rousset *et al.* (2005) reported in a study of meat consumers that they also found a difference in the type of emotions evoked by the consumption of meat, with low meat-eating consumers having more indifference, doubt and disappointment towards red meat than high meat-eating consumers. The results of this study illustrate that the type of product within the same category is also of importance and should also be studied to interpret emotional response. Köster and Mojet (2015) thus stated that in emotion studies, populations should be segmented based on consumption frequency; if this is not done, the resulting variance could conceal emotion differences between products.

7.3.2.6 Principal component analysis of familiarity and emotion attributes

7.3.2.6.1 Canderel

Through the extraction of data related to the familiarity with chocolate and emotional attributes for Canderel, two components were identified as well as the attributes linked to these components, as indicated in Figure 7.6, which explains a large proportion of the variation (with component 1 explaining 35.92% and component 2 explaining 11.31%, thus cumulatively 47.23%). The resulting Eigenvalues were 12.93 and 4.07 for factor 1 and 2 respectively, and thus a large amount of variance was retained by these two components. The PCA map captured in Figure 7.6 demonstrates that there are no relationships between familiarity and emotion attributes for Canderel. Familiarity attributes are all located on or close to the second component, while emotion attributes are located on or close to the first component. The negative emotion attributes of worried, aggressive, bored, guilty and disgusted, however, were further removed from the familiarity attributes than other emotion attributes and hence had an even weaker relationship to familiarity than the positive emotions. Familiarity with Dark tablets, however, showed a higher proximity with emotion attributes particularly negative emotions.

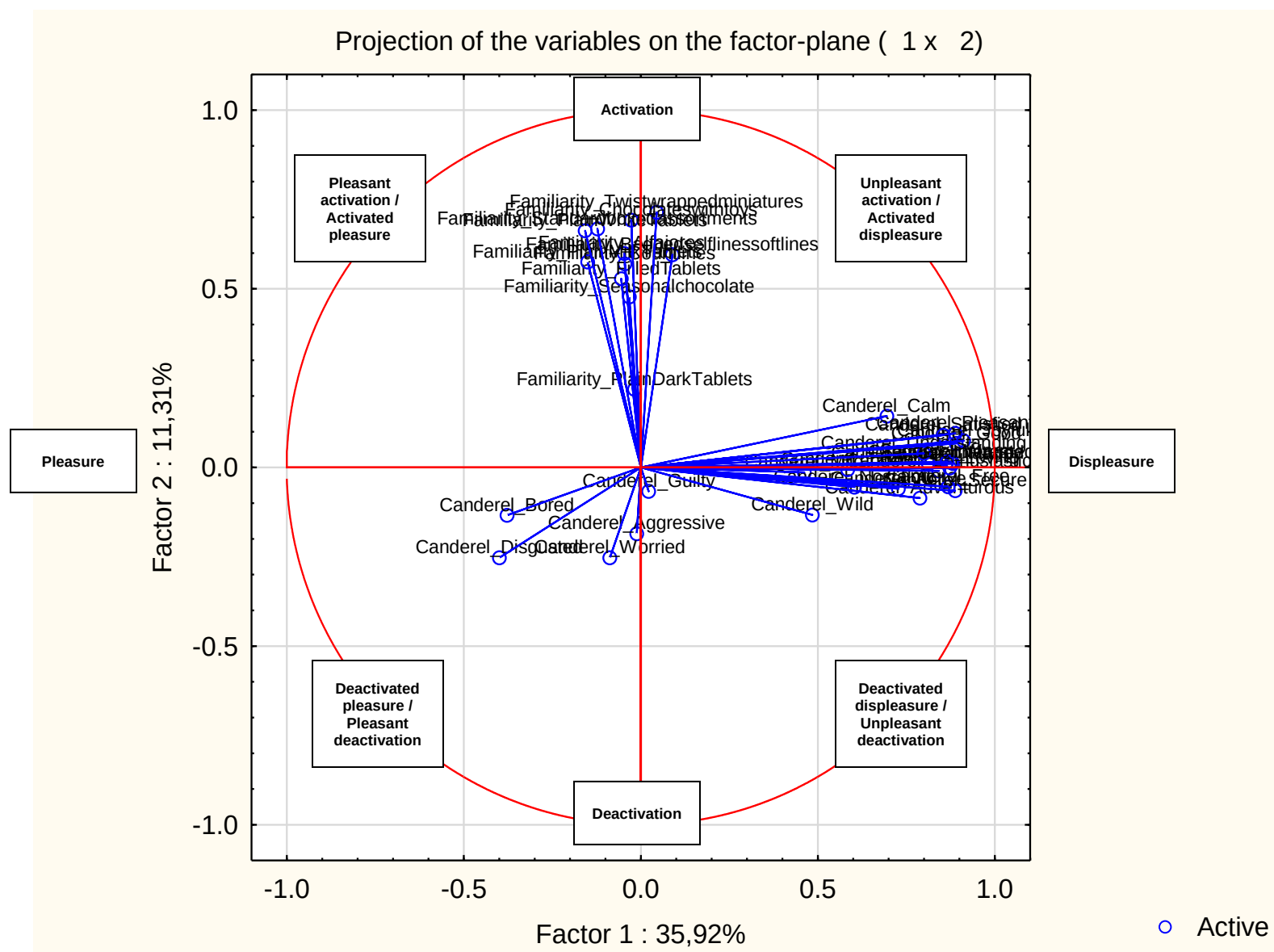


Figure 7.6: PCA Map of familiarity with chocolate and emotion attributes of Canderel

7.3.2.6.2 Lindt

Through the extraction of data related to the familiarity with chocolate types and emotional attributes for Lindt, two components were identified as well as the attributes linked to these components, with component 1 explaining 38.19% and component 2 explaining 10.56%, thus cumulatively 48.75%. The resulting Eigenvalues were 13.75 and 3.80 for factor 1 and 2 respectively, and thus a moderate amount of variance was retained by these two components. The PCA map captured in Figure 7.7 also demonstrates that there are few significant relationships between familiarity and emotion attributes for Lindt. Familiarity attributes are all located on or close to the second component, while emotion attributes are located on or close to the first component. The negative emotions worried, aggressive, guilty, bored and disgusted, however, were also further removed from the familiarity attributes and hence have an even weaker relationship with overall familiarity than the positive emotions. The relationship between familiarity and emotion is, however, the inverse of Canderel when the layouts of the two PCA maps are compared. Familiarity with Dark chocolates is also located close to negative emotions associated with Lindt, as with Canderel.

7.3.2.6.3 Nestlé

Through the extraction of data related to the familiarity with chocolate and emotional attributes for Nestlé, two components were identified as well as the attributes linked to these components, with components 1 explaining 37.54% and component 2 explaining 10.55%, thus cumulatively 48.00%. The resulting Eigenvalues were 13.51 and 3.79 for factor 1 and 2 respectively, and thus a moderate amount of variance was retained by these two components. The PCA map captured in Figure 7.8 demonstrates that some significant relationships exist between familiarity and emotion attributes for Nestlé, with familiarity located on the second component, while emotion attributes are located on the first component. The negative emotions worried, aggressive, guilty, disgusted and bored, however, were further removed from the familiarity attributes and hence had an even weaker relationship with familiarity than the positive emotions. The PCA of Nestlé is very different from that of Canderel and Lindt, and thus the relationship between the familiarity with chocolate and emotional response to chocolate consumption is unique for Nestlé. There is an overall closer proximity between familiarity and emotion attributes.

7.3.2.7 Reliability of the familiarity questionnaire

Acceptable ($\alpha \geq 0.7$) Cronbach's Alphas for the extracted factors for the small chocolate format factor ($\alpha = 0.772$) and for the large chocolate format factor ($\alpha = 0.718$) indicate that the familiarity questionnaire and scale applied, captured usage accurately across chocolate types. Low rank order correlations were noted (in Table 7.6) for both factors, however, reflect the large variations in usage frequencies (small chocolate factor = 0.360; large chocolate factor = 0.390).

7.3.3 The relationship between acceptability and emotion

7.3.3.1 Acceptability of the three chocolates

As indicated in Table 7.12, Lindt achieved the highest acceptability mean score of the three chocolates. It was based on a scale of one to nine where one indicated that the respondent would eat the chocolate every opportunity they had, while four indicated that they would eat it only if they were forced to. It was determined through a T-test that there is no significant difference in the acceptability of Nestlé and Canderel. However, Lindt was found to be significantly ($P \leq 0.05$) more acceptable than the other two chocolates.

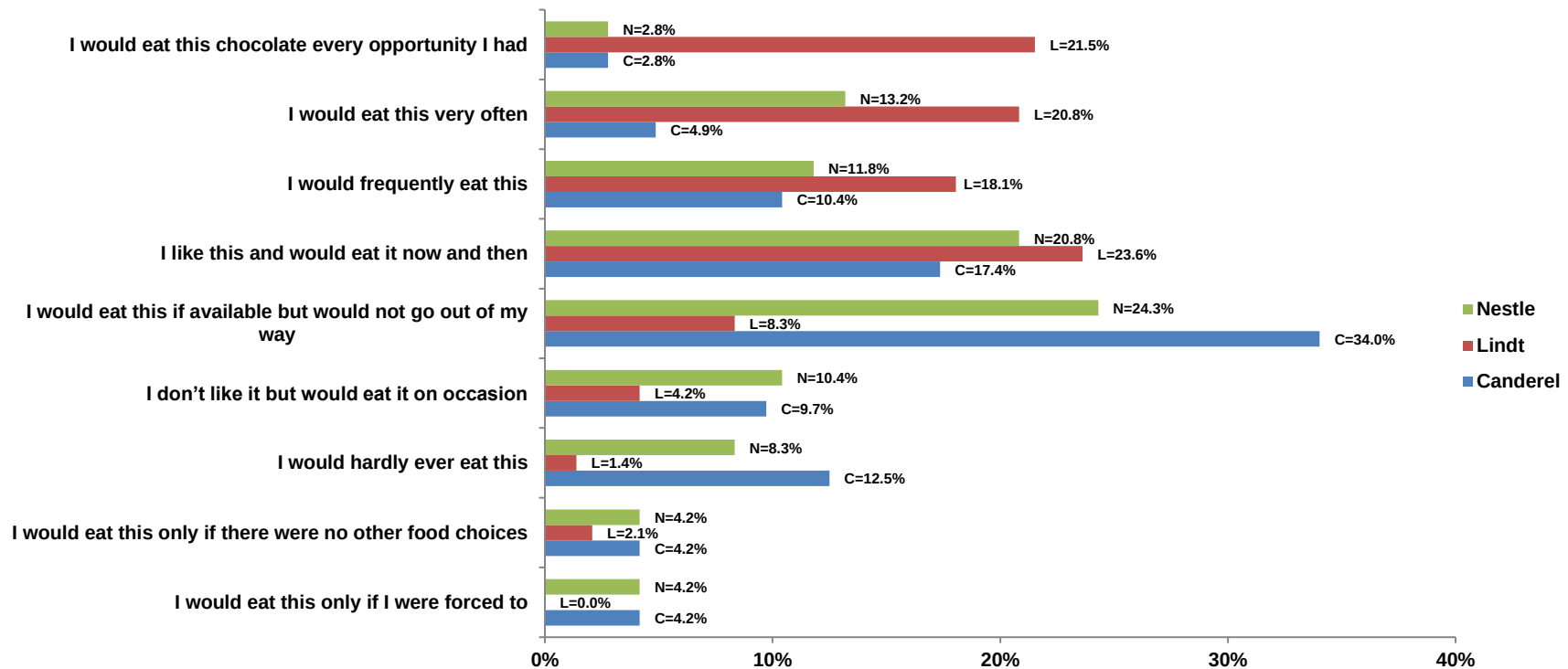
Table 7.12: Mean acceptability scores of the three chocolates

Acceptability	Mean
Lindt	3.4 ^a
Nestlé	4.5 ^b
Canderel	4.8 ^b

Note: Scale: 1 = I would eat this chocolate every opportunity I had, 2 = I would eat this very often, 3 = I would frequently eat this, 4 = I like this and would eat it now and then, 5 = I would eat this if available but would not go out of my way, 6 = I don't like it but would eat it on occasion, 7 = I would hardly ever eat this, 8 = I would eat this only if there were no other food choices, 9 = I would eat this only if I were forced to; Means with different superscripts (^a and ^b) in the same column differ significantly ($P \leq 0.05$).

The percentage frequency of mean acceptability ratings for Canderel, Lindt and Nestlé are captured in Figure 7.9. The rating frequency shows that a third of respondents (34.0%) would eat Canderel if it were available, but it is not a product that they would go out of their way to purchase or consume, while 20.9% of respondents would hardly ever eat it, or would only if there were no other food choice, or if they were forced to. Most respondents (84.0%) would eat Lindt now and then, frequently, often, or every opportunity possible. A quarter of respondents

would not go out of their way to purchase or consume Nestlé (24.3%) or would eat it now and then (20.8%).



Note: Scale: 1 = I would eat this chocolate every opportunity I had, 2 = I would eat this very often, 3 = I would frequently eat this, 4 = I like this and would eat it now and then, 5 = I would eat this if available but would not go out of my way, 6 = I don't like it but would eat it on occasion, 7 = I would hardly ever eat this, 8 = I would eat this only if there were no other food choices, 9 = I would eat this only if I were forced to.

Figure 7.9: Acceptability of the three chocolates as % of responses

7.3.3.2 Acceptability and emotion factor correlations: Data of the three individual chocolates

Spearman's rank order correlations (r) were determined to describe the relationship between acceptability and emotion attributes for as summarised in Table 7.13. All correlations (r) values between acceptability and emotion for Lindt and Nestlé were small ($r=0-r<0.3$). For Canderel, however, both positive and negative emotion had a moderate ($r\geq 0.3-r<0.5$) significant ($P\leq 0.05$) correlation with acceptability, with positive emotion positively correlated to acceptability ($r=0.463$; $P\leq 0.01$), while negative emotion was negatively correlated to acceptability ($r=-0.460$; $P\leq 0.01$). This indicates that the emotional response to Canderel was more accurately captured by its mean acceptability than the other two chocolates.

The mean factor score for the positive emotion factor for all three chocolates was, however, very similar (as reported in Chapter 5), (Canderel=0.780; Lindt=0.802; Nestlé=0.795), while a larger differentiation was noted for the mean factor score for the negative emotion factor (Canderel=0.593; Lindt=0.609; Nestlé=0.525).

Despite this, Lindt was found to be significantly ($P\leq 0.05$) more acceptable than Nestlé and Canderel which achieved similar acceptability mean scores. While Lindt achieved a significantly ($P\leq 0.05$) better acceptability mean rating than Nestlé and Canderel, it appears that consumers did not experience significantly ($P\leq 0.05$) more positive emotion during the consumption of Lindt. The relationship between negative emotion and acceptability of Lindt was stronger than the positive emotion relationship. The emotional response to these chocolates was thus not reflected by the mean acceptability ratings.

Table 7.13: Spearman's rank order correlations (*r*) between emotion factors and acceptability of individual chocolates

	Canderel			Lindt			Nestlé		
	Positive emotion	Negative emotion	Guilty	Positive emotion	Negative emotion	Guilty	Positive emotion	Negative emotion	Guilty
Acceptability	0.463**	-0.460**	0.057	0.010	0.081	0.057	0.094	-0.057	-0.077

Notes: Interpretation of Spearman's rank order correlations based on Cohen's guidelines (1977) (*r*): $r=0$ - $r<0.3$ =Small, $r\geq 0.3$ - $r<0.5$ =Moderate, $r\geq 0.5$ =Strong; Tendencies to correlate ($r\geq 0.3$) are indicated in bold; *Correlation is significant at the $P\leq 0.05$ level (2-tailed), ** Correlation is significant at the $P\leq 0.01$ level (2-tailed).

7.3.3.3 The relationship between acceptability and individual emotion attributes: Data of the three individual chocolates

The Spearman's rank order correlations (r) between individual emotions experienced during the consumption of chocolate and overall acceptability of the three chocolates are reported in Table 7.14.

Table 7.14: Spearman's rank order correlations (*r*) between individual emotion attributes and acceptability

	Canderel		Lindt		Nestlé	
	Spearman's rank order correlations (<i>r</i>)	Emotion Mean score	Spearman's rank order correlations (<i>r</i>)	Emotion Mean score	Spearman's rank order correlations (<i>r</i>)	Emotion Mean score
Positive factor emotions						
Active	0.361**	0.91	0.095	1.01	0.019	1.35
Adventurous	0.349**	0.88	0.027	0.95	0.079	1.39
Calm	0.286**	1.59	0.013	1.64	0.084	2.01
Enthusiastic	0.429**	1.04	0.094	1.11	0.067	1.71
Free	0.387**	1.32	0.076	1.31	0.087	1.83
Good	0.400**	1.57	0.054	1.61	0.107	2.26
Good-natured	0.316**	1.41	0.023	1.45	0.133	2.02
Happy	0.439**	1.58	0.024	1.74	0.069	2.38
Interested	0.508**	1.29	-0.108	1.40	0.058	2.07
Joyful	0.427**	1.30	-0.065	1.49	0.108	2.10
Loving	0.394**	1.31	-0.016	1.41	0.059	2.08
Nostalgic	0.340**	0.80	0.076	0.90	-0.013	1.34
Pleasant	0.450**	1.47	0.029	1.63	0.037	2.12
Satisfied	0.564**	1.32	0.008	1.48	0.011	2.26
Secure	0.327**	1.30	-0.021	1.19	0.111	1.76
Tame	0.160	0.93	-0.064	1.04	0.046	1.29
Understanding	0.320**	1.14	-0.012	1.26	0.108	1.65
Warm	0.378**	1.32	-0.041	1.35	0.037	1.99

Table 7.14 continued

	Canderel		Lindt		Nestlé	
	Spearman's rank order correlations (<i>r</i>)	Emotion Mean score	Spearman's rank order correlations (<i>r</i>)	Emotion Mean score	Spearman's rank order correlations (<i>r</i>)	Emotion Mean score
Wild	0.288**	0.37	-0.038	0.43	-0.011	0.71
Positive factor emotions						
Aggressive	-0.057	0.26	0.019	0.24	0.091	0.17
Bored	-0.389**	0.99	0.118	0.86	-0.037	0.32
Disgusted	-0.478**	0.71	0.019	0.59	0.019	0.19
Worried	-0.136	0.91	0.050	0.34	-0.006	0.25
Unclassified emotion						
Guilty	0.057	0.68	0.057	0.75	-0.077	0.67

Notes: *Emotion Likert scale*: 0=Not at all, 1=Slightly, 2=Moderately, 3=Very, 4=Extremely; Interpretation of Spearman's rank order correlations based on Cohen's guidelines (1977) (*r*): $r=0$ - $r<0.3$ =Small, $r\geq 0.3$ - $r<0.5$ =Moderate, $r\geq 0.5$ =Strong; Tendencies to correlate ($r\geq 0.3$) are indicated in bold; Interpretation of emotion means: <1.0 =Not present at all, ≥ 1 - <2.0 =Slightly present, ≥ 2.0 - <3.0 =Moderately present, ≥ 3.0 - <4.0 =Very present and 4.0=Extremely present; *Correlation is significant at the $P\leq 0.05$ level (2-tailed), **Correlation is significant at the $P\leq 0.01$ level (2-tailed).

These correlations also indicate that the acceptability of Canderel is best reflected by the emotional response (or vice versa) with six small ($r=0-r<0.3$) and 18 moderate ($r\geq 0.3-r<0.5$) significant ($P\leq 0.05$) correlations between overall acceptability and individual emotions noted. Various small ($r=0-r<0.3$) correlations were noted between overall acceptability and individual emotion attributes for Lindt or Nestlé. However, all had very low r values (the highest noted for either Lindt or Nestlé was $r=0.133$). For the majority of the significant ($P\leq 0.05$) correlations between acceptability and the emotions evoked by Canderel, as summarised in Table 7.14, the mean scores of the individual positive emotions were the lowest of the three chocolates (active mean=0.91, adventurous mean=0.88, calm mean=1.59, enthusiastic mean=1.04, good mean=1.57, good-natured mean=1.41, happy mean=1.58, interested mean=1.29, joyful mean=1.30, loving mean=1.31, nostalgic mean=0.80, pleasant mean=1.47, satisfied mean=1.32, understanding mean=1.14, warm mean=1.32, wild mean=0.37) or in two cases the highest of the three chocolates (bored mean=0.99, disgusted mean=0.71) (mean scores also reported in Table 5.2). It thus seems that the lower incidence of positive emotions and a higher incidence of negative emotions experienced correlated with the lower mean acceptability (mean=4.8) score that this chocolate achieved.

Thus, for Canderel it was found that emotions and pleasantness correlated with each other, as were the findings of Spinelli *et al.* (2015) and Ng *et al.* (2013). Lindt, Canderel and Nestlé did, however, have distinct emotional profiles despite respondents not having a clear preference of Nestlé over Canderel, and in situations where there is no distinct preference, the emotion profiles for each sample are mixtures of both positive and negative emotions (Bhumiratana *et al.*, 2014). While Lindt achieved the best acceptability mean score (mean=3.4), it did not achieve the highest number of individual positive emotion scores (as it was second to Nestlé for most positive emotion scores) and achieved higher negative emotion ratings than Nestlé. Nestlé achieved average acceptability (mean=4.5), however, a very positive emotional response. It thus appears that the low acceptability evoked less positive and more negative emotion, however, average and higher acceptability does not significantly increase the positive emotional response to chocolate consumption or decrease the negative emotional response. Liked and disliked products are often very clearly differentiated concerning stronger or weaker associations with positive emotions (e.g. Danner *et al.*, 2017; Jaeger *et al.*, 2017), while emotional properties of similarly liked products may only be somewhat different (e.g. Porcherot *et al.*, 2010; Kuesten *et al.*, 2014; Spinelli *et al.*, 2014; Mojet *et al.*, 2015). The more liked (accepted) chocolates, namely Lindt and Nestlé, did not have any moderate or strong

correlations with acceptability; however, the disliked chocolate, Canderel, had various small, moderate and strong correlations between acceptability and emotion. Dalenberg *et al.* (2014) stated that the EsSense profile is targeted at product users who generally like the product and may, therefore, capture disliking less accurately. However, it seems that in this study it failed to capture liking accurately to differentiate between Lindt and Nestlé (possibly through a more frequent selection of positive emotion attributes or less frequent selection of negative emotion attributes).

Porcherot *et al.* (2010), however, also concluded that the results of acceptability testing are not identical to the results of emotion testing, as positive conceptualisation is not necessarily associated with liking, and conversely, negative conceptualisation is not necessarily associated with disliking (Thomson *et al.*, 2010). Gibson (2006) stated that generally, psychological impacts were independent of the rated pleasantness of the foods. Ng *et al.* (2013) also showed that products with the same or similar hedonic scores did not evoke the same emotional response and that in these cases, emotions differentiated between products beyond hedonic response.

The strength of the various relationships thus did not provide any differentiation between the two equally liked chocolates; however, for the less liked Canderel, it indicated which emotions influenced the lower acceptability most, with satisfied and interested showing the highest r -value ($r=0.546$ and $r=0.508$ respectively), while the mean scores for these emotions were the lowest for Canderel among the three chocolates (satisfied mean=1.32 and interested mean=1.29). While the emotions did not differentiate between Nestlé and Lindt, they may have just added information beyond liking or acceptability, which adds to an understanding of the overall pleasantness of the experience to ultimately explain food choice behaviour, as Porcherot *et al.* (2010) and Gutjar *et al.* (2015) have shown that pleasantness or liking and emotional responses are not identical.

It is also possible that the emotions recorded are the result of disconfirmation. Being familiar with and being a user of a product category does not imply that each product within the category will be equally liked (Dalenberg *et al.*, 2014). When respondents were told they would be eating chocolate, they possibly had a specific liking expectation determined in part by specific memories of similar experiences, and for Lindt and Nestlé these experiences were possibly highly accessible, as these chocolates were similar to chocolates which they have consumed

before, and thus they responded in a consistent emotional manner to these products, irrespective of acceptability. For such memories to arise, the food experience must be sufficiently similar to the original eating experience (Köster, 2009). Canderel, however, is not a product regularly consumed, and thus it possibly did not deliver against their expectation of chocolate and they thus responded accordingly, providing a very different emotional picture based on the disconnection from their current point of view (Schacter *et al.*, 2007). Deliza *et al.* (1996), however, stated that when a positive disconfirmation or negative disconfirmation occurred, the assimilation model predicted that the perceived liking would be more similar to the expected liking. The disconfirmation in this instance may have been so extreme that this was not the case, as when participants perceive a big difference between the expected and actual stimulus, this generates surprise which leads to a contracting effect rather than adaptation (Deliza *et al.*, 1996).

The consumption of Canderel also resulted in a mixed emotional experience (lower mean values for some emotions and higher for others vs. Nestlé and Lindt) and the lowest acceptability. Compared with low arousal states, high arousal states were seen as inhibiting or suppressing food intake (Desmet & Schifferstein, 2008), whereas low to moderate emotions may increase food consumption (Robbins & Fray, 1980). Ershadi *et al.* (2017) reported the opposite, namely that high arousal emotions such as joy and anger have been shown to increase the desire to eat (Macht, 1996; Macht *et al.*, 2002), whereas low arousal, negative emotions (such as sadness) have been indicated to decrease appetite and ultimately consumption (Macht *et al.*, 2002). Food consumption has also been associated with reduced arousal, e.g. feelings of calmness (Blass *et al.*, 1989; Berridge & Robinson, 1998; Macht *et al.*, 2004). It has been concluded that intense emotions are linked with both behaviour and physiological responses that interfere with consumption, and hence the emotional response to Canderel may have impacted the acceptability rating in a manner that reflects this suppression of consumption.

What is interesting, though, is the statement of Gutjar *et al.* (2015), which is that the emotions strongly correlated with liking have low distinctive value compared to liking, whereas emotions which weakly correlate with liking are of interest as they convey information not captured by liking. Thus, emotions of interest are those with high or lower mean scores but with low correlation with acceptability. Both Lindt and Nestlé achieved relatively high mean scores for various emotions. However, these had very low correlations with acceptability, and these are of

interest (i.e. calm and happy for Lindt, and satisfied and happy for Nestlé). Furthermore, Gutjar *et al.* (2015) found that only a small part of emotion is strongly associated with liking and that these emotions would thus have added little value compared to measuring only liking. They specifically reported that boredom, sadness and shame had a weak association with liking. Moderate associations were dissatisfaction, fascination, fear, hope and pride. Desire, disgust, joy, satisfaction, enthusiastic, good, happy, pleased and pleasant showed a strong association with liking. These findings are in line with the results of Canderel but not of Nestlé and Lindt, as the top five emotions with the highest association for Canderel with liking were satisfied, interested, disgusted, pleasant and happy.

Another point of view is that more basic emotions are not useful in differentiating between products. Ershadi *et al.* (2017) found that inducing basic emotions such as anger, sadness, and happiness had no impact on respondents' desire to consume foods that varied in energy density or taste quality. Furthermore, negative emotions of both high and low arousal and positive high arousal emotions were unable to alter how much respondents wanted to consume foods that were high or low in kilojoules, or sweet or savoury in taste. The emotion list in this study may thus have been too limited to uncover the "drivers" of acceptability. Lastly, unclassified emotions may also add more information as they are neither positive nor negative, as Ng *et al.* (2013) found large correlations between liking and unclassified emotions such as eager, polite, steady and understanding in a study of blackcurrant squash. In this study, however, the unclassified emotions were not more effective at differentiating between the chocolates as none of the six emotions was significantly different between the three chocolates.

7.3.3.4 Principal component analysis of acceptability and emotion attributes

7.3.3.4.1 Canderel

Through the extraction of data related to acceptability and emotional attributes, two components were identified as well as the attributes linked to these components, which explains a large proportion of the variation (with component 1 explaining 50.33% and component 2 explaining 9.11% of the variation, thus cumulatively 59.44%). The resulting Eigenvalues were 13.08 and 2.37 for factor 1 and 2 respectively, and thus a large amount of variance was retained by these two components. The PCA map (captured in Figure 7.10) demonstrates that there is a relationship between acceptability and the negative emotions associated with Canderel, as they are located in the same quadrant. However, King and Meiselman (2010) stated that only when emotions which are categorised in the same principal component as acceptability have a

correlation value of 0.5 and higher, are they concluded to be related to overall acceptability. Canderel was the only chocolate of the three which had Spearman's rank order correlations (r) between acceptability and emotion greater than 0.5 (interested $r=0.508$, and satisfied $r=0.564$), with disgusted close to 0.5 ($r=-0.478$); however, neither interested nor satisfied was located in the same quadrant as acceptability. Thus, based on the statement of King and Meiselman (2010), disgusted was the only emotion related to overall acceptability, and this also placed acceptability of Canderel in the emotion quadrant of deactivated pleasure.

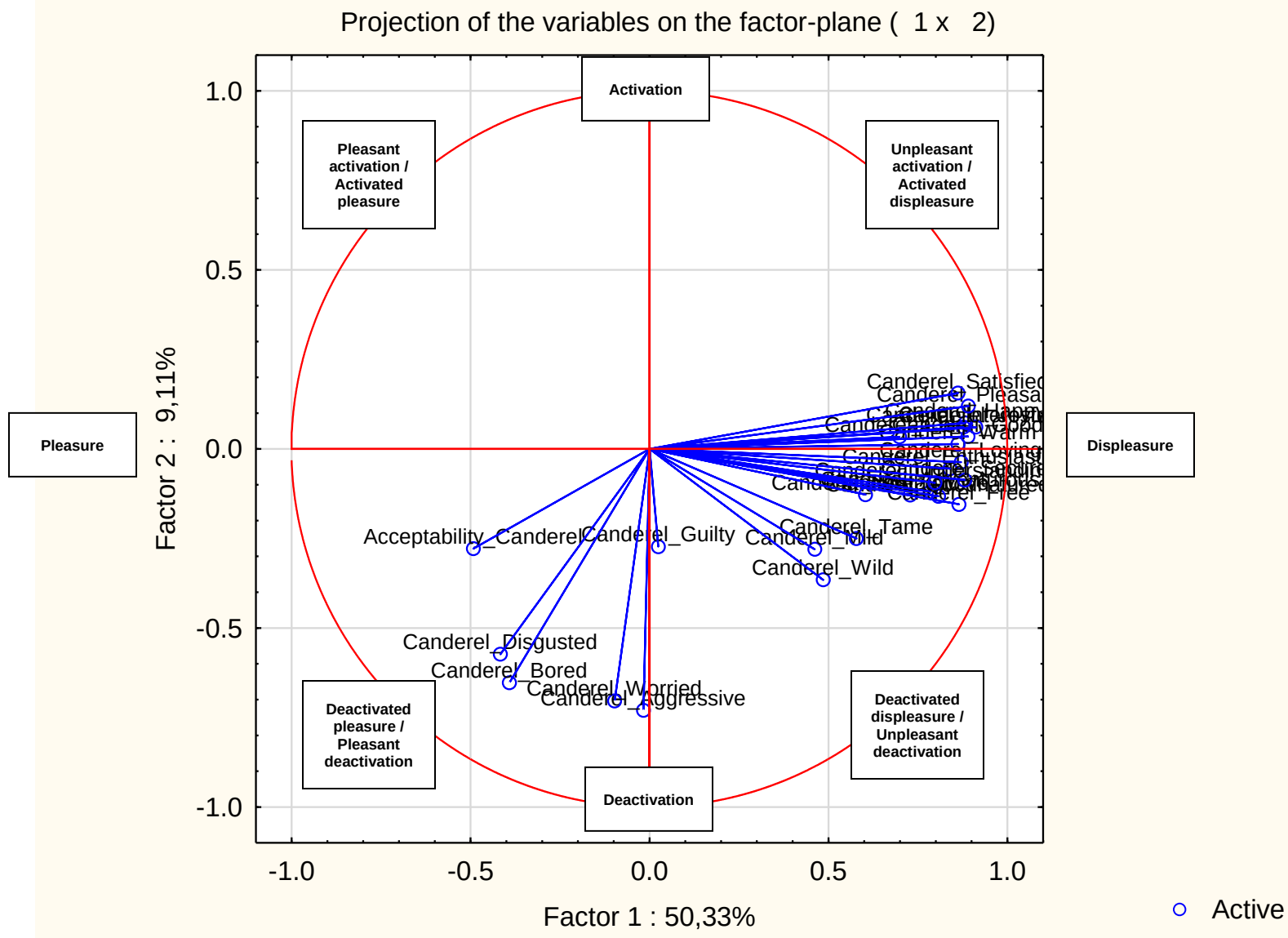


Figure 7.10: PCA map of acceptability and emotion attributes of Canderel

7.3.3.4.2 Lindt

Through the extraction of data related to acceptability and emotional attributes, two components were identified as well as the attributes linked to these components, which explains a large proportion of the variation (with component 1 explaining 51.60% and component 2 explaining 8.78% of the variation, thus cumulatively 60.38%). The resulting Eigenvalues were 13.42 and 2.28 for factor 1 and 2 respectively, and thus a large amount of variance was retained by these two components. The PCA map (captured in Figure 7.11) demonstrates that there is no significant relationship between acceptability and emotional attributes, as no emotions are located in the same principal component as acceptability or have a correlation value of 0.5 and higher (King & Meiselman, 2010). The PCA map layout of Lindt is the inverse of the PCA map of Canderel for emotion location. However, the acceptability of Lindt was not located in a quadrant along with emotion as with Canderel but is located in its own quadrant (deactivated displeasure), yet very close to the centre of the map. This demonstrates that the influence of emotion on the acceptability of Lindt was limited.

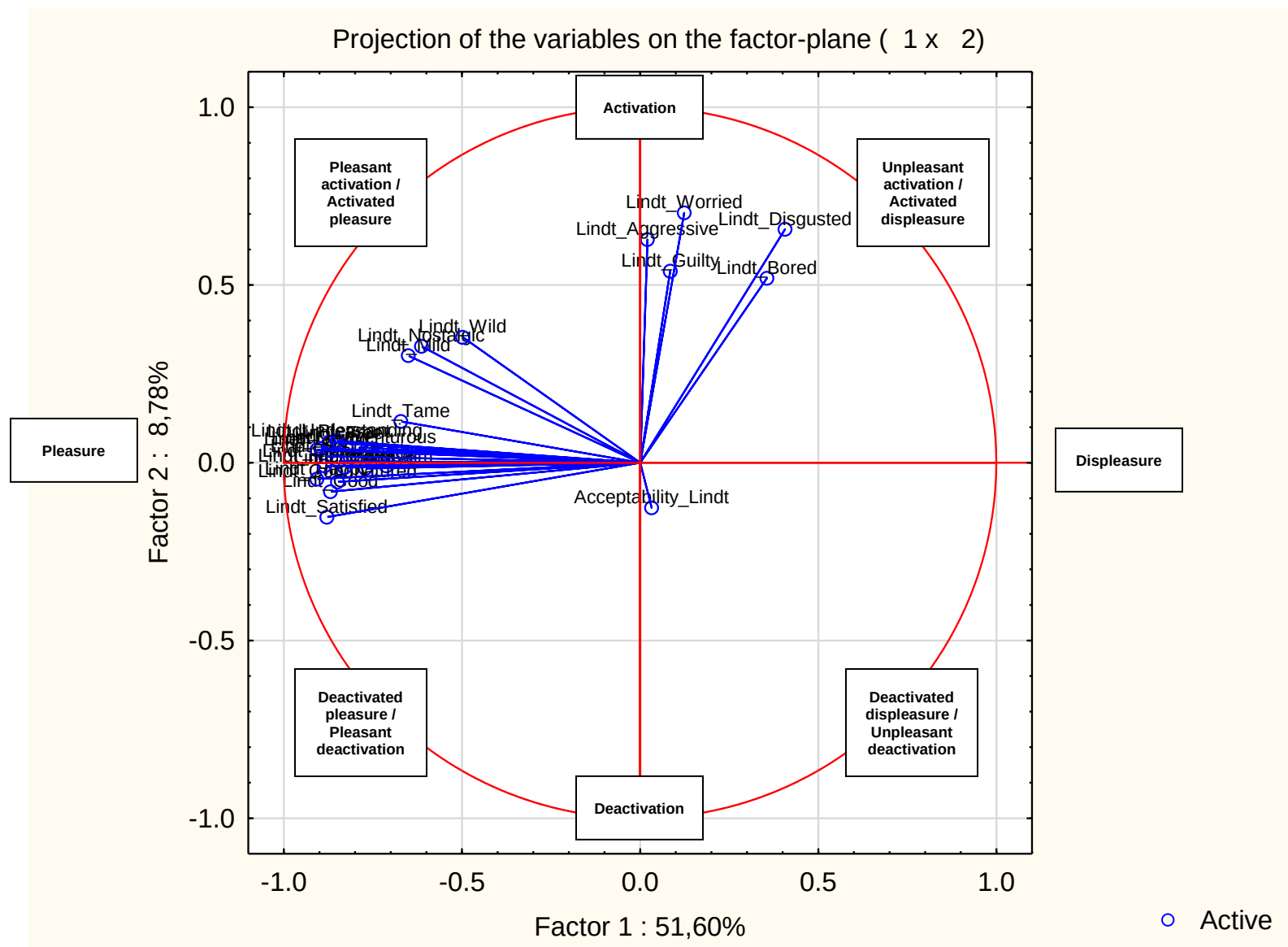


Figure 7.11: PCA map of acceptability and emotion attributes of Lindt

7.3.3.4.3 Nestlé

Through the extraction of data related to acceptability and emotional attributes, two components were identified as well as the attributes linked to these components, which explains a large proportion of the variation (with component 1 explaining 50.46% and component 2 explaining 7.98% of the variation, thus cumulatively 58.44%). The resulting Eigenvalues were 13.10 and 2.07 for factor 1 and 2 respectively, and thus a large amount of variance was retained by these two components. The PCA map (captured in Figure 7.12) demonstrates that there is no significant relationship between acceptability and any emotional attributes for Nestlé; while some emotions are categorised in the same principal component as acceptability, none have a correlation value of 0.5 and higher and are thus concluded to not be related to overall acceptability (King & Meiselman, 2010). The PCA map of Nestlé is similar to that of Canderel in terms of emotions included in each quadrant and with regards to the positioning relative to acceptability, with aggressive, bored, disgusted and worried located in the same quadrant as acceptability. Acceptability was positioned in the deactivated pleasure quadrant but was also as with Lindt positioned very close to the centre of the map, demonstrating that the influence of emotion on the acceptability of Nestlé was limited.

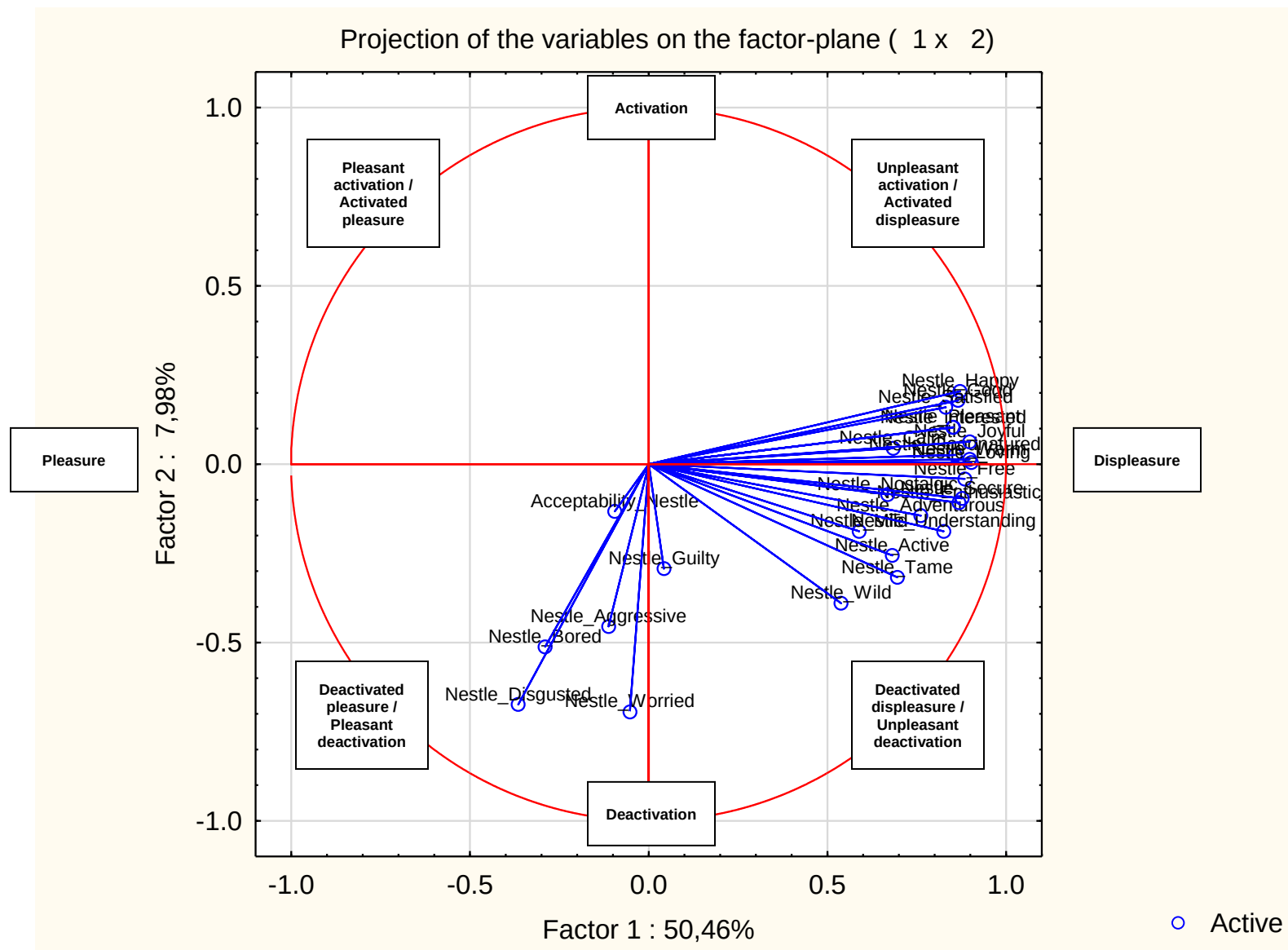


Figure 7.12: PCA map of acceptability and emotion attributes of Nestlé

7.3.4 The relationship between attitude and emotion

7.3.4.1 Respondents' attitude towards chocolate

Figure 7.13 captures the attitude of respondents towards the chocolate category as mean attribute scores. It was based on a scale of one to five where one indicated that the respondent strongly disagreed, while five indicated that the respondent strongly agreed (1=Strongly disagree to 5=Strongly agree). The most frequently selected attributes were that respondents enjoy indulging in chocolate (mean=3.53) and that it cheers them up (mean=3.40). Chocolate is, however, also considered to be high in fat and of poor nutritional value (mean=3.27). Chocolate is less often consumed for hunger (mean=1.62).

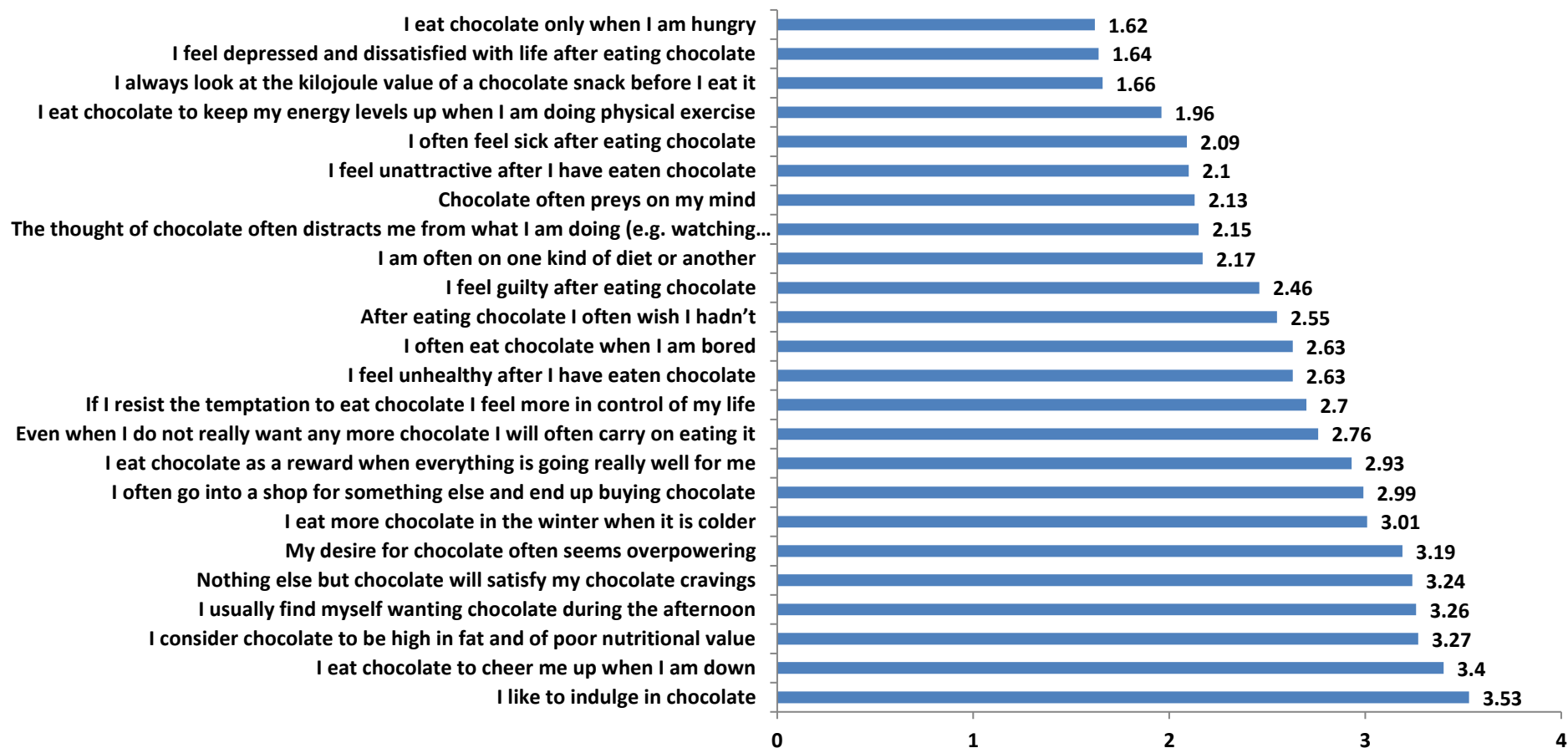


Figure 7.13: Mean scores of chocolate category attitude attributes

Note: Likert scale: 1=Strongly disagree, 2=Disagree, 3=Neither agree nor disagree, 4=Agree, 5=Strongly agree.

7.3.4.2 Factor analysis to group the attitudes towards chocolate

A factor analysis was performed with the attitude data which was collected. Initially, five factors with Eigenvalues greater than one were extracted. A series of factor analyses were conducted, which indicated that four factors gave the most interpretable solution. Based on these four factors, the Bartlett's test of sphericity which tests the overall significance of all the correlations within the correlation matrix was significant ($\chi^2=1433.78$, $P\leq 0.01$), indicating that it was appropriate to use the factor analytic model on this set of data. The Kaiser-Meyer-Olkin measure of sampling adequacy indicated that the strength of the relationships among variables was high (KMO=0.833); thus, it was acceptable to proceed with the analysis. An Oblimin rotation was performed since factors were expected to be correlated. The obtained pattern matrix is displayed in Table 7.15, and all factor loadings except for the attitudes "I always look at the kilojoule value of a chocolate snack before I eat it" and "I often eat chocolate when I am bored" were above 0.4 and are thus all displayed. The four extracted factors together accounted for 55.85% of the variance. The internal consistency of all four factors was high, with acceptable ($\alpha\geq 0.7$) Cronbach's Alpha values.

Factor analysis thus revealed four factors which were sufficient to explain the underlying structure of the attitude of the respondents. The pattern matrix in Table 7.15 revealed factor one to consist of ten items, and based on the moods included in each factor, and it was labelled "negative attitude". The second factor consisted of seven items and based on the attitudes included in each factor, and it was labelled "emotional attitude". The third factor consisted of three items and based on the attitudes included in each factor, and it was labelled "functional attitude". The fourth factor consisted of four items and based on the attitudes included in each factor, and it was labelled "obsession attitude". All attitudes loaded onto a factor. Factor loadings were the highest for the functional attitude factor and the lowest for the obsession attitude factor.

Table 7.15: Pattern matrix with factor extractions for attitudes

Factors	Negative Attitude	Emotional Attitude	Functional Attitude	Obsession Attitude
Items:	1	2	3	4
After eating chocolate I often wish I hadn't	0.897			
I feel guilty after eating chocolate	0.871			

Table 7.15 continued

Factors	Negative Attitude	Emotional Attitude	Functional Attitude	Obsession Attitude
Items:	1	2	3	4
I feel unhealthy after I have eaten chocolate	0.780			
I feel unattractive after I have eaten chocolate	0.767			
If I resist the temptation to eat chocolate I feel more in control of my life	0.686			
I feel depressed and dissatisfied with life after eating chocolate	0.656			
I often feel sick after eating chocolate	0.655			
I consider chocolate to be high in fat and of poor nutritional value	0.649			
I am often on one kind of diet or another	0.481			
I always look at the kilojoule value of a chocolate snack before I eat it	0.274			
My desire for chocolate often seems overpowering		0.856		
I like to indulge in chocolate		0.749		
Even when I do not really want any more chocolate I will often carry on eating it		0.745		
I often go into a shop for something else and end up buying chocolate		0.690		
Chocolate often preys on my mind		0.648		
Nothing else but chocolate will satisfy my chocolate cravings		0.590		
I usually find myself wanting chocolate during the afternoon		0.554		

Table 7.15 continued

Factors	Negative Attitude	Emotional Attitude	Functional Attitude	Obsession Attitude
Items:	1	2	3	4
I eat chocolate to keep my energy levels up when I am doing physical exercise			0.742	
I eat chocolate only when I am hungry			0.677	
I eat more chocolate in the winter when it is colder			0.618	
I eat chocolate as a reward when everything is going really well for me				0.635
The thought of chocolate often distracts me from what I am doing (e.g. watching TV)				0.522
I eat chocolate to cheer me up when I am down				0.503
I often eat chocolate when I am bored				0.395
Inter-item correlations	0.424	0.450	0.556	0.372
Cronbach Alpha	0.882	0.851	0.556	0.704
Mean factor score	2.339	3.010	2.200	2.780
Standard deviation	1.124	1.258	0.976	1.172

Note: *Likert scale: 1=Strongly disagree, 2=Disagree, 3=Neither agree nor disagree, 4=Agree, 5=Strongly agree*; Cronbach's Alpha: $\alpha \geq 0.5$ =Accepted with caution, $\alpha \geq 0.7$ =Acceptable; $\alpha \geq 0.8$ =Good; Mean factor score: <1.0 =Strongly disagree, ≥ 1.0 - <2.0 =Disagree, ≥ 2.0 - <3.0 =Neither agree nor disagree, ≥ 3.0 - <4.0 =Agree and 5.0 =Strongly agree; Shaded loadings indicate items that attribute loaded meaningful on one factor.

According to Thomson and Crocker (2015) product conceptualisations, although infinitely diverse, can be reduced to three broad categories, namely functional (e.g. "will refresh me", "will wash my clothes cleaner"), emotional ("will make me happy", "will calm me"), and abstract ("sophisticated", "trustworthy"). Factor analysis of the attitudes included in this study also yielded a functional and emotional factor; however, no abstract factor was identified, possibly as distinct and descriptive attitude statements were presented to the respondents. The attitude

attribute list included in this study allowed for the creation of the two additional factors which were a combination of those attitudes related to driving consumption (obsession attitude factor) or inhibiting consumption (negative attitude factor). The additional factor, that of obsession attitude, could, however, also be combined within the emotional factor as some of the obsession attitude attributes had a high factor loading scores on the emotional factor as well.

Various attitude attributes had high correlation scores within the factor. In the negative factor, the attitude “After eating chocolate I often wish I hadn’t” had the highest inter-factor correlation (0.897), followed by an attitude related to guilt (0.871). The attitude of referring to kilojoules of food before consuming it had a very low inter-factor correlation (0.274) and was thus not a very significant contributor to this factor. In the emotional factor, “my desire for chocolate often seems overpowering” was the most highly correlated (0.856). In the functional factor, consuming chocolate for energy levels was the highest correlated (0.742), while in the obsession factor, the fact that chocolate is consumed as a reward showed the highest correlation (0.635). The attitudes which had the highest correlation scores were, however, not those which achieved the highest mean, but appeared to be key attributes which captured the essence of the individual factors.

Based on mean factor scores, respondents have a predominantly emotional attitude towards chocolate consumption, and it is less often viewed as a functional food category. The Dutch Eating Behaviour Questionnaire (Van Strien *et al.*, 1986) measures chocolate eating behaviour, and Lagast *et al.* (2018) recently applied this to measure chocolate eating behaviour. This questionnaire measures three types of eating behaviour: emotional eating, external eating and restricted eating. That study reported that respondents considered pleasure as the most important attitude, followed by general health and lastly “using food as a reward”. These findings are in line with the findings of this study where most respondents reported indulging in chocolate (most likely for pleasure), while consuming chocolate as a reward was also reported at a high frequency. General health was not as prominent in this study, although the third most reported attitude was that of chocolate being high in fat and of poor nutritional value, while other health-related attitudes were reported less frequently.

7.3.4.3 The relationship between attitude and emotion factors

7.3.4.3.1 Attitude and emotion factor correlations: Combined data of all chocolates

Spearman's rank order correlations (r) were determined to describe the relationship between the attitude and emotion factors for all chocolates and are captured in Table 7.16.

Table 7.16: Spearman's rank order correlations between emotion and attitude factors overall

Attitude factor	Positive emotion	Negative emotion	Guilty
Negative attitude	-0.150**	0.164**	0.303**
Emotional attitude	0.127*	0.026	0.078
Functional attitude	0.089	0.039	-0.013
Obsession attitude	0.160**	0.088	0.016

Notes: Interpretation of Spearman's rank order correlations based on Cohen's guidelines (1977) (r): $r=0$ - $r<0.3$ =Small, $r\geq 0.3$ - $r<0.5$ =Moderate, $r\geq 0.5$ =Strong; Tendencies to correlate ($r\geq 0.3$) are indicated in bold; *Correlation is significant at the $P\leq 0.05$ level (2-tailed), **Correlation is significant at the $P\leq 0.01$ level (2-tailed).

A moderate ($r\geq 0.3$ - $r<0.5$) significant ($P\leq 0.01$) positive correlation was noted between the emotion guilty and the negative attitude factor only ($r=0.303$; $P\leq 0.01$). Although all other correlations were small ($r=0$ - $r<0.3$), two were significant ($P\leq 0.05$) as a negative correlation was noted between the positive emotion factor and the negative attitude factor ($r=-0.150$; $P\leq 0.01$) and a positive correlation between the negative emotion factor and the negative attitude factor ($r=0.164$; $P\leq 0.01$). A negative attitude to the category is thus likely to evoke negative and guilty emotions.

Directionally, the positive emotion factor was furthermore positively correlated to the emotional ($r=0.127$; $P\leq 0.05$), and obsession factor ($r=0.160$; $P\leq 0.01$). The negative emotion factor correlation (r) values were, however, lower than the positive emotion correlation values. Thus, only those consumers with a negative attitude towards the chocolate category would be less likely to experience positive emotion during consumption, while those with any other attitude towards the segment would experience positive emotion during consumption. Those with a functional attitude may experience guilt.

7.3.4.3.2 Attitude and emotion factor correlations: Data of the three individual chocolates

The Spearman's rank order (r) correlation values between attitude and emotion factors for each individual chocolate are captured in Table 7.17.

Table 7.17: Correlations between emotion and attitude factors for individual chocolates

		Emotional Attitude	Obsession Attitude	Negative Attitude	Functional Attitude
Canderel	Positive emotion	0.073	0.119	-0.199	0.047
	Negative emotion	0.070	0.163	0.036	0.007
	Guilty	0.005	-0.020	0.230**	-0.058
Lindt	Positive emotion	0.086	0.132	-0.258	0.095
	Negative emotion	0.060	0.091	0.278	-0.001
	Guilty	0.150	0.050	0.299**	0.099
Nestlé	Positive emotion	0.206*	0.214*	-0.092	0.117
	Negative emotion	-0.018	-0.081	0.136	-0.014
	Guilty	0.103	0.024	0.309**	-0.062

Notes: Interpretation of Spearman's rank order correlations based on Cohen's guidelines (1977) (r): $r=0$ - $r<0.3$ =Small, $r\geq 0.3$ - $r<0.5$ =Moderate, $r\geq 0.5$ =Strong; Tendencies to correlate ($r\geq 0.3$) are indicated in bold; *Correlation is significant at the $P\leq 0.05$ level (2-tailed), **Correlation is significant at the $P\leq 0.01$ level (2-tailed).

Only one moderate ($r\geq 0.3$ - $r<0.5$) significant ($P\leq 0.01$) positive correlation was noted between guilty emotion experienced during consumption of Nestlé and a negative category attitude ($r=0.309$, $P\leq 0.01$).

A functional attitude to the category had very low Spearman's rank order (r) correlations values with any of the emotion factors for all of the chocolates. The correlations between the functional attitude factor and the positive emotion factors were positive for all three chocolates, while the correlations between the functional attitude factor and the negative emotion factor were negative for Lindt and Nestlé but positive for Canderel, indicating that those consumers who had a functional approach to the category, experienced more negative emotion during the consumption of Canderel. Consumers with a functional approach were also more likely to experience guilt during the consumption of Lindt. Generally, the functional attitude factor had lower Spearman's rank order (r) correlation values with emotion than the other attitude factors,

indicating that functional chocolate consumers may experience less emotion than those of the other attitude factors.

A negative attitude resulted in a negative correlation with positive emotion for all three chocolates, and a positive correlation with negative emotion, and thus these consumers were less inclined to experience positive emotion and more inclined to experience negative emotion during chocolate consumption. A respondent with a negative attitude is also more likely to experience guilt when consuming chocolate, as the negative factor was significantly correlated ($P \leq 0.01$) with guilt for all three chocolates (Canderel $r=0.230$, $P \leq 0.01$, Lindt $r=0.299$, $P \leq 0.01$, and Nestlé $r=0.309$, $P \leq 0.01$). Guilt was thus experienced by this group of respondents irrespective of the chocolate type consumed and was thus possibly related to the category and not to the individual chocolates.

Only two significant correlations ($P \leq 0.05$) were noted for the emotional and obsession attitude factor with the positive or negative emotion factors, both during the consumption of Nestlé. The Spearman's rank order correlations values (r) of these two relationships were, however, small ($r=0$ - $r<0.3$). Furthermore, for Nestlé, both factors correlated positively with guilt and negatively with negative attitude. The same was noted for Lindt, with positive emotions also positively correlating to these factors. For Canderel, however, while positive emotion correlated positively with both factors, so did negative emotion, while guilt had a positive correlation with emotional attitude and a negative correlation with obsession attitude. Canderel had lower correlation coefficients than Lindt for positive emotions, and higher correlation coefficients than Lindt for negative emotions, with very low guilt correlation coefficients. The highest guilt correlation coefficient was noted for Lindt. Thus, directionally, the low sugar chocolate evoked less emotion in these consumer types and Lindt evoked more, both positive and negative, as well as guilt.

7.3.4.4 The relationship between attitude and individual emotion attributes: Data of the individual chocolates

7.3.4.4.1 Negative attitude factor

Spearman's rank order correlations (r) were determined to describe the relationship between the attributes from the negative attitude factor and emotion factors for all chocolates and are captured in Table 7.18.

Table 7.18: Spearman's rank order correlations (*r*) between emotion attributes and attitudes from the negative attitude factor for individual chocolates

Attitude	Canderel		Lindt		Nestlé	
	Emotion	Spearman's rank order correlations (<i>r</i>)	Emotion	Spearman's rank order correlations (<i>r</i>)	Emotion	Spearman's rank order correlations (<i>r</i>)
After eating chocolate I often wish I hadn't	Guilty	0.259**	Bored	0.237**	Guilty	0.298**
			Disgusted	0.255**		
			Guilty	0.248**		
			Loving	0.228**		
			Secure	0.264**		
I feel guilty after eating chocolate	Guilty	0.284**	Bored	0.240**	Guilty	0.323**
			Disgusted	0.255**		
			Good	0.253**		
			Guilty	0.354**		
			Happy	0.243**		
			Interested	0.251**		
			Joyful	0.249**		
			Loving	0.245**		
			Pleasant	0.246**		
			Satisfied	0.255**		
			Secure	0.290**		
			Understanding	0.296**		
			Warm	0.226**		

Table 7.18 continued

Attitude	Canderel		Lindt		Nestlé	
	Emotion	Spearman's rank order correlations (<i>r</i>)	Emotion	Spearman's rank order correlations (<i>r</i>)	Emotion	Spearman's rank order correlations (<i>r</i>)
I feel unhealthy after I have eaten chocolate	Disgusted	0.237**	Disgusted	0.304**	-	
I feel unattractive after I have eaten chocolate	-		Guilty	0.251**		
If I resist the temptation to eat chocolate I feel more in control of my life			Disgusted	0.243**	Guilty	0.234**
	Active	-0.252**				
	Enthusiastic	-0.232**		-		
	Free	-0.238**				
I feel depressed and dissatisfied with life after eating chocolate	Good	-0.234**	Enthusiastic	0.250**		
	Happy	-0.267**	Happy	0.265**		
	Understanding	-0.223**	Interested	0.240**		
			Joyful	0.251**		
			Secure	0.244**		
			Understanding	0.232**		
I often feel sick after eating chocolate	-		-		-	
I consider chocolate to be high in fat and of poor nutritional value	Active	-0.236**	Active	-0.230**	Secure	-0.223**
	Free	-0.246**	Disgusted	0.277**		
	Good	-0.294**	Good	0.263**		
	Good-natured	-0.227**	Happy	0.269**		

Table 7.18 continued

Attitude	Canderel		Lindt		Nestlé	
	Emotion	Spearman's rank order correlations (r)	Emotion	Spearman's rank order correlations (r)	Emotion	Spearman's rank order correlations (r)
I consider chocolate to be high in fat and of poor nutritional value	Interested	-0.243**	Interested	0.270**		
	Joyful	-0.262**	Joyful	0.319**		
	Pleasant	-0.253**	Loving	0.306**		
	Satisfied	-0.261**	Nostalgic	0.230**		
	Secure	-0.222**	Pleasant	0.274**		
			Satisfied	0.282**		
			Secure	0.291**		
			Understanding	0.297**		
I am often on one kind of diet or another		-	Disgusted	0.253**	Guilty	0.228**
			Guilty	0.310**		
I always look at the kilojoule value of a chocolate snack before I eat it			Bored	0.221**		
			Disgusted	0.257**		
		-	Good	0.247**		-
			Guilty	0.233**		

Notes: Interpretation of Spearman's rank order correlations based on Cohen's guidelines (1977) (r): $r=0$ - $r<0.3$ =Small, $r\geq 0.3$ - $r<0.5$ =Moderate, $r\geq 0.5$ =Strong; Only $r\geq 0.2$ are reported; Tendencies to correlate ($r\geq 0.3$) are indicated in bold; *Correlation is significant at the $P\leq 0.05$ level (2-tailed), **Correlation is significant at the $P\leq 0.01$ level (2-tailed).

Multiple (66) small ($r=0-r<0.3$) and four moderate correlations ($r\geq 0.3-r<0.5$) were noted between individual emotion attributes and attitudes from the negative attitude factor. Of the four moderate correlations, three were related to Lindt, with the attitude “I feel guilty after eating chocolate” correlating with the emotion guilty ($r=0.354$, $P\leq 0.01$), and the attitude “I am often on one kind of diet or another” also correlating with the emotion guilty ($r=0.310$, $P\leq 0.01$); and the attitude “I feel unhealthy after I have eaten chocolate” correlating with the emotion disgusted ($r=0.304$, $P\leq 0.01$). For Nestlé the attitude “I feel guilty after eating chocolate” correlated with the emotion guilty ($r=0.323$, $P\leq 0.01$).

Across the three chocolates, the attitudes “I consider chocolate to be high in fat and of poor nutritional value” and “I feel guilty after eating chocolate” showed the most number of small ($r=0-r<0.3$) and moderate ($r\geq 0.3-r<0.5$) significant ($P\leq 0.05$) Spearman’s rank order (r) correlations for the negative attitude factor with emotions across chocolates (22 and 15 correlations respectively), and were thus the attitudes which had a clear relationship with emotion.

The emotional attribute guilty had the most (11) small ($r=0-r<0.3$) and moderate ($r\geq 0.3-r<0.5$) correlations with negative attitude factor attributes, and was correlated to more negative emotion factor attributes when reviewing the chocolates individually vs. the overall grouping reported in the previous section (including “I feel unattractive after I have eaten chocolate”, “If I resist the temptation to eat chocolate I feel more in control of my life”, and “I always look at the kilojoule value of a chocolate snack before I eat it”. Guilt was thus induced in many respondents who had a negative attitude towards the category, irrespective of the sensory experience of the chocolates as previously noted.

While guilt was often experienced, so was disgust, and these were both correlated to an attitude of feeling unhealthy and unattractive after eating chocolate (Canderel disgusted $r=0.237$, $P\leq 0.01$, Lindt disgusted $r=0.304$, $P\leq 0.01$, Lindt guilty $r=0.251$, $P\leq 0.01$), for those who are often on one kind of diet or another (Lindt disgusted $r=0.257$, $P\leq 0.01$, Lindt guilty $r=0.310$, $P\leq 0.01$, Nestlé guilty $r=0.228$, $P\leq 0.01$) and consumers who always look at the kilojoule value of a chocolate snack before they eat it (Lindt disgusted $r=0.257$, $P\leq 0.01$, Lindt guilty $r=0.233$, $P\leq 0.01$).

Various positive emotions were negatively correlated with the attitudes of “If I resist the temptation to eat chocolate I feel more in control of my life”, “I feel depressed and dissatisfied

with life after eating chocolate” and “I consider chocolate to be high in fat and of poor nutritional value” for Canderel. For Lindt the attitudes “I feel depressed and dissatisfied with life after eating chocolate” and “I consider chocolate to be high in fat and of poor nutritional value” were positively correlated with various positive emotions. Lindt had the smallest ($r=0-r<0.3$) correlations between negative attitude and emotional response both with positive and negative emotions, while Nestlé had very few correlations. Correlations for Lindt and Nestlé were mostly positive between negative attitude factor attributes and positive emotions, while they were mostly negative for Canderel. Respondents who had a negative attitude were thus less likely to experience positive emotions when consuming Canderel.

The positive emotions joyful, loving, and understanding had the smallest ($r=0-r<0.3$) and moderate ($r\geq 0.3-r<0.5$) significant ($P\leq 0.05$) correlations with negative attitude factor elements across all three chocolates, while the negative emotion guilty had the most significant ($P\leq 0.05$) positive correlations with negative attitude factor elements. Thus, despite having a negative attitude towards the category, consumers would still experience some positive emotions, but also guilt.

7.3.4.4.2 Emotional attitude factor

Spearman’s rank order correlations (r) were determined to describe the relationship between the attributes from the emotional attitude factor and emotion factors for all chocolates, which are captured in Table 7.19. No negative emotions had correlation values (r) with emotional attitude factors larger than 0.2 for any of the chocolates, and thus respondents with an emotional attitude were less likely to experience negative emotion. Only one Spearman’s rank order correlation (r) larger than 0.2 was noted for Canderel, while there was none for Lindt. Nestlé had numerous small ($r=0-r<0.3$) and moderate ($r\geq 0.3-r<0.5$) significant positive correlations between the emotional attitude factor and positive emotions. Respondents with an emotional attitude were thus more likely to experience positive emotion when consuming Lindt than when consuming the other two chocolates.

“Nothing else but chocolate will satisfy my chocolate cravings” and “My desire for chocolate often seems overpowering” had the most correlations with emotions for Nestlé (11 and 7 correlations respectively). The emotions happy, joyful and satisfied had the most correlations with emotional attitude factors for Nestlé (three, four and four correlations). The stronger correlations for Nestlé ($r\geq 0.3$) were between “My desire for chocolate often seems

overpowering”, and the emotions joyful and satisfied and “Nothing else but chocolate will satisfy my chocolate cravings” and the emotion warm. Consumers who thus craved chocolate or had a strong desire to consume it experienced positive emotions of happiness and joy when consuming Nestlé.

Table 7.19: Correlations between emotion attributes and attitudes from the emotional attitude factor for individual chocolates

Attitude	Canderel		Lindt		Nestlé	
	Emotion	Spearman's rank order correlations (<i>r</i>)	Emotion	Spearman's rank order correlations (<i>r</i>)	Emotion	Spearman's rank order correlations (<i>r</i>)
My desire for chocolate often seems overpowering		-		-	Happy	0.247**
					Joyful	0.315**
					Loving	0.224**
					Pleasant	0.236**
					Satisfied	0.370**
					Secure	0.259**
					Warm	0.254**
I usually find myself wanting chocolate during the afternoon		-		-		-
Chocolate often preys on my mind		-		-	Joyful	0.245**
					Loving	0.240**
					Pleasant	0.224**
					Satisfied	0.284**
					Tame	0.225**
					Warm	0.232**
Nothing else but chocolate will satisfy my chocolate cravings	Secure	0.261**		-	Adventurous	0.249**
					Free	0.256**
					Good	0.231**

Table 7.19 continued

Attitude	Canderel		Lindt		Nestlé	
	Emotion	Spearman's rank order correlations (<i>r</i>)	Emotion	Spearman's rank order correlations (<i>r</i>)	Emotion	Spearman's rank order correlations (<i>r</i>)
Nothing else but chocolate will satisfy my chocolate cravings					Good-natured	0.236**
					Happy	0.275**
					Joyful	0.281**
					Loving	0.236**
					Pleasant	0.274**
					Satisfied	0.259**
					Secure	0.283**
					Warm	0.311**
Even when I do not really want any more chocolate I will often carry on eating it		-		-		-
I like to indulge in chocolate		-		-	Happy	0.242**
					Joyful	0.260**
					Satisfied	0.258**
					Secure	0.248**
I often go into a shop for something else and end up buying chocolate		-		-		-

Notes: Interpretation of Spearman's rank order correlations based on Cohen's guidelines (1977) (r): $r=0$ - $r<0.3$ =Small, $r\geq 0.3$ - $r<0.5$ =Moderate, $r\geq 0.5$ =Strong; Tendencies to correlate ($r\geq 0.3$) are indicated in bold; Only $r\geq 0.2$ are reported; *Correlation is significant at the $P\leq 0.05$ level (2-tailed), **Correlation is significant at the $P\leq 0.01$ level (2-tailed).

7.3.4.4.3 Functional attitude factor

Spearman's rank order correlations (r) were determined to describe the relationship between the attributes from the functional attitude factor and emotion factors for all chocolates which are captured in Table 7.20. On an individual chocolate level, the functional attitude factor attributes had very few small ($r=0-r<0.3$) correlations with emotion, indicating that respondents who consume chocolate for functional reasons are less likely to experience emotion.

Table 7.20: Correlations between emotion attributes and attitudes from the functional attitude factor for individual chocolates

	Canderel		Lindt		Nestlé	
	Emotion	Spearman's rank order correlations (<i>r</i>)	Emotion	Spearman's rank order correlations (<i>r</i>)	Emotion	Spearman's rank order correlations (<i>r</i>)
I eat chocolate to keep my energy levels up when I am doing physical exercise		-	Active Warm	0.261** 0.239**	Disgusted Warm	-0.254** 0.234**
I eat chocolate only when I am hungry		-		-	Tame	0.265**
I eat more chocolate in the winter when it is colder		-		-		-

Notes: Interpretation of Spearman's rank order correlations based on Cohen's guidelines (1977) (*r*): $r=0$ - $r<0.3$ =Small, $r\geq 0.3$ - $r<0.5$ =Moderate, $r\geq 0.5$ =Strong; Only $r\geq 0.2$ are reported; *Correlation is significant at the $P\leq 0.05$ level (2-tailed), **Correlation is significant at the $P\leq 0.01$ level (2-tailed).

7.3.4.4.4 Obsession attitude factor

Spearman's rank order correlations (r) were determined to describe the relationship between the attributes from the obsession attitude factor and emotion factors for all chocolates and are captured in Table 7.21. All noted correlations were small ($r=0-r<0.3$) yet significant ($P\leq 0.05$) positive correlations, and the majority (13) were for Nestlé, while only two were noted for Canderel and none for Lindt. The attribute "I eat chocolate as a reward when everything is going really well for me" had the most correlations with emotions, with seven small correlations noted, limited to Nestlé. The emotions adventurous and joyful were positively correlated to three of the four obsession attitude factor attributes for Nestlé.

Table 7.21: Correlations between emotion attributes and attitudes from the obsession attitude factor for individual chocolates

	Canderel		Lindt		Nestlé	
	Emotion	Spearman's rank order correlations (<i>r</i>)	Emotion	Spearman's rank order correlations (<i>r</i>)	Emotion	Spearman's rank order correlations (<i>r</i>)
I eat chocolate as a reward when everything is going really well for me	Free	0.229**	-		Adventurous	0.222**
	Warm	0.264**			Good-natured	0.231**
					Happy	0.264**
					Joyful	0.252**
					Loving	0.235**
					Satisfied	0.235**
					Warm	0.254**
The thought of chocolate often distracts me from what I am doing (e.g. watching TV)	-		-		Adventurous	0.263**
					Joyful	0.230**
I eat chocolate to cheer me up when I am down	-		-		Adventurous	0.258**
					Happy	0.226**
					Joyful	0.277**
					Warm	0.243**
I often eat chocolate when I am bored	-		-		-	

Notes: Interpretation of Spearman's rank order correlations based on Cohen's guidelines (1977) (r): $r=0$ - $r<0.3$ =Small, $r\geq 0.3$ - $r<0.5$ =Moderate, $r\geq 0.5$ =Strong; Only $r\geq 0.2$ are reported; *Correlation is significant at the $P\leq 0.05$ level (2-tailed), **Correlation is significant at the $P\leq 0.01$ level (2-tailed).

7.3.4.5 Principal component analysis of attitude and emotion attributes

7.3.4.5.1 Canderel

Through the extraction of data related to the attitude and emotional attributes, two components were identified as well as the attributes linked to these components, which explains a large proportion of the variation (with component 1 explaining 27.30% and component 2 explaining 13.30% of the variation, thus cumulatively 40.60%). The resulting Eigenvalues were 13.39 and 6.52 for factor 1 and 2 respectively, and thus a large amount of variance was retained by these two components. The PCA map (captured in Figure 7.14) indicates that there are underlying relationships between attitude and emotion attributes for Canderel, with all emotion and attitude attributes located in the activation quadrants, with some classified as activated pleasure and others as activated displeasure. Most of the attitude attributes are all located on or close to the second component, while the majority of emotion attributes are located on or close to the first component. The emotions worried, aggressive and bored were, however, located along with factor 1, the attitude factor, and for Canderel these are thus more related to attitude than other emotions. Furthermore, the PCA map of Canderel is not comparable to the other two chocolates presented in the following sections as all attitude factors are located in the top two quadrants of the PCA map, along with the emotional attributes related to activation.

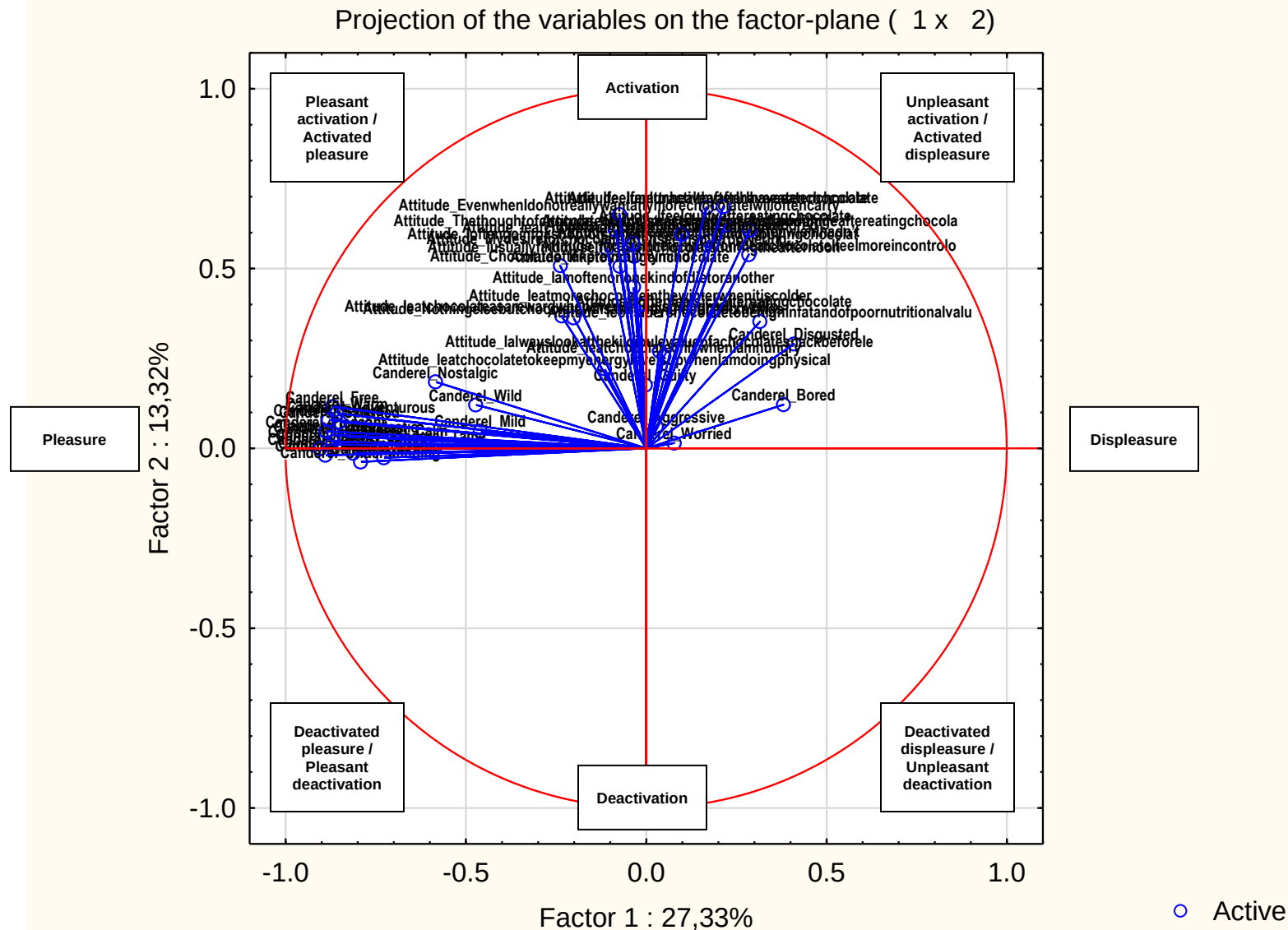


Figure 7.14: PCA map of attitude attributes and emotion attributes of Canderel

7.3.4.4.2 Lindt

Through PCA information was extracted from a multivariate data table and was expressed in a new set of variables or principal components, and through the extraction of data related to the attitude and emotional attributes, two components were identified as well as the attributes linked to these components, which explains a large proportion of the variation (with component 1 explaining 28.89% and component 2 explaining 13.42% of the variation, thus cumulatively 42.20%). The resulting Eigenvalues were 14.11 and 6.57 for factor 1 and 2 respectively, and thus a large amount of variance was retained by these two components. The PCA map (indicated in Figure 7.15) illustrates that there are some underlying relationships between attitude and emotion attributes for Lindt; however, most of the attitude attributes are all located on or close to the second component, while the majority of emotion attributes are located on or close to the first component. The emotions worried and aggressive were located along with factor 1, the attitude factor. The location of emotions and attitudes are, however, the reverse of Canderel with the majority located in the bottom half of the PCA map, thus related to deactivation.

7.3.4.4.3 Nestlé

Through PCA, information was extracted from a multivariate data table and was expressed in a new set of variables or principal components, and through the extraction of data related to the attitude and emotional attributes, two components were identified as well as the attributes linked to these components, which explains a large proportion of the variation (with component 1 explaining 28.16% and component 2 explaining 13.14% of the variation, thus cumulatively 41.30%). The resulting Eigenvalues were 14.11 and 6.58 for factor 1 and 2 respectively, and thus a large amount of variance was retained by these two components. The PCA map (indicated in Figure 7.16) indicates the existence of various relationships between attitude and emotion attributes for Nestlé. Attitude attributes are all located on or close to the second component, while emotion attributes are located on or close to the first component. The emotions worried and disgusted, however, are, based on the location on the PCA map, disconnected from the other emotions in relation to the attitude attributes. The emotion adventurous also has a higher association with the attitude attributes as it is located in the same segment of the PCA as the attitude elements and had a higher factor coordinate score for factor 1 than factor 2. In this PCA map, the emotion attribute location mirrors to a certain extent that of Lindt.

7.3.4.6 Reliability of the attitude questionnaire

The Cronbach's Alpha for each of the extracted factors (0.882 for the negative attitude factor; 0.851 for the emotional attitude factor; 0.556 for the functional attitude and 0.704 for the obsession attitude factor) indicates that the attitude questionnaire and scale applied captured negative, emotional and obsession attitude accurately. The functional attitude factor, however, had a low mean score, and thus the low Cronbach's Alpha may be related to a low incidence of functional attitudes experienced rather than an inability to capture these attitudes by the tool and scale employed.

7.3.5 Summary of Spearman's rank order correlation (r) values between emotion factors and the consumer behaviour variables

Table 7.22 captures all the correlation (r) values between emotion factors and the consumer behaviour variables.

Table 7.22: Summary of correlations between emotion factors and consumer behaviour variable factors

		Canderel			Lindt			Nestlé		
		Positive emotion	Negative emotion	Guilty	Positive emotion	Negative emotion	Guilty	Positive emotion	Negative emotion	Guilty
Mood factor	Positive mood	0.081	-0.038	0.066	0.114	-0.011	-0.054	0.245**	-0.083	0.017
	Negative mood	0.044	0.082	0.123	0.038	0.138	0.335**	0.106	0.114	0.218*
Acceptability		-								
Familiarity	Small chocolates	0.041	0.029	0.091	0.209*	-0.145	0.145	0.272**	-0.119	0.075
	Large chocolates	0.135	0.032	0.028	0.232**	-0.103	0.062	0.231**	-0.095	0.058
Attitude	Emotional	0.073	0.070	0.005	0.086	0.060	0.150	0.206*	-0.018	0.103
	Obsession	0.119	0.163	-0.020	0.132	0.091	0.050	0.214*	-0.081	0.024
	Negative	-0.199	0.036	0.230**	-0.258	0.278	0.299**	-0.092	0.136	0.309**
	Functional	0.047	0.007	-0.058	0.095	-0.001	0.099	0.117	-0.014	-0.062

Notes: Interpretation of Spearman's rank order correlations based on Cohen's guidelines (1977) (r): $r=0$ - $r<0.3$ =Small, $r\geq 0.3$ - $r<0.5$ =Moderate, $r\geq 0.5$ =Strong; Tendencies to correlate ($r\geq 0.3$) are indicated in bold; *Correlation is significant at the $P\leq 0.05$ level (2-tailed), **Correlation is significant at the $P\leq 0.01$ level (2-tailed).

Two moderate correlations ($r \geq 0.3$ - < 0.5) were noted between the consumer behaviour variable factors and emotion, and both related to the emotion guilt (for Lindt guilty emotion was correlated to negative mood $r = 0.335$, $P \leq 0.01$, and for Nestlé guilty emotion was correlated to negative attitude $r = 0.309$, $P \leq 0.01$). Consumers are thus more likely to experience guilt when consuming chocolate if they had a pre-existing negative attitude towards the category, or if they were in a negative mood before they consumed it.

Various small ($r = 0$ - 0.3) yet significant ($P \leq 0.05$) relationships were also noted, including firstly a further relationship between guilty emotion and negative emotion for Canderel. For Nestlé positive mood was correlated with positive emotion, and small chocolate familiarity was also correlated with positive emotion. Consumers were thus more likely to have a positive emotional experience with chocolate if they were already in a positive mood, and if they were consumers of small chocolates. Lindt consumers were likely to experience positive emotion whether they were small or large chocolate consumers, but a negative attitude towards the category would result in a negative emotional experience with this chocolate (due to a positive correlation with negative emotion and a negative correlation with positive emotion).

7.4 CONCLUSION

Mood and emotion have a weak relationship on a factor level. Directionally, positive mood is likely to suppress or reduce the experience of negative emotion and would thus result in a positive emotional experience, while a negative mood is likely to result in a negative emotional experience. The relationship between mood and emotion attributes for individual chocolates was varied, with most correlations noted for the mainstream chocolate Nestlé, fewer for the luxury chocolate Lindt and very few for the diabetic chocolate Canderel. Mood thus broadly influences emotional response, either promoting a positive or negative response.

The emotional experience differs between large format and small format chocolate users, but both are positive in nature. The positive emotions experienced during the consumption of Lindt and Nestlé were positively influenced by both chocolate formats, while the emotional experience of Canderel was not related to the usage of either format. The usage of small chocolates, however, created a more positive emotional experience, but a tendency was noted for small chocolate consumers to experience more guilt during consumption than large chocolate consumers. Chocolate format does seem to possibly influence emotion.

The emotional response to Canderel was more accurately captured by its mean acceptability than Lindt and Nestlé, as the emotional response to these two chocolates was not reflected by the mean acceptability ratings. Emotional attributes appear to capture disliking more accurately than liking.

A negative attitude to the category is likely to evoke negative and guilty emotions, while those with a functional attitude are likely to experience less emotion than the other attitude factors but may experience guilt. Emotional and obsession attitude are less likely to evoke emotion during consumption. A consumer's attitude towards the category is therefore likely to impact emotional response.

In conclusion, the four consumer behaviour variables investigated, namely mood, familiarity, acceptability and attitude appear to have an influence on emotional response.

CHAPTER 8

THE RELATIONSHIP BETWEEN THE SENSORY PROPERTIES OF, EMOTIONAL RESPONSE TO AND CONSUMER BEHAVIOUR TOWARDS CHOCOLATE – A STRUCTURAL EQUATION MODEL (ARTICLE SUBMITTED TO FOOD QUALITY AND PREFERENCE: SUBMISSION NO: FQAP_2019_825)

*Please note: As this chapter was prepared for submission to the Journal Food Quality and Preference, repetition from previous chapters will be noted. Language and style used in this working article are in accordance with the requirements of the Journal Food Quality and Preference. Please refer to Appendix AC for proof of submission to Journal.

THE RELATIONSHIP BETWEEN THE SENSORY PROPERTIES OF, EMOTIONAL RESPONSE TO AND CONSUMER BEHAVIOUR TOWARDS CHOCOLATE – A STRUCTURAL EQUATION MODEL

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ABSTRACT

The aim of this study was to determine if relationships exist between emotion, sensory properties and selected internal consumer behaviour variables (namely mood, familiarity, acceptability and attitude) and if they do, to determine the direction and strength of these relationships. The total sample for this study consisted of 149 respondents who were all chocolate consumers (should have consumed chocolate at least once in the past year). Chocolate was chosen as a product for exploration because, based on a review of the literature regarding the sensory properties and emotions, moods and attitudes related to chocolate, it can be viewed as a more complex food type in terms of the above concepts, and is thus well-positioned to provide insight into the various areas that will be investigated.

Only Milk chocolate in tablet format was selected for the study, and real products (vs. model foods) available in the retail space were included. Three different milk chocolates were included after they had been selected from a set of 12 products as they were found to be sensorily varied by a trained panel. A questionnaire was compiled specifically for this study incorporating various existing questionnaires and scales in their original form and other adapted questionnaires, while other sections were developed by the researcher and was applied as Computer-Assisted Self Interviewing (CASI). Three Structural Equation Models (SEMs) were prepared through positive and negative emotion lenses after which a combined positive and negative emotion model was constructed. The analysis validates the concept model and verifies that in this study, a relationship exists between sensory properties, consumer behaviour variables and emotional response. Based on model fit values, when combined, all measured variables have a meaningful relationship with one another as well as with a positive and negative emotional experience.

KEY WORDS

- Emotion
- Emotional response
- Sensory properties
- Consumer behaviour
- Chocolate

1. Introduction

Emotion is a subject undergoing intense study in academic and business research (Bagozzi et al., 1999; Johnson & Stewart, 2005; Bakamitsos, 2006). The concept of emotional response has been applied to a very wide range of industries, even extending to the automotive industry (Nakada, 1997; Chang et al., 2006; Tsutsumi & Sasaki, 2008), which suggests that it is a useful commercial tool. The study of emotions within consumer research studies and the outputs achieved has also grown rapidly (Chaya et al., 2015; Meiselman, 2015). However, the application of these findings to food products have been rare (Nakada, 1997; Chang et al., 2006; Tsutsumi & Sasaki, 2008). Meiselman (2015) recently reported that ten years prior, virtually no conference presentations and journal papers examined the emotions associated with food products, and only recently has the relationship between food quality and emotions began to intrigue food researchers (Jaeger & Hedderley, 2013).

As sensory properties have been indicated to influence emotional product experiences (Thomson et al., 2010), studies in this field have investigated the potential of analysing emotions alongside sensory properties of food products (and in certain cases liking or acceptability as well) to better understand consumers' food choices (Edwards et al., 2013). For example, in a study of odours of dairy products conducted by Seo et al. (2009), the relationship between sensory properties and adjective pairs of emotions was investigated, and significant correlations were found between specific sensory properties and emotions evoked. Emotional measurement could be used in conjunction with sensory analysis in order to understand how taste, olfactory and visual aspects of a product evoke subconscious feelings and emotions that could ultimately drive hedonic measures and choice behaviour (Ferrarini et al. (2010). However, the link between the specific sensory properties of food products (such as chocolate) and the emotions they evoke has not been adequately measured to date.

It is crucial that consumers can relate brand essence to a product; a link that is of primary importance to marketing efforts. While this is ultimately based on the sensory experience which conveys the emotional aspects of a product (King et al., 2010), one cannot ignore that various internal consumer behaviour variables have been found to have emotional connotations or influence emotional response, including mood (Desmet & Schifferstein, 2008), familiarity (Jiang et al., 2014), acceptability (Oliver, 1993) and attitude (Wilkie, 1994). According to Rolls (2005) it is important to consider the various aspects involved in the relationships among sensory attributes, emotional responses and hedonic ratings of food products when we extend the emotional response concept to complex food products. This was, for example, considered in the design of the M-R model (Russell & Mehrabian, 1977), where significant causal relationships were indicated among sensory experience and positive/negative emotions, but also behavioural intentions and buying behaviour are considered. The existence of such relationships have been reported in several studies (Jang & Namkung, 2009; Kim & Moon, 2009; Jang et al., 2012). Lindstrom (2005) revealed that positive and negative emotions play a partially mediating role in the relationship between sensory experience and behavioural intentions and that sensory experience can strengthen behavioural intentions through emotions, and thus that the relationships are also not necessarily one-directional. Consumers' behavioural response to emotions also varies (Canetti et al., 2002) based on the fact that emotions differ in their antecedent conditions, physiological correlates, frequency of occurrence and duration (Scherer et al., 1986). It has thus been reported that there are broadly three factors which can affect emotional responses to food items, namely sensory properties, the type

of food, and thirdly the characteristics of the individual (Jiang et al., 2014), which could include numerous variables. As a result, Mora et al. (2018) proposed that apart from the sensory differences among products, other factors linked to consumers and their behaviour could be included in a study of emotional response. However, such studies that simultaneously explore the effects of sensory experience on consumer emotions and behaviour are rare (Chen & Lin, 2018).

The role of mood (and its dimensions) in impacting consumer behaviour has been acknowledged by various authors and researchers (Hoyer et al., 2012; Solomon et al., 2012) and it is acknowledged that it impacts the affective (emotional) responses to food (Ferber & Cabanac, 1987; Willner & Healy, 1994). Moods have been found to affect eating responses along the entire process of ingestion: motivation to eat (Macht & Simons, 2000), food choice (Oliver & Wardle, 1999; Gibson, 2006), and even chewing (Macht, 1998), eating speed (Krebs et al., 1996) and amount ingested (Greeno & Wing, 1994), also extending to metabolism and digestion (Wing et al., 1990; Blair et al., 1991).

Familiarity is a consequence of food frequency, as increased usage and thus, product exposure or experience increases the familiarity with a product (Keenan, 2015). It has been noted that memory, attention and product familiarity are all closely related to one another (Peter et al., 2010). Repeatedly exposing people to stimuli creates and strengthens stimulus-response associations that are stored in people's memory. With increasing product familiarity people make associations between the identity of a particular object and other conceptual associations held in mind (Thomson et al., 2010). Some conceptual associations are learned from external sources (such as advertising or word of mouth) and some are based on internal experiences (Thomson et al., 2010). Associations that consumers assign to a product is based on these experiences and learning, and part of these associations have emotional connotations (Gutjar et al., 2015b).

Product acceptance, appeal, or liking has over many years been the measure used to understand the preference and food choice behaviour (Peryam & Pilgrim, 1957; Pilgrim, 1961; Kamen, 1962; Pilgrim & Kamen, 1963; de Graaf et al., 2005). However, Dalenberg et al. (2014) found that a model containing product liking alone only moderately fitted the consumer choice behaviour. The relationship between food choice and liking is weak in real world situations (Dalenberg et al., 2014), and thus liking does not accurately predict food choice. It has also

recently (in the past five years) been indicated that evoked emotions better predict food choice than liking alone (Dalenberg et al., 2014) as emotional profiles provide new information not captured by liking scores (Gutjar et al., 2015b). Studies have also revealed the presence of an “attitude effect” in emotional response, which is when prior attitudes influence emotions experienced (McHugo et al., 1991). As attitude is an inclination to react to stimuli (Mellott, 1983; Oundo et al., 2014), it thus possesses motivation that encourages particular consumer behaviour or limits certain actions (Anilkumar & Joseph, 2012). Consumer behaviour is also not just viewed as a result or outcome of an attitude. It is also seen as a way to measure the consumer’s attitude towards an object (Albarracin et al., 2014).

From a commercial point of view, emotional response can be applied as product development and differentiation tool, seeing that the emotional linkage between brand and consumer is important in building strong brands (Hultén, 2011), ultimately ensuring a positive product experience. It is crucial that consumers can relate brand essence (what a brand stands for) to the physical product (including its sensory properties), a link that is of primary importance to marketing efforts (King et al., 2010). If emotional response could be related to the sensory properties of foods, the insights would not only aid in the understanding of the emotional signature of a product or product category but will also assist in the development of products for target consumer categories (Ng & Hort, 2014; Schiffman & Kanuk, 2014), alongside a marketing mix which conveys this emotional profile. Furthermore, if the consumer is incorporated from a behaviour point of view, consumer response and product adoption could be anticipated.

Although determining sensory acceptability (liking) is widely used in marketing and consumer research, high market failure rates for newly launched products demonstrate the need for a broader perspective on consumers’ food product experience (Thomson et al., 2010; Cardello et al., 2012). Product innovation is critical for company survival in a competitive global market and to achieve growth, profitability and increase competitiveness (Stewart-Knox & Mitchell, 2003; Costa & Jongen, 2006; Biazzo et al., 2016). Therefore, in a competitive environment, pleasantness and performance might not be enough (Porcherot et al., 2010). The fact, however, is that the vast majority of newly launched food products fail to achieve sales targets (Stewart-Knox & Mitchell, 2003), and there is as a result an increased reliance on emotional profiles of products for a differential advantage in the modern marketplace where products are of similar quality and price (Schifferstein et al., 2013), or similar in technical and performance properties (Churchill & Behan, 2010). The low rate of innovation and high failure rate of new

food products also suggest that the methodology used for new food product development is possibly flawed (Rudolph, 1995; Stewart-Knox & Mitchell, 2003). Many of those conducting sensory and consumer research on products are looking for a method which adds new information not already included in sensory and hedonic measures (Porcherot et al., 2010; King et al., 2013; Jiang et al., 2014).

Recent studies in the field of emotion research have started investigating the possibility of including emotion alongside sensory acceptability (liking) in consumer studies of food products as it has been indicated that sensory properties influence emotional product conceptualisations and ultimately consumers' food choices. Findings from these studies confirm that the measurement of food-evoked emotions provides new information beyond liking and that food products can be differentiated more effectively based on their emotional profiles (Thomson & MacFie, 2007; King et al., 2010; Cardello et al., 2012; Jaeger & Hedderley, 2013; Ng et al., 2013). While some such studies, e.g., (Macht & Dettmer, 2006; Seo et al., 2009; Thomson et al., 2010; Agudelo et al., 2015; Chaya et al., 2015; Kostyra et al., 2016) have investigated emotional response to food or beverage products, and none has been conducted in a South African setting to the knowledge of the researcher. Very few have included a consumer behaviour component such as mood, familiarity, acceptability or attitude to understand how these emotional responses will translate into action, and no studies have also been conducted through the application of this type of research approach.

By measuring the emotional response to the sensory properties of chocolate, the sensory properties that most influence a positive or negative emotional response and ultimately acceptance, and the different emotions that are evoked, can be identified. Furthermore, the role of consumer behaviour in emotional response can be determined. Mpinganjira et al. (2013) specifically stated that it is important to understand the field of consumer behaviour through the contribution of multiple disciplines, as this would provide an opportunity to investigate and explain a particular phenomenon from different viewpoints. The industry can also be informed of the drivers of consumer experience with local chocolate products.

Chocolate was chosen as a product for exploration in the present study because, based on a review of the literature regarding the sensory properties and emotions, moods and attitudes related to chocolate, it can be viewed as a more complex food type in terms of the above concepts, and is thus well-positioned to provide insight into the various areas that will be

investigated. Chocolate has been studied by many researchers and from these, tools to apply in similar studies have also been published by such researchers (Viaene & Januszevska, 1997; Ziegler et al., 2001; Sune et al., 2002; Golob et al., 2004; Lasekan et al., 2007; de Melo et al., 2009; Kennedy & Heymann, 2009; Nightingale, 2009; Thamke et al., 2009; Thomson et al., 2010; Leite et al., 2013; Norhayati & Ayob, 2014).

As outlined above, the consumer behaviour variables (namely mood, familiarity, acceptability and attitude) included in this study have all been indicated to have an emotional component. The aim of this study was to determine if relationships exist between emotion, sensory properties and selected internal consumer behaviour variables (namely mood, familiarity, acceptability and attitude), and if they do, to determine the direction and strength of these relationships. This was done in order to present a joined emotion, sensory and consumer behaviour model of chocolate consumption to describe what has been coined the “whole consumer experience” (Plaehn & Lundahl, 2006), based on the definition of a model by (Schiffman & Kanuk, 2007) namely, “A representation of reality designed to show the relationships between the various elements of a system or process under investigation”. This can only be done by looking beyond individual product attributes and towards the whole consumer experience to better understand the impact of consumer behaviour.

2. Materials and methods

2.1 Participants

The total sample for this study consisted of 149 respondents who were all students attending a Business School of a South African University and who were all chocolate consumers (should have consumed chocolate at least once in the past year in order to have a level of familiarity with the product category to be considered a chocolate consumer). A descriptive demographic profile of the study respondents is summarized in Table 1.

Table 1. Descriptive demographic profile of chocolate respondents included in this study

Demographic profile	Percentage of respondents (%)	Number of respondents (n)
Age		
18-29 years	23	34
30-39	37	55
40-49	26	38
50-59	9	14
60 years and older	5	8
Gender		
Male	26	38
Female	74	111
Ethnicity		
Black	13	20
White	62	92
Coloured	7	11
Indian	15	23
Asian	0	0
Not prepared to answer	2	3
Highest level of education		
Grade 12	13	19
Certificate/Diploma	33	49
Degree	22	32
Post-graduate degree	33	49

2.2 Chocolate samples

To ensure that variability in chocolate types did not influence respondents and impact results, only milk chocolate in tablet format was selected for the study, as it is the most popular format in South Africa (Research, 2011), consumers prefer plain milk chocolate in general over dark chocolate (Ronquest-Ross et al., 2015). As a consumer-centric study, the aim was to include real products to capture real responses to products that have a level of familiarity, and thus no model foods were included. Three different milk chocolates were selected from a set of 12 products as they were found to be sensorily varied by a trained panel. The consumer panel consequently evaluated these products sold in the retail space in South Africa. Samples can be presented blind, branded or unbranded, packaged or unpackaged, and can be tasted or not tasted; however, in a study where the EsSense profile was applied, different emotional profiles were indicated for blind taste, packaged and unpackaged taste conditions (Gutjar et al., 2015a). Thus, the same product elicited different emotions based on either the intrinsic (sensory) or

extrinsic (packaging) product properties (Gutjar et al., 2015a). As the objective of this study was to measure the emotional response to sensory properties (intrinsic), samples were presented blind and unbranded. Branding was removed by melting the surface of the chocolates with a hot spoon without distorting the surface or shape significantly, and the sample was then cooled down to room temperature (approximately 20°C). Four blocks (20g) were then packaged in individual small zip-lock plastic bags (4cm x 4cm) and labelled with a three-digit code; and they were then packed in cooler bags to ensure they remained within room temperature range (15 °C - 25 °C) until consumed. This was repeated for all three samples sequentially. A combination of water and water biscuits was provided to respondents to cleanse the palate between chocolate samples. Respondents were each provided with three water biscuits (weighing 8g per biscuit, thus 24g of biscuits was provided), one to be consumed before the first, second and third chocolate sample was assessed. They were sealed in a zip-lock bag, and a 330ml bottle of still mineral water was provided as well.

2.3 Data collection

Questionnaires not only deal with extensive lists of emotions (Meiselman, 2015) as well as other variables, but it has also been found that product-specific questionnaires are expected to be more discriminating in comparison to a standardised questionnaire (Ng et al., 2013). A questionnaire was compiled specifically for this study, incorporating various existing questionnaires and scales in their original form (some of which were specifically developed for chocolate) and other adapted questionnaires, while other sections were developed by the researcher. The questionnaire was developed in English as a language generally understood and spoken by most South Africans (Alexander, 2007) as it is the second language of most South Africans and is the most dominant language used for research in South Africa (Casale & Posel, 2011). The questionnaire consisted of various sections as indicated in Figure 1 which also captures the tools and scales employed in each section. All data collected in these sections were included and analysed to prepare the model except for the demographic information indicated in section 3.

The questionnaire in this study was applied as Computer-Assisted Self Interviewing (CASI), designed on the Survey Monkey platform (Advantage plan). A comparison of the results of a Pen and paper personal interview (PAPI) with CASI found that CASI had more complete item response rates than the various paper and pencil methods (Johnson et al., 2001; Bowling, 2005; Ng & Hort, 2014) which would benefit this study where full completion of each section is

required for correlation analysis. It also saved significant time, improved data accuracy due to the length of the questionnaire of this study and reduced respondent fatigue by allowing respondents to complete the questionnaire at their own pace and allowing them to take breaks as they needed. It offered the flexibility to record responses in the respondents' natural setting, which is important for emotion response studies, and thus created an evoked chocolate consumption context. Self-administered questionnaires are also best for accurately capturing honest emotional response as well as attitudinal questions, as sensitive health problems are often under-reported in face-to-face or telephone interviews, compared with self-administered questionnaires (Rhodes et al., 1995; Garcia-Losa et al., 2001).

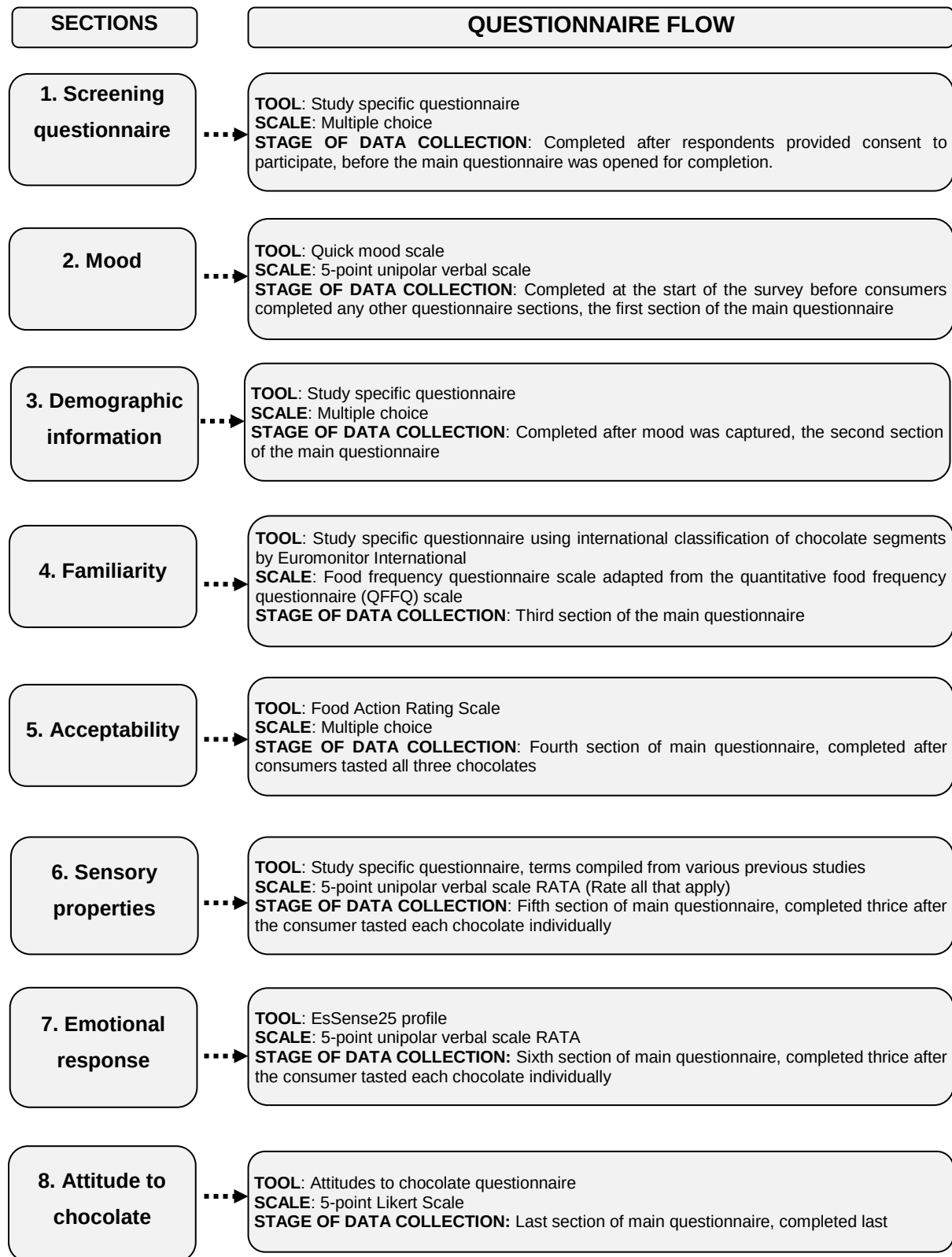


Figure 1. Sections of the research questionnaire

2.4 Data analysis

An exploratory factor analysis of the results was performed using the Principal component method of extraction for the data set to reduce and group the number of variables and to create pattern matrixes for the variables of sensory attributes, emotion attributes, mood, familiarity and attitude. An Oblimin rotation was performed since factors were expected to be correlated. This resulted in the extraction of two factors for sensory attributes, namely sweet and bitter, two for mood, namely positive and negative, two for familiarity, namely small chocolates and large chocolates, and four for attitude, namely negative, functional, emotional and obsession. The internal consistency of all factors was high, with acceptable Cronbach's Alpha's for all factors ($\alpha \geq 0.6$ which is regarded as acceptable according to Hair (2006)).

In order to determine and represent the relationships between the variables and their factors investigated in this study, structural equation modelling (SEM) was employed, as it is a method regularly used for representing dependency or causal relationships in multivariate data, or to represent, estimate and test a network of relationships (dependent or causal) between variables (both measured variables and latent constructs) in multivariate data in social sciences (Bag, 2015). SEM addresses primarily two objectives: 1) To understand the patterns of correlation or covariance among a set of variables, and 2) To explain as much of their variance as possible with the specified model (Kline, 2011). The purpose of the model, furthermore, in the most common form of SEM, is to account for variation and covariation of the measured variables (Kline, 2011).

Three SEM's were prepared, firstly through positive (Figure 1) and negative (Figure 2) emotion lenses, after which a combined positive and negative emotion model was constructed (Figure 3). The preparation of the positive and negative SEM's fulfilled one objective of a greater research study, during which the emotional chocolate eating experience was also investigated and described. That investigation revealed that the experience is mainly positive with low incidence of reported negative emotion, and through correlation analysis between emotion and the other variables investigated in the study (sensory attributes, mood, familiarity, acceptability and attitude), it was further revealed that significant ($P \leq 0.05$) relationships exist between these variables and positive or negative emotion, and that these relationships were unique. This existence of these significant ($P \leq 0.05$) relationships between the numerous studied concepts (as found in the greater study which was conducted) serves as justification for the conceptualisation of the model in this study, and the possible existence of multiple

dependencies as justification for the inclusion of all factors under investigation in the construction of the model. However, as some of these identified relationships were unique to either positive or negative emotion, combining positive and negative emotion data to prepare a combined SEM would have had a dilutive effect or would have masked some of these relationships. The unique statistically significant ($P \leq 0.05$) relationships were indicated between some of the selected variables on both an individual attribute and a factor level; however, to uncover the overall relationships between the various concepts, only factors were included in the SEM as the number of individual attributes linked to the various concepts included in the study was too extensive to consider. After the SEMs had been prepared for positive and negative emotion, a combined positive and negative model (Figure 3) was constructed based on the output of these SEMs.

3. Results

3.1 Positive emotion model

3.1.1 Positive emotion model fit indices

Fit indices determine how well a model fits the sample data (McDonald & Ho, 2002) and demonstrate which of the various proposed models has the most superior fit. As it is considered good practice to report multiple fit indices (Hancock et al., 2010), the RMSEA, CMIN/DF, and CFI were determined for the models. Firstly, the RMSEA was calculated as in recent years it has become regarded as one of the most informative fit indices due to its sensitivity to the number of estimated parameters in the model (Diamantopoulos et al., 2000). The RMSEA indicates how well the model, with unknown but optimally chosen parameter estimates, would fit a population's covariance matrix (Byrne, 2013), and is related to residual in the generated model. In a well-fitting model the RMSEA lower limit is close to 0, and the acceptable model fit is indicated by an RMSEA value of 0.06 or less (Hu & Bentler, 1999), as a smaller RMSEA value indicates better model fit. MacCallum et al. (1996) used 0.01, 0.05, and 0.08 to indicate excellent, good, and mediocre fit respectively but clearly emphasised the arbitrariness in the choice of cut-off points. Blunch (2012), however, stated that models with RMSEA values of 0.10 and larger should not be accepted. The results of the SEM (Figure 1) based on positive emotion resulted in an RMSEA of 0.086 with a 90% confidence interval which is a mediocre but acceptable fit.

Furthermore, the CMIN/DF (Chi-square or minimum discrepancy) divided by DF (degrees of freedom) was calculated to determine the goodness of fit, as suggested by Mueller (1999). The

Chi-square test is viewed by some as an overly strict indicator of model fit, given its power to detect even trivial deviations from the proposed model (Hancock et al., 2010). Wheaton et al. (1977) suggested a ratio of approximately five or less “as beginning to be reasonable”; however, Mueller (1999) stated that the interpretation of this value depends on the viewpoint of the researcher. In practice some would thus interpret ratios as high as three, four or even five as still representing a good model fit. The model (Figure 1) yielded a Minimum Sample Discrepancy divided by Degrees of Freedom (CMIN/DF) value of 4.284 which is thus viewed as a good fit.

Lastly, the Comparative Fit Index (CFI) was calculated (Bentler, 1990), a revised form of the NFI (normed fit index) which takes into account sample size (Byrne, 2013) and thus performs well even when the sample size is small (Tabachnick et al., 2007). It is in essence equal to the discrepancy function adjusted for sample size. A cut-off criterion of $CFI \geq 0.90$ was initially suggested (Hu & Bentler, 1999); however, recent studies have shown that a value greater than 0.90 is needed in order to ensure that miss-specified models are not accepted (Hu & Bentler, 1999). From this, a value of $CFI \geq 0.95$ is presently recognised as indicative of good fit (Hu & Bentler, 1999). Mueller (1999) also described values of above 0.9 as indicative of a good overall fit for a Comparative Fit Index. A relatively lower Comparative Fit Index (CFI) of 0.847 was found for the model.

In Table 2, the output of the SEM is reported including the RMSEA, CMIN/DF and CFI, and based on these three parameters results, the overall fit of the model was regarded as satisfactory to proceed.

Table 2. Fit indices of SEM of sensory and consumer behaviour variables and positive emotion

	RMSEA	CMIN/DF	CFI
Default model	.086	4.284	.847

Notes: RMSEA indicates how well the model would fit a population’s covariance matrix, values of 0.10 and larger are not accepted; CMIN/DF determines goodness of fit and five or less is reasonable; CFI is a revised NFI taking into account sample size, and a value above 0.95 is indicative of good fit.

3.1.2 Results of SEM analysis of positive emotion model

CFI was relatively low, however, as it was close to 0.9 and RMSEA and CMIN/DF was satisfactory, parameter estimates were further examined through regression analysis. Table 3 contains the results of the SEM, including standardised and unstandardised regression weights, standard error (S.E.), critical ratios (C.R.) and *P*-values.

Table 3. Results of the SEM for the positive emotion model

Dependent variable	Independent variable	Unstandardised regression weight	Standardised regression weight (β -value)	S.E.	C.R.	<i>P</i> -value
Positive emotion	Acceptability	0.067	0.136	0.026	2.585	$P \leq 0.01$
Positive emotion	Attitude	0.510	0.106	0.313	1.629	0.103
Positive emotion	Familiarity	0.414	0.127	0.171	2.420	$P \leq 0.01$
Positive emotion	Positive mood	0.304	0.193	0.074	4.095	$P \leq 0.01$
Positive emotion	Negative mood	0.172	0.062	0.135	1.274	0.203
Positive emotion	Sensory sweet	0.038	0.024	0.080	0.473	0.636
Positive emotion	Sensory bitter	0.086	0.067	0.064	1.348	0.178

Notes: Standardised regression weight: $\beta \geq 0.8$ =Significant influence of the independent variable on the dependent variable, $\beta \geq 0.5$ Moderate influence, $\beta < 0.2$ Small influence, $\beta \geq 0.4$ Viewed as practically significant; S.E.=Approximate standard deviation, High S.E. value=Low fit, low S.E. value=High fit; C.R.=Ratio of any one deviation of the observed value from the mean to the standard deviation, if C.R.>1.96 for a regression weight path is significant at the .05 level or better; *P* values: *Statistically significant at the $P \leq 0.05$ level (2-tailed), **Statistically significant at the $P \leq 0.01$ level (2-tailed).

Regression weights can be standardised or unstandardised. Unstandardised coefficients are raw coefficients produced by regression analysis performed on original data with unstandardised variables and can be used for prediction of the dependent variable. Standardised regression coefficients (or β -coefficients) are transformations of unstandardised estimates, which are standardised so that the variances of dependent and independent variables are and give an indication of the importance of predictors. The standardised β -coefficient represents the importance of the independent variables (familiarity, positive mood, negative mood, bitter sensory, sweet sensory, acceptability and attitude) in relation to the dependent variable (positive emotion) (Schneider *et al.*, 2010). Larger coefficient values point to a larger effect of the one variable on the other. If $\beta \geq 0.8$, there is a significant influence of the independent variable on the dependent variable, while if it is $\beta \geq 0.5$, there is a moderate

influence. A $\beta \geq 0.2$ indicates a small influence. A $\beta \geq 0.4$ was, however, viewed as a practically significant contribution in this study. For the regression weights of the variables concerning positive emotion, none of the β -coefficients was above 0.2, and thus none of the variables had a strong unique influence on positive emotion. All regression weights were, however, positive and thus all relationships of the variables with positive emotion were in the same direction.

The standard error (S.E.) is the approximate standard deviation of a statistical sample population and measures the accuracy with which a sample represents a population. It indicates how far a data point is from the regression line on average and indicates how precise a model's prediction is in using the units of the dependent variable. A high S.E. value indicates a low fit; while a low S.E. value indicates a high fit. The highest S.E. and thus lowest fit was noted for attitude concerning positive emotion, while the lowest S.E. and thus highest fit was indicated for acceptability.

The maximum likelihood test statistic is the critical ratio (C.R.), for which the P -value was also calculated to determine significance. Positive mood, familiarity and acceptability were the only variables that had a statistically significant unique influence on positive emotion.

3.1.3 Covariance and correlations of the positive emotion model

As the independent variables in this model covariate, various positive and negative correlations between these variables are included in the model. Covariances are the measure of the strength of a linear relationship between two continuous random variables, because if one variable increases as the other decreases, the two variables covary. The covariance also determines the direction of the linear relationship between two variables. The correlation coefficient is a standardised measure of covariance and can range between -1.0 to 1.0, whereby a correlation of -1.0 indicates a perfect negative correlation, and a correlation of 1.0 indicates a perfect positive correlation.

In Table 4, the significant ($P \leq 0.05$) relationships between the variables are reported, which were both positive and negative within the positive emotion model. A negative correlation coefficient with $P \leq 0.05$ exists between negative mood and acceptability (correlation coefficient=-0.097), and between acceptability and bitter sensory (correlation coefficient=-0.251), and thus the relationship between acceptability and bitter sensory is stronger than between acceptability and negative mood and is the strongest inverse relationship. A positive correlation coefficient with

$P \leq 0.05$ exists between familiarity and attitude (correlation coefficient=0.347) and between acceptability and familiarity (correlation coefficient=0.123), with the familiarity-attitude relationship being the stronger. Positive coefficients also exist between sensory sweet and acceptability, with a correlation coefficient of 0.346. Attitude, furthermore, has three positive correlation coefficients with negative mood (correlation coefficient=0.184), sweet sensory (correlation coefficient=0.170), and sensory bitter (correlation coefficient=0.132), indicating that of the three variables, negative mood has the stronger relationship with attitude. Lastly, a positive correlation coefficient (0.163) was noted between negative mood and bitter sensory. The overall strongest of the positive relationships were between familiarity and attitude (0.347).

Table 4. Covariance and correlations between independent variables of the positive emotion model

Independent variables		Covariance				Correlation
Variable 1	Variable 2	Estimate	S.E.	C.R.	P-value	Coefficient
Familiarity	Attitude	0.021	0.007	3.067	$P \leq 0.01$	0.347
Acceptability	Familiarity	0.073	0.032	2.292	$P \leq 0.05$	0.123
Negative mood	Acceptability	-0.068	0.034	-2.015	$P \leq 0.05$	-0.097
Sensory sweet	Acceptability	0.433	0.065	6.679	$P \leq 0.01$	0.346
Acceptability	Sensory bitter	-0.378	0.076	-4.968	$P \leq 0.01$	-0.251
Negative mood	Attitude	0.013	0.005	2.705	$P \leq 0.01$	0.184
Sensory sweet	Attitude	0.022	0.009	2.557	$P \leq 0.05$	0.170
Sensory bitter	Attitude	0.021	0.010	2.112	$P \leq 0.05$	0.132
Negative mood	Sensory bitter	0.044	0.013	3.289	$P \leq 0.01$	0.163

Notes: Estimate indicates contribution to model; S.E.=Approximate standard deviation - High S.E. value=Low fit, Low S.E. value=High fit; C.R.=Ratio of any one deviation of the observed value from the mean to the standard deviation, if $C.R. > 1.96$ for a regression weight path is significant at the .05 level or better; only $P \leq 0.5$ (statistically practical significant) is reported; Correlation coefficient of -1.0 indicates a perfect negative correlation, and a correlation of +1.0 indicates a perfect positive correlation.

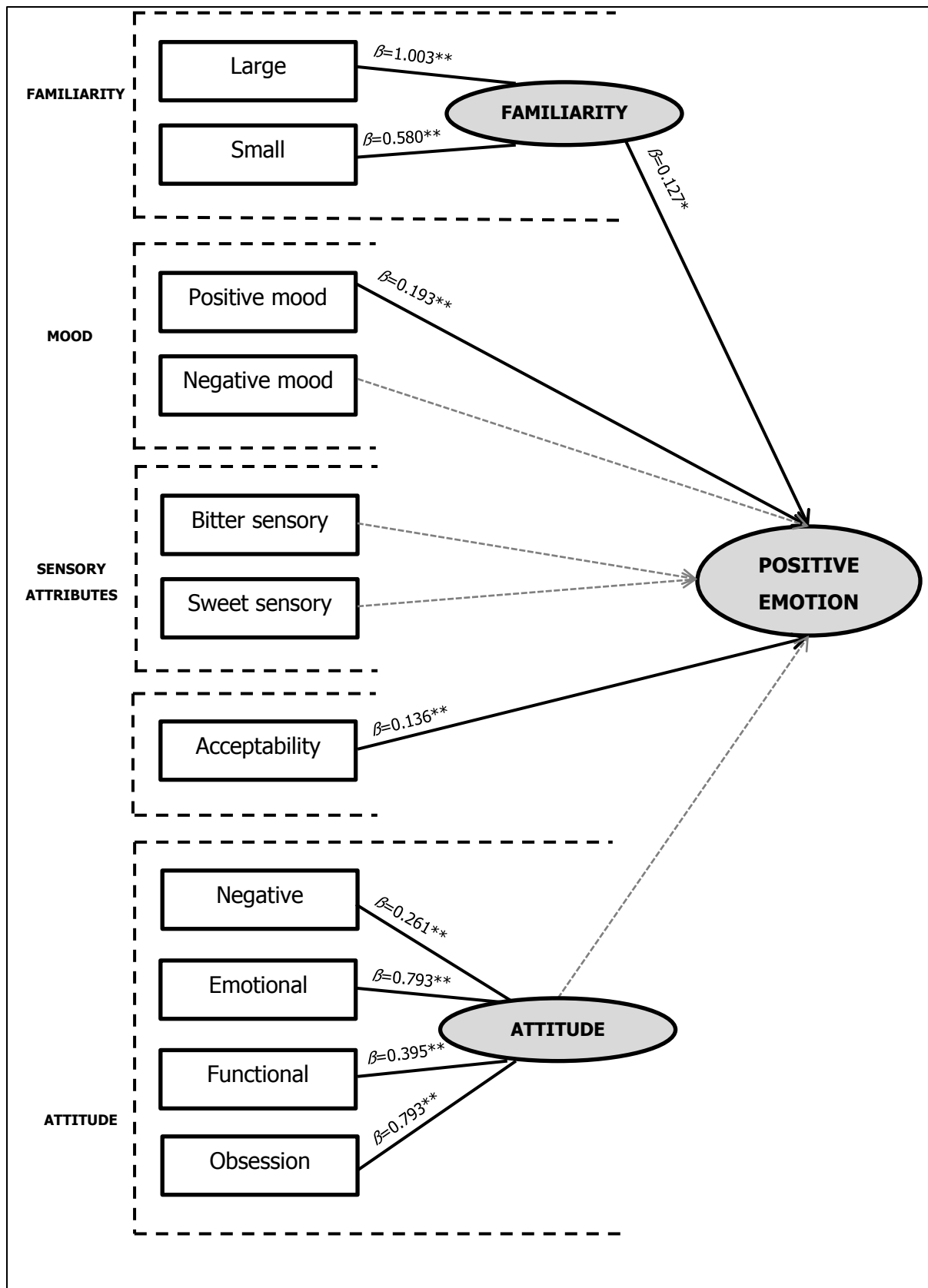
3.1.4 Squared multiple correlations of measured variables of the positive emotion model

Boomsma (2000) advises that in structural equation modelling, squared multiple correlations of each equation should be reported. As the SEM depicts a system of regression equations (Molenaar *et al.*, 2000), a squared multiplied correlation “R-square” is associated with the error term in each equation. The error terms represent the portion of the variables that are not

explained. In this SEM, an R-square of 0.107 was indicated for positive emotion, thus indicating that the model explains 10.7% of the overall variation, a medium effect.

3.1.5 Positive emotion model

The structural model of positive emotion along with sensory and behaviour factors constructed based on Beta (β) coefficients, is indicated in Figure 2. The relationships between exogenous variables are indicated in Table 4 and are not indicated in the model as the objective was for the model to capture the relationship between emotion and other variables. Practical significance (P -value) was determined on a 5% and 10% level due to the small sample size (Ellis & Steyn, 2003).



Notes: *P* values: Only significant ($P \leq 0.10$ or $P \leq 0.05$) relationships are indicated, *Statistically

significant at the $P \leq 0.10$ level (2-tailed), **Statistically significant at the $P \leq 0.05$ level (2-tailed); Non-significant regression weights are represented with dashed lines. Beta (β) coefficient: $\beta \geq 0.2$ =Small influence; $\beta \geq 0.5$ =Moderate influence; $\beta \geq 0.4$ =Practically significant.

Figure 2. SEM of positive emotion, sensory properties and consumer behaviour variables

3.2 Negative emotion model

3.2.1 Negative emotion model fit indices

In Table 5, the output of the SEM for the negative emotion model is reported. The results of the SEM based on negative emotion resulted in an RMSEA of 0.087 with a 9% confidence interval which is a mediocre fit and is comparable to the RMSEA of 0.086 of the positive model. The CMIN/DF resulted in a ratio of 4.389, also similar to that of the positive emotion model (at 4.284), and this result is also reasonable. The CFI of 0.839 is relatively lower and is comparable to the CFI of the positive model (0.847).

Table 5. Fit indices of SEM of all variables and negative emotion

	RMSEA	CMIN/DF	CFI
Default model	0.087	4.389	0.839

Notes: RMSEA indicates how well the model would fit a population's covariance matrix, values of 0.10 and larger are not accepted; CMIN/DF determines goodness of fit and five or less is reasonable; CFI is a revised NFI taking into account sample size, and a value above 0.95 is indicative of good fit.

3.2.2 Results of SEM analysis of the negative emotion model

CFI was relatively low, however, as it was close to 0.9 and RMSEA and CMIN/DF were satisfactory, parameter estimates were further examined through regression analysis. Table 6 contains the results of the SEM, including standardised and unstandardised regression weights, standard error (S.E.), critical ratios (C.R.) and P -values.

Table 6. Results of the SEM of the negative emotion model

Dependent variable	Independent variable	Unstandardised regression weight	Standardised regression weight (β -value)	S.E.	C.R.	P- value
Negative emotion	Acceptability	-0.017	-0.058	0.016	-1.085	0.278
Negative emotion	Attitude	0.184	0.065	0.180	1.021	0.307
Negative emotion	Familiarity	-0.053	-0.027	0.102	-0.524	0.600
Negative emotion	Positive mood	0.025	0.027	0.045	0.555	0.579
Negative emotion	Negative mood	0.061	0.037	0.082	0.746	0.455
Negative emotion	Sensory sweet	0.004	0.004	0.048	0.075	0.941
Negative emotion	Sensory bitter	0.152	0.200	0.039	3.933	$P \leq 0.01$

Notes: Standardised regression weight: $\beta \geq 0.8$ =Significant influence of the independent variable on the dependent variable, $\beta \geq 0.5$ =Moderate influence, $\beta < 0.2$ =Small influence, $\beta \geq 0.4$ =Viewed as practically significant; S.E.=Approximate standard deviation, High S.E. value=Low fit, Low S.E. value=High fit; C.R.=Ratio of any one deviation of the observed value from the mean to the standard deviation, If C.R.>1.96 for a regression weight path is significant at the .05 level or better; P values: *Statistically significant at the $P \leq 0.05$ level (2-tailed), **Statistically significant at the $P \leq 0.01$ level (2-tailed).

Although only sensory bitter has a statistically significant effect on negative emotion, standardised regression weights between the variables of attitude and familiarity are comparable to those of the positive emotion model, with small differences in values, both larger and smaller than the negative model. Variables with a smaller overall influence in the negative model compared to the positive model include functional attitude, emotional attitude and small familiarity, while obsession attitude and large familiarity had a larger influence in the negative model.

As furthermore indicated in Table 6, based on standardised regression weights, bitter sensory variables had a statistically significant meaningful individual correlation ($\beta = 0.2$, $P \leq 0.01$) with negative emotion which indicates a small influence, while the positive emotion model had no meaningful correlations (as all β values were below 0.2).

S.E. values indicate a high fit between negative emotion and acceptability and a low fit between negative emotion and attitude. Only negative emotion and sensory bitter variables had a C.R. value above 1.96 and are thus significant ($P \leq 0.05$).

3.2.3 Covariance and correlations of the negative emotion model

Positive coefficients also exist between sensory sweet and acceptability, with a correlation coefficient of 0.346, in line with the correlations noted in the positive model. Attitude furthermore has three positive correlation coefficients with negative mood (correlation coefficient=0.183, slightly weaker than in the positive model), sweet sensory (correlation coefficient=0.170 in line with the positive model), and sensory bitter (correlation coefficient=0.132, also in line with the positive model), indicating that of the three variables, negative mood has the stronger relationship with attitude. Lastly, a positive correlation coefficient (0.163) was noted between negative mood and bitter sensory, also in line with the positive model. The strongest of the positive relationships were between familiarity and attitude.

Table 7. Covariance and correlations between independent variables of the negative emotion model

Independent variables		Covariance				Correlation
Variable 1	Variable 2	Estimate	S.E.	C.R.	P-value	Coefficient
Familiarity	Attitude	0.021	0.007	2.927	$P \leq 0.01$	0.345
Acceptability	Familiarity	0.066	0.031	2.158	$P \leq 0.05$	0.115
Negative mood	Acceptability	-0.068	0.034	-2.015	$P \leq 0.05$	-0.097
Sensory sweet	Acceptability	0.434	0.065	6.680	$P \leq 0.01$	0.346
Acceptability	Sensory bitter	-0.378	0.076	-4.968	$P \leq 0.01$	-0.251
Negative mood	Attitude	0.013	0.005	2.693	$P \leq 0.01$	0.183
Sensory sweet	Attitude	0.022	0.009	2.553	$P \leq 0.05$	0.170
Sensory bitter	Attitude	0.021	0.010	2.110	$P \leq 0.05$	0.132
Negative mood	Sensory bitter	0.044	0.013	3.289	$P \leq 0.01$	0.163

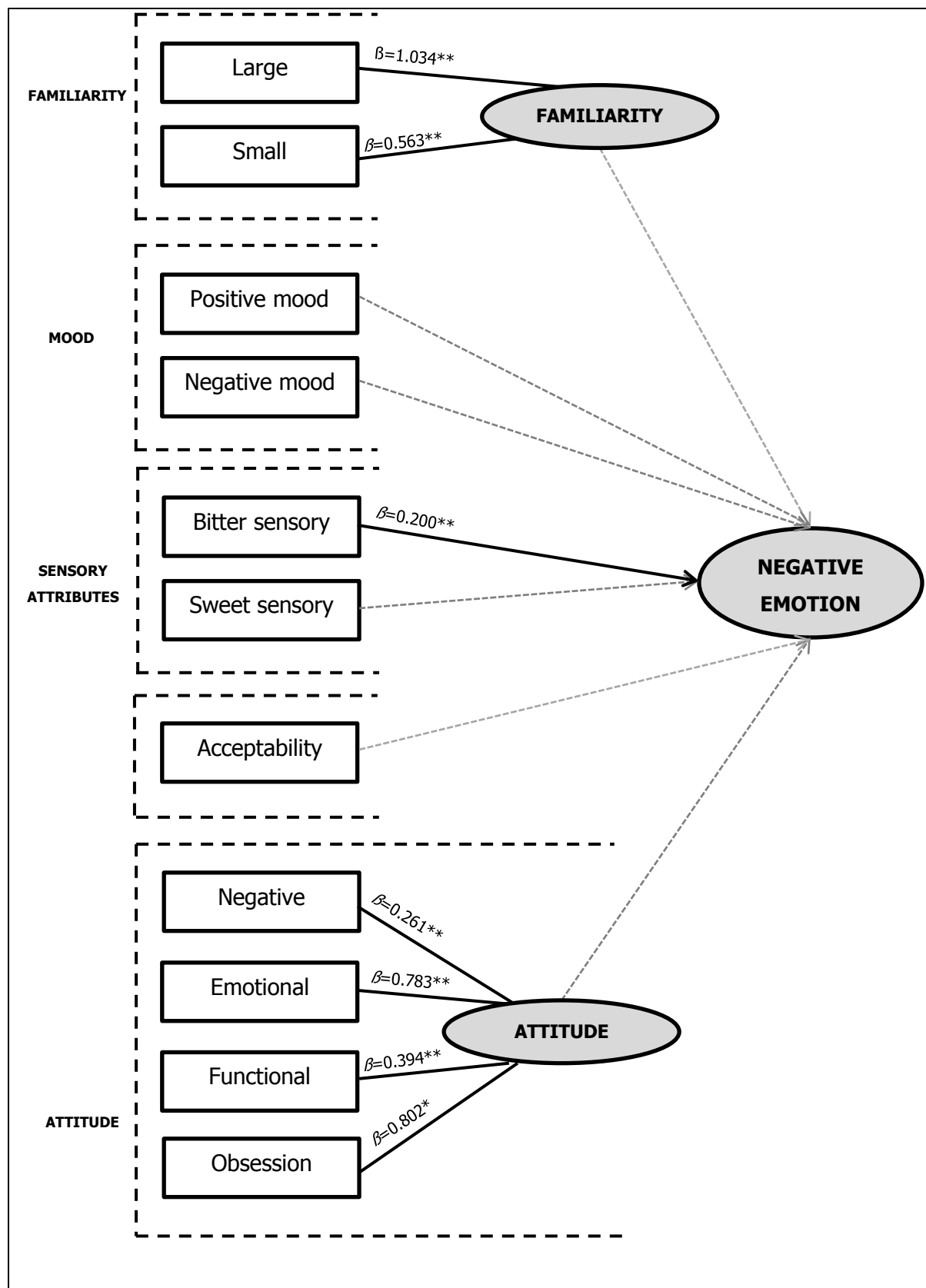
Notes: Estimate indicates contribution to model; S.E.=Approximate standard deviation - High S.E. value=Low fit, Low S.E. value=High fit; C.R.=Ratio of any one deviation of the observed value from the mean to the standard deviation, if C.R.>1.96 for a regression weight path is significant at the 0.05 level or better; only $P \leq 0.5$ (statistically practical significant) is reported; correlation coefficient of -1.0 indicates a perfect negative correlation, and a correlation of +1.0 indicates a perfect positive correlation.

3.2.4 Squared multiple correlations of measured variables

In this SEM, an R-square of 0.061 was indicated for negative emotion, thus indicating that the model explains 6.1% of the overall variation, a small effect.

3.2.5 Negative emotion model

The structural model of positive emotion along with sensory and behaviour factors constructed based on Beta (β) coefficients, is indicated in Figure 3. The relationships between exogenous variables are indicated in Table 8 and are not indicated in the model.



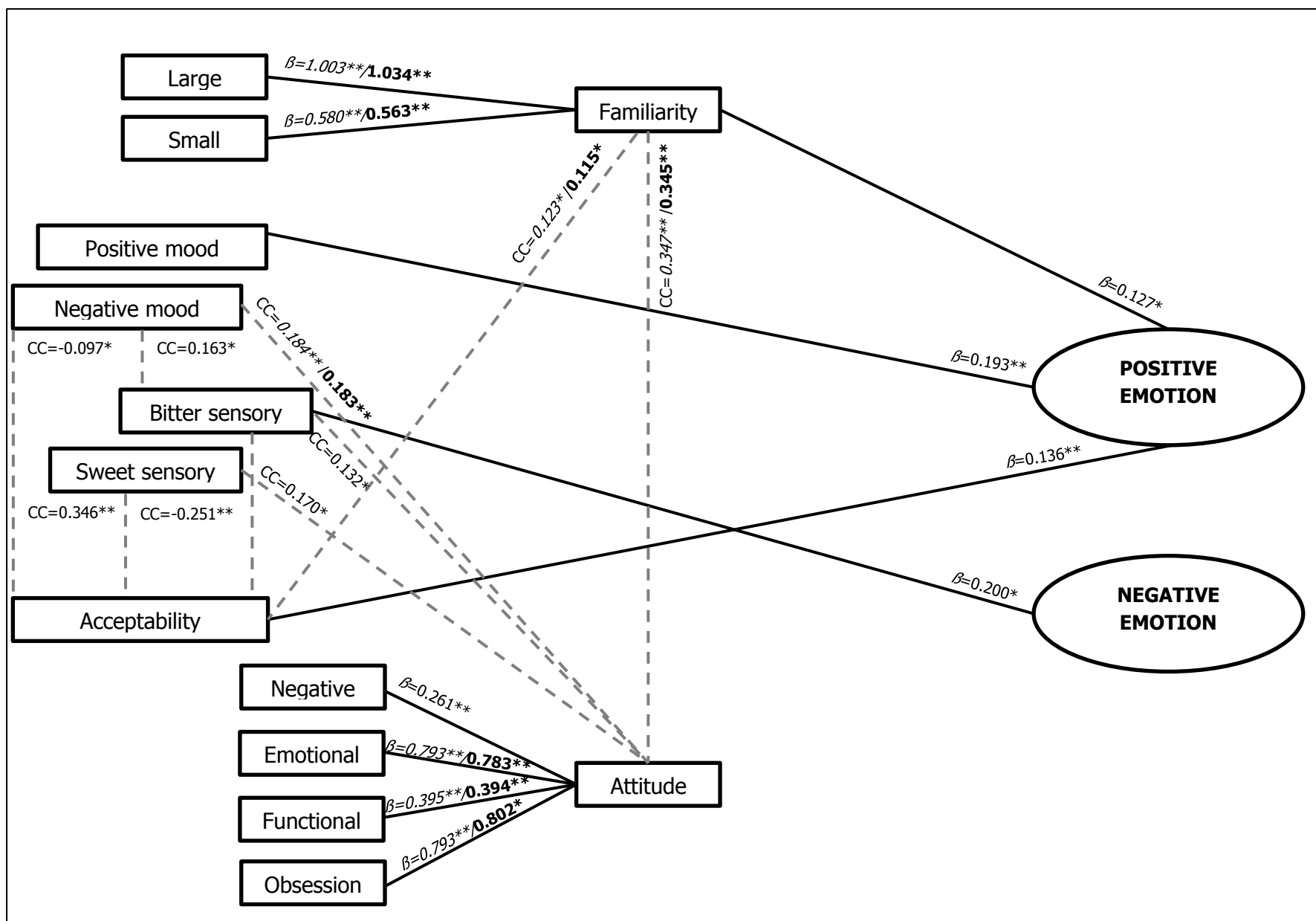
Notes: *P* values: Only significant ($P \leq 0.10$ or $P \leq 0.05$) relationships are indicated; *Statistically

significant at the $P \leq 0.10$ level (2-tailed), **Statistically significant at the $P \leq 0.05$ level (2-tailed); Non-significant regression weights are represented with dashed lines; Beta (β) coefficient: $\beta \geq 0.2$ =Small influence; $\beta \geq 0.5$ =Moderate influence; $\beta \geq 0.4$ =Practically significant.

Figure 3. SEM of negative emotion, sensory properties and consumer behaviour variables

3.3 Constructed model of positive and negative emotion

Figure 4 captures both the significant ($P \leq 0.10$ and $P \leq 0.05$) effects of all variables on both positive and negative emotions and the associated Beta (β) values as an output of the SEMs, as well as the significant ($P \leq 0.05$ and $P \leq 0.01$) correlation coefficients between the variables and their factors.



Notes: P -values related to Beta (β) coefficients: Only significant ($P \leq 0.10$ or $P \leq 0.05$) relationships are indicated; *Statistically significant at the $P \leq 0.10$ level (2-tailed), **Statistically significant at the $P \leq 0.05$ level (2-tailed); P -values related to correlation coefficients: Only significant ($P \leq 0.05$ or $P \leq 0.01$) relationships are indicated; *Statistically significant at the $P \leq 0.05$ level (2-tailed), **Statistically significant at the $P \leq 0.01$ level (2-tailed); Beta (β) coefficient: $\beta \geq 0.2$ =Small influence; $\beta \geq 0.5$ =Moderate influence; $\beta \geq 0.4$ =Practically significant; Contribution of variables to emotion represented as β -values are indicated with solid lines, correlation coefficients (CC) between variables are indicated with dashed lines; Where CC's between variables are different for the positive and negative emotion model, the positive emotion model values are indicated in italics, and the negative emotion model values are indicated in bold.

Figure 4. Constructed model of positive emotion, negative emotion, sensory properties and consumer behaviour variables

4. Discussion

4.1 Positive emotion model

The SEM of positive emotion indicates that positive mood had the largest statistically significant effect on positive emotion of all the variables ($\beta = 0.193$, $P \leq 0.05$), although this effect has a β -value below 0.2. Consumers who are in a positive mood when they consume chocolate are thus more likely to experience positive emotion during consumption. This is followed by acceptability ($\beta = 0.136$, $P \leq 0.05$), which indicates that consumers are more likely to have a positive emotional experience with chocolate if they find it acceptable. Familiarity was also indicated to have a small effect on positive emotion ($\beta = 0.127$, $P \leq 0.10$). Negative mood, bitter sensory, sweet sensory and attitude made nonsignificant contributions to positive emotion, and these variables are thus unlikely to evoke or influence a positive emotional experience.

4.2 Negative emotion model

The SEM of negative emotion indicates that bitter sensory had only statistically significant effect on negative emotion of all the variables ($\beta = 0.200$, $P \leq 0.05$), although this effect is small ($\beta \geq 0.2$ - < 0.5). Chocolate with high bitterness is thus more likely to evoke a negative emotional experience for a consumer during consumption. Familiarity, positive mood, negative mood, sweet sensory, acceptability and attitude made non-significant contributions to negative emotion, and these variables are thus unlikely to evoke or influence negative emotional experience.

4.3 Constructed model of positive and negative emotion

Certain consumer behaviour variables (positive mood, familiarity and acceptability) affect positive emotion, while none of the consumer behaviour variables affects negative emotion. The remaining consumer behaviour variables included in the SEM (negative mood and attitude) had no effect on either positive or negative emotion. Of the sensory attributes, the bitter attributes had an effect on negative emotion only, while sweet sensory attributes do not affect either positive or negative emotion. It was noted that the β -coefficient values were higher for the variable (bitter) which affected negative emotion (bitter sensory $\beta=0.200$) than for the variables (mood, acceptability and familiarity) which had an effect on positive emotion (positive mood $\beta=0.193$, acceptability $\beta=0.136$ and familiarity $\beta=0.127$), indicating that the strength of the effect of bitter sensory on negative emotion was higher.

Three of the four variables which had an effect on emotion (familiarity, acceptability, bitter sensory) were, however, significantly ($P \leq 0.05$ or $P \leq 0.01$) correlated to other variables in the model indicating that other variables in the model may have indirectly influenced the variables which directly affect emotion.

Familiarity, which had an effect on positive emotion, was significantly positively correlated to acceptability (correlation coefficient in positive model = 0.123, $P \leq 0.05$) and attitude (correlation coefficient in positive model = 0.347, $P \leq 0.01$); however, familiarity most likely influenced acceptability (as familiarity leads to acceptability (Gibson, 2006)) and attitude (as through associated learning, consumers developed attitudes towards food products (Jiang *et al.*, 2014)), and these two variables likely did not have an indirect impact on positive emotion.

Acceptability, which also had an effect on positive emotion, significantly ($P \leq 0.05$ or $P \leq 0.01$) positively correlated with familiarity (correlation coefficient in positive model = 0.123, $P \leq 0.05$) which as stated above most likely influenced acceptability as familiarity leads to acceptability (Gibson, 2006). It was also significantly positively correlated to sweet sensory (correlation coefficient in positive model = 0.346, $P \leq 0.01$) and significantly negatively correlated to bitter sensory (correlation coefficient in positive model = -0.251, $P \leq 0.01$); however, the correlation coefficient value of sweet sensory was higher than that of bitter sensory. This might suggest that a sweeter or less bitter product is more likely to influence acceptability, which in turn affects positive emotion. According to Leite *et al.* (2013), sweetness presents a high negative correlation with bitterness, and chocolate samples with a higher intensity of bitterness obtained

lower sweetness ratings. Respondents in sensory research studies have, however, indicated that they found the balance between the sweet and bitter taste to be of importance (De Pelsmaeker *et al.*, 2017), and thus the extent of sweetness or bitterness may not be as relevant as the overall sensory experience based on this relationship. Thus, both the sweet and bitter sensory variables are equally important in influencing acceptability.

Bitter sensory is indicated as a variable which might have a positive effect on negative emotion and was significantly positively correlated to negative mood (correlation coefficient in negative model=0.163, $P \leq 0.01$). Mood was included as the first variable in the questionnaire and was thus measured before any other questions might have influenced the respondents. Mood is not focused on a referent (King and Meiselman (2010); Ferdenzi *et al.* (2013) and is not in response to a specific thing (Meiselman, 2015), and it is thus unlikely that bitter sensory influenced mood, but rather that a negative mood resulted in a bitter sensory experience. It has been said that sensory experience is crucial in affecting emotions, and that sensory stimulus is a critical antecedent of consumer emotions. However, they are closely intertwined, affecting one another in both directions (Pishghadam & Shayesteh, 2017). As emotion is a component of a larger group of reactions known as affective feelings which also includes moods (Meiselman, 2015), and specific emotions present themselves as moods (Ekman, 1992; Frijda, 1993), it can be concluded that mood could have influenced the experience of the bitter sensory variable and in turn emotion.

Bitter sensory was also significantly positively correlated to attitude (correlation coefficient in negative model=0.132, $P \leq 0.05$), a variable that was also classified as an affective feeling (Meiselman, 2015), and thus this relationship can also be interpreted in both directions. Learning theories that relate to attitude formation include classical conditioning, instrumental conditioning and cognitive learning theory (Schiffman *et al.*, 2008; Mpinganjira *et al.*, 2013; Botha *et al.*, 2019), and instrumental conditioning is when the consumer is satisfied with the performance of an unknown, newly purchased or used brand, product or category, and then a favourable attitude is likely to be developed for it. Eagly and Chaiken (1993) stated that attitudes are a tendency to evaluate a target object with some degree of favour or disfavour, and are based on emotional reactions, behaviours toward and cognitive evaluations of the object. The evaluation of the chocolates and the experience of the bitter factor could thus have influenced attitude formation.

Bitter sensory was lastly also significantly positively correlated to familiarity (correlation coefficient in negative model=0.132, $P \leq 0.05$), however, as with mood, familiarity was captured early in the questionnaire and could thus not have been influenced by the bitterness of the chocolates. Familiarity has been found to have an important bearing on consumer experience (Sester *et al.*, 2013) as it creates knowledge of products and brands which could influence products' sensory profiles (Schiffman & Kanuk, 2010; Stolzenbach *et al.*, 2013; Crocker & Thomson, 2014; Spinelli *et al.*, 2015; Thomson & Crocker, 2015). Familiarity could thus have been a frame of reference within which the sensory attributes and thus, the bitterness of the products was evaluated.

5. Conclusion

Using structural equation modelling and multiple regression analysis, this analysis validates the concept model and verifies that in this study a possible relationship exists between sensory properties, consumer behaviour variables and emotional response, with similar conclusions reached by other researchers (mentioned in the introduction). Based on model fit values, when combined, all measured variables have a meaningful relationship with one another as well as with a positive and negative emotional experience. Relationships between the variables in the negative model and positive model were similar with small differences in β -values, and thus relationships are consistent irrespective of the emotional experience.

In the positive emotion model, positive mood most affected positive emotion, followed by acceptability and familiarity, while in the negative emotion model, bitter sensory correlated most with negative emotion. These variables were in turn significantly correlated to other variables included in the SEM identified to play an indirect role in the effect of the variables on emotion.

6. References

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CHAPTER 9

SUMMARY AND CONCLUSION

9.1 INTRODUCTION

One of the challenges facing consumer scientists is to provide actionable information to guide product formulation design which will fit consumer demands (Agudelo *et al.*, 2015), and not only to provide product descriptions (Moskowitz & Hartmann, 2008; Ares *et al.*, 2014). The identification of a product formulation that is aligned with consumer preferences during the product development process is very important for the food industry (van Kleef *et al.*, 2006), and requires a solid understanding of consumers' perception of products, both from a sensory and hedonic point of view (Worch, 2012). While questions regarding the sensory properties of products have traditionally been included in consumer tests alongside overall liking questions in order to provide information which can guide product design (Meilgaard *et al.*, 2006), some researchers have started tapping into the field of emotion measurement to explain these likes and dislikes. The industry is only now moving towards harnessing product-related emotions for competitive advantage (Thomson *et al.*, 2010). Very few studies have, however, explored the relationship between emotion and the sensory properties of food, although sensory properties have been indicated as one of the sources of food emotion (Desmet & Schifferstein (2008). Furthermore, a limited number of studies have investigated the relationship between consumer behaviour variables such as mood, familiarity, product acceptability and attitude, and emotional response, and none have extended this to the emotional response to sensory properties.

Most studies investigate emotion, sensory properties and consumer behaviour in isolation. Investigating and describing these relationships for a product such as chocolate, which has been proven to be highly associated with emotion, can provide insight into the role of emotion and consumer behaviour in shaping the response of consumers to food products and sensory properties. This study aimed to provide a view on the emotions which most influence product acceptance, the relationships of these emotions with the sensory properties of a food product, and how internal consumer behaviour variables could influence emotional response.

It was a quantitative, descriptive cross-sectional study implemented by means of an electronic questionnaire to collect quantifiable data in an attempt to describe the consumers' sensory and emotional experience with chocolate as well as acceptability of the chocolates evaluated, their mood, familiarity with and attitude towards chocolate. The relationships between these various constructs were determined. This study further aimed to supplement the existing international literature regarding the relationship between sensory properties and emotional response, as well as generate such data in a South African context. It furthermore addressed the gap in the literature about consumer behaviour in relation to emotional response in order to determine what role internal consumer behaviour variables play in the emotions experienced during the consumption of chocolate. This chapter contains an overall concluding discussion regarding the outcomes and findings of each objective of the study, which was addressed through the collection and analysis of data. This chapter will also report on contributions made by the study, observed limitations and recommendations, should similar studies be conducted in the future. The objectives for this study, as stated in Chapter 1, were as follows:

Literature-related objective

To conduct a literature review regarding emotion, emotional response to food products and specifically chocolate, emotion measurement, sensory science, consumer mood, familiarity, food acceptability as well as attitude.

Empirical objectives

Determine whether a relationship exists between:

1) Consumers' evaluation of the sensory properties of chocolate and consumers' emotional response to it in order to:

- a) Prepare a sensory profile for chocolate;
- b) Prepare an emotional profile for chocolate;
- c) Determine whether specific sensory properties can be linked to positive or negative emotions categories and specific emotions; and
- d) Compile a model indicating the relationship between the emotional response and the sensory properties of chocolate.

Determine whether a relationship exists between:

- 2) Consumers' mood and consumers' emotional response to chocolate;
- 3) Consumers' familiarity with chocolate and consumers' emotional response to it;

- 4) The acceptability of chocolate and consumers' emotional response to it;
- 5) Consumer's attitude towards chocolate and consumers' emotional response to it.

Implication-related objectives

Inform the emotion, sensory and consumer research community as to:

- a) Whether sensory properties can evoke specific emotions and thus whether products in the chocolate segment could be differentiated based not only on their sensory but also on their emotional profile;
- b) Whether a consumer's mood impacts a consumer's emotional response to a product or product category, and thus whether emotional response is not an isolated incident but is related to or impacted by other affective feelings;
- c) Whether usage frequency and thus familiarity impacts emotional response to chocolate;
- d) Whether acceptability of chocolate impacts the emotions experienced when consuming it, and thus which types of emotions (positive or negative), or which specific emotions are most influenced by acceptability;
- e) Whether a pre-existing attitude impacts a consumer's emotional response to a product or product category, and thus whether emotional response is not an isolated incident but is related to or impacted by other affective feelings; and
- f) Inform the commercial community how internal consumer behavioural variables influence emotional response, and how these could be incorporated in product development research methodologies in order to design products and marketing mixes that deliver against consumer expectations.

This chapter will be approached according to the objectives of the study. The discussion will start with the literature-related objectives, followed by the empirical objectives and lastly the implication-related objectives.

9.2 LITERATURE-RELATED OBJECTIVE

To conduct a literature review regarding emotion, emotional response to food products, specifically chocolate, emotion measurement, sensory science, consumer mood, familiarity, food acceptability and attitude.

To obtain a thorough understanding of the study elements, an in-depth literature review was conducted (Chapter 2), which provided a review of the most important and critical aspects of the

current knowledge on the various topics under investigation (Onwuegbuzie & Frels, 2016), namely emotion and emotion research, sensory evaluation, and consumer behaviour, specifically literature related to mood, familiarity, acceptability and attitude. Applicable search words were used in various combinations in different online search engines, such as Ebscohost, Science Direct, One Search and Google Scholar. Subject-specific textbooks were also consulted, along with relevant recent grey literature (grey literature has been defined by the Luxembourg Convention on Grey Literature (1997/2012) as “*information produced on all levels of government, academics, business and industry in electronic and print formats not controlled by commercial publishing*”).

Upon analysis of the literature, a unique interpretation and comprehensive overview of various reviews were compiled. Through this literature review, the problem statement of the study was explored in terms of the current state of affairs regarding the subject at hand and previous research that had been conducted in the field. The literature study suggested the existence of relationships between emotional response and sensory properties of food; however, varied findings were reported from the numerous studies which were conducted. This relationship has been implied by some researchers and statistically proven by others, but these studies were conducted with diverse methodologies, tools and food (or beverage) products. This relationship has not been investigated extensively as the existence of a relationship between these two concepts is a recent discovery. The literature further implicated emotion within consumer behaviour, as the internal consumer behaviour variables which were explored in this study (mood, familiarity, acceptability and attitude) were reported to have an emotional basis or component. No reports were, however, found on the direct measurement of the relationship between emotional response and the internal consumer behaviour variables in question. The literature review enabled the researcher to design the study, report on the findings and arrive at conclusions in a scientific manner.

9.3 EMPIRICAL OBJECTIVES

9.3.1 Objective 1: Determine whether a relationship exists between consumers' evaluation of the sensory properties of chocolate and their emotional response to it

9.3.1.1 Objective 1a: Preparing a sensory profile for chocolate

In Chapter 4, sensory profiles were presented which were based on the mean sensory attribute ratings of the three chocolates. The combination of the profile of these three chocolates into one combined profile illustrated the variation in the sensory experiences between the

chocolates, driven by the intensity of the sensory attributes. It demonstrated that the objective set for the selection of the chocolates to be included in this study, which was for them to be varied in their sensory properties, was achieved. The different sensory profiles are in line with the study findings of Schouteten *et al.* (2015) who also selected diverse products where emotion and sensory terms were rated by consumers; it was subsequently reported that the sensory profiles of products evaluated were also varied and clearly defined. In this study, there was, however, similarities in the profiles of Canderel and Nestlé for some of the sensory attributes, only varying slightly in intensity to which the sensory attributes were experienced. The profiles of these two chocolates were found to be almost identical for the attributes mouth-coating, melting, adherence and burnt flavour, however significantly ($P \leq 0.05$) different for the other ten measured attributes. The profile of Canderel was, however, very different from those of Lindt and Nestlé for most attributes. It was concluded that unique sensory profiles could be prepared for the three chocolates.

9.3.1.2 Objective 1b: Preparing an emotional profile for chocolate

The sensory data revealed that the three chocolates varied in sensory attributes. Despite this variance, the emotional profiles of the three chocolates presented in Chapter 5 (which are based on mean emotion attribute ratings) indicate that the emotional experience of these chocolates during consumption was very similar. Schouteten *et al.* (2015) reported similar findings from a study they conducted, as a limited number of emotion terms differed between yoghurt samples studied although sensory profiles were clearly defined. The mean values of various emotions indicated for Canderel and Lindt were not significantly ($P \leq 0.05$) different, even though these chocolates had different sensory profiles, ingredients and propositions. The mean values of most emotions related to Nestlé were significantly different ($P \leq 0.05$) to the other two chocolates. It was concluded that emotional profiles could be prepared for the three chocolates; however, these profiles were similar.

9.3.1.3 Objective 1c: Determine whether specific sensory properties can be linked to specific emotions

The relationship between sensory and emotion attributes was reviewed based on individual attribute correlations which were reported in Chapter 6. All emotions except for understanding and guilty correlated significantly ($P \leq 0.05$) with various sensory attributes across the three chocolates, both with positive and negative correlation values. No single individual sensory attribute was, however, correlated to an individual emotion attribute across the chocolates.

Regarding specific sensory attribute categories, the aroma attribute had most correlations with emotion, followed by the visual attribute of gloss, while the correlation between texture attributes and emotions was limited. It was concluded that specific sensory properties could be linked to specific emotions, however, only for individual chocolates. Aroma and gloss attributes were most correlated to emotion attributes.

9.3.1.4. Objective 1c: Determine whether specific sensory properties can be linked to positive or negative emotions categories

The relationship between the sensory and emotion attributes was also investigated on a factor level, as reported in Chapter 6. Factor analysis (outlined in Chapter 4 and 5) resulted in the extraction of two factors for both sensory and emotional attributes, namely sweet and bitter sensory factors, and positive and negative emotional factors, while the emotion guilty did not load onto either of the extracted emotion factors. As the three chocolates were varied in sensory profiles but emotional profiles were similar, unique relationships between the sensory and emotion factors were noted. No significant ($P \leq 0.05$) relationships were identified between the sensory and emotion factors for Nestlé which was rated average for most sensory attributes. For Lindt, which was found to be high in sweetness, a significant relationship was noted between the positive emotion factor and the bitter sensory factor. For Canderel, which was high in bitterness, the negative emotion factor had a significant relationship with both sweet and bitter sensory factors, while the positive emotion factor had a significant relationship with the sweet sensory factor. These findings are in line with that of Chaya *et al.* (2015) who reported that sweet and bitter sensory attributes were found to influence emotion categories, scoring high on pleasant emotion categories for high sweetness and low bitterness, and low on unpleasant emotion categories for low sweetness and high bitterness.

The relationship between the set of sensory attributes and individual emotional attributes was also investigated, and various relationships were noted between the set of sensory attributes and both positive and negative individual emotion attributes for Canderel, specifically disgusted, good, happy, pleasant and satisfied, while none were noted for Lindt and Nestlé.

Relationships were also investigated between individual sensory and emotion attributes. On this level, positive emotions had a higher number of relationships with sensory attributes than negative emotions. All positive emotions, except for understanding, correlated significantly ($P \leq 0.05$) with various sensory attributes across the three chocolates, both with positive and

negative correlation values. The positive emotional attributes which had the highest number of significant ($P \leq 0.05$) correlations with sensory attributes were pleasant, happy and active, while free, mild, secure and tame had the least number of significant correlations. All negative emotions, except for the unclassified emotion guilty, also significantly ($P \leq 0.05$) correlated with various sensory attributes, both with positive and negative correlations, but these were limited to the chocolate Canderel. Disgusted had the highest number of correlations while worried had the least. Two sensory attributes from the bitter factor, namely bitter flavour and bitter aftertaste had more correlation with emotions than sensory attributes from the sweet factor; however, these were with predominantly negative and unclassified emotions.

It was concluded that the relationship between sensory and emotion factors is unique due to the unique sensory profile of each chocolate; however, the sweet and bitter factors seemed to influence emotional response in opposing ways. The contribution of the set of sensory properties to the emotional experience is also based on the unique sensory profiles of the chocolates. All emotions, except for understanding and guilty, were correlated to sensory attributes; however, positive emotions had a higher number of correlations with sensory attributes than negative emotions.

9.3.1.5. Objective 1d: Compiling a model indicating the relationship between the emotional response and the sensory properties of chocolate

Three models reported in Chapter 6 were constructed to visualise the contribution of the sensory attributes of the three chocolates to the emotional response, with β -coefficients indicating the strength of the effect of the sensory attributes on emotion attributes. The Canderel model included five sensory attributes (burnt flavour, coffee flavour, creaminess, melting and sweet aroma) which made small ($\beta \geq 0.2 < \beta 0.5$) contributions to six emotions (disgusted, free, good, guilty, happy, nostalgic) and both positive and negative contributions were noted. The biggest contribution noted was by the sensory attribute burnt flavour contributing negatively to the emotion happy. For Lindt, three sensory attributes (burnt flavour, gloss, milky flavour) made a small ($\beta \geq 0.2 < \beta 0.5$) contribution to nine emotion attributes (calm, disgusted, good, happy, joyful, nostalgic, pleasant, warm and worried) and all contributions were positive. The most significant contribution noted was by the sensory attribute milky flavour contributing positively to the emotion worried. For Nestlé, seven sensory attributes (bitter aftertaste, gloss, creaminess, sweet aroma, vanilla flavour, milky flavour and burnt flavour) made a small ($\beta \geq 0.2 < \beta 0.5$) contribution to 20 emotions (active, adventurous, calm, enthusiastic,

free, good, good-natured, guilty, happy, interested, joyful, mild, nostalgic, satisfied, secure, tame, understanding, warm, wild and worried), and both positive and negative effects were noted. The biggest contribution noted was by the sensory attribute burnt flavour, contributing negatively to the emotion wild. It was concluded that models can be constructed which reflect the unique contributions of sensory attributes to emotion attributes.

9.3.2 Objective 2: Determine whether a relationship exists between consumers' mood and consumers' emotional response to chocolate

The relationship between mood and emotion attributes was investigated on both a factor and individual attribute level and is reported in Chapter 7. Two mood factors were extracted during factor analysis, namely positive mood and negative mood. No significant ($P \leq 0.05$) correlations were indicated between mood factors and emotion factors for all chocolates combined. Although not significant, a positive mood state was positively correlated with positive emotion and negatively correlated with negative emotion, while a negative mood state was positively correlated with both positive and negative emotion, however, more so with negative emotion. On an individual chocolate level, correlations between factors were also determined for the mood and emotion factors of the three individual chocolates, and the existence of three relationships were noted, namely a) A positive medium correlation between the negative mood of respondents and guilty emotion experienced when consuming Lindt; b) The same correlational tendency was noted for Nestlé; and c) Thirdly, for Nestlé, a positive correlational tendency was noted between positive mood and positive emotion. No correlations were noted for Canderel.

Correlations between individual mood and emotion attributes for all chocolates combined were also determined. Although no significant ($P \leq 0.05$) correlations were found, the majority of positive mood attributes were positively correlated to various positive emotions, with only one positive mood attribute (clear-headed) negatively correlated to a negative emotion (bored), and one more positive attribute (drowsy) negatively correlated to a positive attribute (secure). Negative mood attributes had very few correlations with emotion attributes in comparison to positive mood attributes. On an individual chocolate level, for Canderel, three small ($r = 0 - r < 0.3$) significant ($P \leq 0.05$) positive correlations were identified between the mood and emotion attributes, and the influence of consumers' mood on the emotions experienced during the consumption of this chocolate seems to have been limited. Twelve small ($r = 0 - r < 0.3$) yet significant ($P \leq 0.05$) correlations were identified during mood and the emotions experienced

during the consumption of Lindt. Twenty small ($r=0-r<0.3$) yet significant ($P\leq 0.05$) correlations existed between mood and the emotions experienced during the consumption of Nestlé. The emotions which had significant relationships with positive moods were all positive (or unclassified in the case of guilty), while the reverse was true for negative moods and related emotions. The mood wide-awake had the most (nine) significant ($P\leq 0.05$) correlations with emotions, followed by the mood relaxed (with five), and these two mood states thus resulted in a more emotional experience.

It was concluded that the relationship between mood and emotion is weak on a factor level when the data of all chocolates were combined, but directionally, a positive mood would result in a positive emotional experience and possibly suppress negative emotion; however, a negative mood does not result in a negative emotional experience with chocolate. The relationship between factors on an individual chocolate level is still limited but unique to each chocolate. On an individual attribute level when all chocolates are combined, consumers in a positive mood are more likely to experience positive emotions and less likely to experience negative emotions during chocolate consumption, and respondents in a negative mood are likely to experience fewer positive and negative emotions. Consumers in a negative mood experience less emotion than those in positive mood with very few correlations noted between negative mood attributes and emotion attributes. On an individual attribute level for the individual chocolates, correlations were unique, and between all three chocolates, positive emotions were more likely to correlate with positive moods while negative mood had few correlations. The moods wide-awake and relaxed were more likely to evoke emotion.

9.3.3 Objective 3: Determine whether a relationship exists between consumers' familiarity with chocolate and consumers' emotional response to it

The relationship between familiarity and emotion attributes was investigated on both a factor and individual attribute level and is reported in Chapter 7. Two factors were extracted for familiarity through factor analysis, namely a large chocolate format factor and a small chocolate format factor. No significant correlations ($P\leq 0.05$) were noted between emotion factors and chocolate familiarity factors for all chocolates combined. Although not significant, correlation values between positive emotions and chocolate were higher than between negative emotion and chocolate usage, and more so for larger formats than smaller. Correlation values between guilty and the small chocolate format factor were larger than the correlation with the large chocolate format factor. When reviewing factor correlations for individual chocolates, no

significant ($P \leq 0.05$) correlations were noted either. Positive emotions experienced during consumption of Lindt and Nestlé correlated positively with small and large chocolate format factors, and negative emotions correlated negatively with small and large chocolate format factors. The correlations values of the familiarity factors with positive emotions were also found to be higher than correlation values between familiarity and negative emotions. The emotional experience of Canderel was not related to either the small or large chocolate factor. For the emotion guilty, higher correlation values were recorded for small chocolate users than large chocolates for all three chocolates.

On an individual attribute level, no significant correlations were identified between the emotions evoked by the consumption of Canderel and familiarity with chocolates of the small chocolate or large chocolate factor. Mainly positive emotions were evoked by the consumption of Lindt and Nestlé amongst both small chocolate and large chocolate users. The emotions active and adventurous in particular were correlated to small chocolate usage frequency for Lindt and Nestlé users, specifically to Alfajore familiarity. Twist wrapped miniature and seasonal chocolate users did not find that Nestlé or Lindt evoked significant emotion. Various emotions evoked by the consumption of Lindt and Nestlé showed significant correlations with large chocolate usage, particularly good (Lindt), warm (Lindt and Nestlé), loving (Lindt and Nestlé), interested (Nestlé), joyful (Nestlé), and tame (Nestlé). Plain milk tablet and Plain white tablet users experienced the most emotion, with Filled tablet, Plain dark tablet and Countline consumers reporting fewer emotions.

It was concluded that on a factor level for all chocolates combined, specific format familiarity did not significantly influence the emotional experience with chocolate. On a product level, large chocolate users had a more positive experience than small chocolate users, as small chocolate consumers are more likely to have a negative or guilty chocolate eating experience. Regular consumption of specific types of chocolates influenced emotions evoked during the consumption of Nestlé and Lindt, the luxury chocolate, but not during the consumption of Canderel.

9.3.4 Objective 4: Determine whether a relationship exists between the acceptability of chocolate and consumers' emotional response to it

As reported in Chapter 7, Nestlé and Canderel were found to be equally acceptable; however, Lindt was significantly more acceptable than these two chocolates. While Lindt and Nestlé had

higher acceptability ratings than Canderel, and this did not result in more significant correlations or increases or decreases in mean emotion scores for any emotion attributes. Most emotions had a significant ($P \leq 0.05$) positive correlation with acceptability for Canderel, while Lindt and Nestlé had no significant correlations with any emotions. For the majority of emotion attributes evoked by Canderel which showed significant correlations with acceptability, the mean positive emotion scores for Canderel were the lowest between the three chocolates, and the mean negative emotion scores were the highest between the three chocolates.

While Lindt had the highest acceptability mean rating, it did not have the highest positive emotion scores (as it was second to Nestlé for most positive emotion scores) and had higher negative emotion ratings than Nestlé. Lindt, which achieved the best acceptability scores, had average negative emotion mean scores, some close to that of Canderel which had the lowest acceptability scores for the emotions aggressive, bored, and disgusted; and had the highest mean score for the emotion guilt. Nestlé had average acceptability, however, a very positive emotional response.

It was concluded that low mean acceptability scores are correlated to a lower incidence of positive emotions and higher incidence of negative emotions experienced, but high acceptability does not deliver a significant increase in the positive emotional experience or significant reduction in the negative emotional experience. Less accepted products are thus better reflected in an emotional profile.

9.3.5 Objective 5: Determine whether a relationship exists between consumer's' attitude towards chocolate and consumers' emotional response to it

The relationship between attitude and emotion attributes was investigated on both a factor and individual attribute level and is reported in Chapter 7. Four attitude factors were extracted through factor analysis, namely "negative attitude", "emotional attitude", "functional attitude" and "obsession attitude". Based on correlations between attitude and emotion factors for the combined data of all chocolate, it appears as if a negative attitude towards the chocolate category were likely to result in a consumer experiencing negative emotion and guilt during consumption, while there is an absence of positive emotion. A negative attitude also resulted in a negative correlation with positive emotion for all three chocolates. A functional attitude to the category does not deliver any significant correlations with emotion factors for any of the chocolates, and overall lower correlation values than any of the other attitude factors, indicating

that functional chocolate consumers experience less emotion than those of the other attitude factors. Emotional and obsession attitude factors had weak relationships with emotion factors, despite that the attitude attributes contained in these factors appear to be more emotional than the other two factors, as only the obsession attitude factor was significantly ($P \leq 0.05$) correlated to positive emotion factor.

When reviewing the relationship between the factors at an individual chocolate level, no significant correlations were noted for any of the chocolates between functional attitude attributes and emotion attributes, and these correlation values were lower than for any of the other attitude factors. An emotional and obsession attitude resulted in a directionally positive emotional experience. Both the obsession and emotional attitude factors were positively correlated to the positive emotion factor of Nestlé only, and negatively to the negative emotion factor. Although no significant ($P \leq 0.05$) correlations were identified between the emotional factors of Canderel and Lindt and the emotional and obsession attitude factors, Canderel had lower correlation coefficients than Lindt for positive emotions, and higher correlation coefficients than Lindt for negative emotions, with very low guilt correlation coefficients for Canderel and the highest guilt correlation coefficients for Lindt. Thus, directionally, the diabetic chocolate, Canderel, evoked less emotion in these consumer types, and Lindt, the luxury chocolate, evoked more emotion, both positive and negative. Lindt explicitly evoked more guilt amongst emotional and obsession consumers compared to the other two chocolates, Canderel and Nestlé.

On an individual attribute level for all chocolates combined, various individual negative attitude factor attributes are significantly ($P \leq 0.05$) correlated with the unclassified and negative emotion attributes guilty and disgusted. Consumers who experienced the emotions guilt and disgust had an attitude of feeling unhealthy and unattractive after eating chocolate, felt that they are often on one kind of diet or another and are those consumers who always look at the kilojoule value of a chocolate snack before they eat it. The negative attitude factor attributes are also negatively correlated with various positive emotions, such as good, joyful, pleasant and secure. The negative attitude attribute that chocolate is high in fat and of poor nutritional value had the highest number of correlations with positive emotions. A functional attitude towards the chocolate category correlates very poorly with emotional attributes when all chocolates are combined, as only one attitude attribute had a very low correlation value with an emotion. For the obsession attitude factor for the data of all chocolates combined, only one attitude

significantly correlated with various positive emotions, which is the attitude of consuming chocolate as a reward. These evoked emotions of freedom, goodness, happiness, loving and warmth. These correlations were, however, all small. Despite the existence of an emotional factor, not many emotions correlated either positively or negatively with this factor. Respondents with an emotional attitude to the chocolate category are, however, likely to experience emotions of satisfaction, warmth and security when consuming it.

Lindt showed the most correlations between consumer attitude and emotional response in general, while Nestlé had very limited correlations. The positive emotions joyful, loving, and understanding had the most significant correlations ($P \leq 0.05$) with negative attitude factor elements across all three chocolates, while the negative emotion guilty had the most significant positive correlations with negative attitude factor elements.

Correlations between negative attitude factor attributes and positive emotions were mostly negative for Canderel, while correlations for Lindt and Nestlé were mostly positive. Thus, consumers who have a negative attitude are less likely to experience positive emotions when consuming Canderel. The functional attitude factor had very few significant correlations with emotions, limited to Lindt and Nestlé. On an individual chocolate level, no negative emotions significantly correlated with emotional attitude factors for any of the chocolates. Canderel had only one significant correlation between a positive emotion and emotional attitude factors, while Lindt had no correlations. Nestlé had multiple correlations between the emotional attitude and positive emotions. Lindt showed no emotion correlation with obsession attitude factors, and Canderel had only two, which were not significant.

It was concluded that a negative attitude results in a negative emotional experience with the product category, and consumers with this type of attitude are more likely to experience guilt during consumption. Functional chocolate consumers experience less emotion than those of the other attitude factors. The obsession attitude is not very emotional as it evokes very little emotional response. Despite the existence of an emotional factor, not many emotions correlated either positively or negatively with this factor.

9.4 IMPLICATION RELATED OBJECTIVES

As outlined in the introduction, very limited literature has been published on the topics researched in this study. Consequently, the publication of these results will add to the growing

body of knowledge regarding the areas of sensory and consumer research and consumer behaviour. The data of this study support the existence of relationships between sensory attributes and emotion, as well as between emotion and consumer behaviour, indicating that there is a close relationship between two fields which have traditionally fallen under two separate disciplines, namely that of sensory and consumer science. This data further emphasises the need for the continuation of the shift that is taking place from studying the food product to studying both the food product and the consumer (Köster, 1981; McBride, 1990; Meiselman, 1993; Trijpp, 1995).

Portions of the study have been presented at various conferences to date and have been met with great interest, as it is a new angle of approaching sensory and consumer studies which have not been considered before:

- 1) SAAFOST Congress, Century City Conference Center, Cape Town, 3-6 September 2017 (Oral presentation);
- 2) SAAFECS Congress, St Georges Hotel, Pretoria, 5-9 March 2018, (Oral presentation);
- 3) Eighth European Conference on Sensory and Consumer Research (Eurosense), Verona, Italy, 2-5 September 2018, (Poster presentation).

9.5 CONTRIBUTIONS OF THE STUDY

As outlined in Chapter 3, the study was expected to make various contributions.

1. The results obtained from this study could contribute to new knowledge which could be published in various academic journals, thereby contributing to the research mission of the NWU.

One article has been submitted to the Journal Food Quality and Preference (Chapter 8), and another article (Appendix W) has been drafted for submission to the same journal.

2. While ample research studies related to emotional response and emotional response to food have been conducted internationally, to date, only a few of these studies which measured the relationship between the sensory properties of a food product and the emotions they evoke have been published, and no emotion-sensory research has been conducted (assumption based on lack of published literature) in South Africa to the knowledge of the researcher.

To the researcher's knowledge, this is the first African study to investigate the relationship between sensory properties and emotional response of a food product. While this study extends the international knowledge of these relationships which have been explored by other

researchers, it establishes a basis of knowledge of these never-before-explored relationships in South Africa, a developing country with its own unique characteristics, challenges and opportunities.

3. No studies are known to have been conducted to measure the impact of consumer behaviour variables (mood, familiarity, acceptability or attitude) on the emotional response to the sensory properties of food, merging the field of sensory and consumer science in order to provide actionable product design insights.

This study identified and described a variety of relationships between the various constructs which were included in this study at various levels (overall factor level, factor level for individual chocolates, at an overall attribute level and an attribute level for individual chocolates). These findings indicate that emotional response is related to the sensory attributes of chocolate, and that this emotional response is influenced by various internal consumer behaviour variables, which support the known fact that consumer behaviour is complex and multi-dimensional. These relationships have not previously been explored in conjunction; the various sub-relationships, specifically the relationship between emotion and consumer behaviour in the context of sensory attributes have enjoyed very limited attention in the literature. Mpinganjira *et al.* (2013) explicitly stated that it is important to understand the field of consumer behaviour from the viewpoint of multiple disciplines, as this would provide an opportunity to investigate and explain a particular phenomenon taking into account multiple disciplines. It thus indicated what the importance is of considering consumer behaviour components when sensory food research is conducted, which would put a new lens on the design of and approach to true consumer-focused studies. From a new product development point of view, the selection of a product formulation that is aligned to the furthest extent with consumer preferences is very important for the food industry, which requires a solid understanding of consumers' perception of products, both from a sensory and hedonic point of view. From a consumer perspective, the study highlighted the relative importance of consumer behaviour components in sensory studies and could allow for the design of products based on a more "holistic" view of the consumer. Broadly, it brought the two fields of sensory and consumer science together. Although various theories exist in these different disciplines which are well researched and defined, the combination and integration of these topics provide a different and unique point of view to what has been made known to date and that has also allowed for new insights to emerge; this combination is often overseen or deliberately ignored.

4. The study allowed for the development of a model that could simulate response to products which, once verified, could be reused by others, or the methodology followed in this study could be applied to design similar models for other food categories which could lead to the development of more “consumer-centric” products.

This model could reduce research time significantly and could be an ongoing tool for product developers.

5. The findings also prove that from an industry perspective, the traditional approaches of product design and innovation may be insufficient to design truly competitive and sustainable products, unless multiple angles of a consumer is considered, as all are important to evaluate for the purposes of product design and marketing, and are often based on relationships between constructs and not simply the findings of the various constructs in isolation.

This study attempted to provide a more holistic understanding of the emotional experience with a food product from both a consumer science and sensory science perspective, which is to some extent a multidisciplinary or multi-angle approach. Although the study was limited in sample size, recruited sample group and the product category studied, the findings can be used as a starting point to formulate a new approach to product development and innovation.

6. The study furthermore established a methodology within which to assess various constructs and assess the relationship between them.

It was implemented with questionnaires and tools that have been validated for sensory and consumer studies, which can now be further applied by researchers for the investigation of other food categories, and this within the field of either consumer or sensory science.

9.6 LIMITATIONS AND RECOMMENDATIONS

Should anyone be interested in replicating the study, the addition of a new data set generated amongst consumers recruited and interviewed in the same manner could offer the opportunity to make the findings even more generalisable. Furthermore, the study could be replicated with different consumer groups with changes to the data collection procedure to also validate the generalisability of the methodology that was implemented. The application of the methodology, tools and scales to collect data on other product categories would be valuable to explore beyond the chocolate category and to understand if similar relationships between emotion and sensory attributes, and emotion and consumer behaviour exist beyond the chocolate segment.

Further studies, from a data analysis point of view, should, however, focus on a different approach to the analysis to uncover relationships, as the findings from the various correlation analyses performed in this study point to the possibility that underlying relationships within the set of sensory attributes and/or the set of emotional attributes may have influenced the overall relationship between sensory and emotional attributes. This may extend to the consumer behaviour variables which were investigated.

Furthermore, the inclusion of demographic variables which are important from a South African point of view should be considered in data analysis, as they could uncover significant relationships which were not considered in the current study, as the objective of this study was to include a homogenous sample size based on specifically identified inclusion criteria, rather than investigating the impact of demographics as a further dimension of data analysis.

Lastly, the inclusion of a more extensive list of sensory and emotion attributes in order to better describe and differentiate samples and allow for the identification of unique relationships within chocolate samples, as well as universal relationships between samples, should be considered. Products could be more differentiated with a larger number of emotions as consumers use a large number of emotion words to evaluate products (Jaeger *et al.*, 2018), which is also true for sensory attributes. This could also extend to the generation of a chocolate specific lexicon by South African consumers vs. the application of an internationally validated tool.

9.7 CONCLUSION

This study has described the product variables which were under investigation (sensory attributes, emotion attributes, and the consumer behaviour variables mood, familiarity, acceptability and attitude), the relative importance of each and the relationship between them in a local context, to showcase that these variables are all interdependent, but that the factors of the variables and individual attributes also have a level of interdependency. It has generated the first data within the field of emo-sensory research in South Africa and has shown that integrated studies are viable and valuable. It is important to note, however, that the results and conclusions of this study are only applicable to this sample group since random sampling was not applied. Further research should be done in order to generalise the findings to other food products.

CHAPTER 10

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APPENDIX A: AUTHeR APPROVAL OF THE STUDY

Checklist by the Research Proposal Committee for the Ethics Committee Research Using Human Participants

Title:	Exploring the relationship between selected internal consumer behaviour variables and the emotional response to the sensory properties of chocolate		
Researchers:	DR Annchen Mielman & Ms Neoline le Roux		
Using people?	Yes	☒	
	No	☐	
Executive summary of the research:			
Potential risk level	Minimal	☒	Motivate:
	Medium	☐	
	High	☐	
Recommendation for the ethics committee	Full review	☒	
	Expedited review	☐	Motivate:
	Exempted from review	☐	Motivate:
Any Comments			
Committee members present during the review	Prof Petra Bester, Prof Gerda Reitsma, Dr Lanthe Kruger & Dr Angelinah Wilson		
Date of review	27 February 2017		

Dr IM Kruger

Digitally signed by Dr IM Kruger
DN: cn=Dr IM Kruger, o=HIMU,
ou=University of the Western Cape,
email=im.kruger@uwc.ac.za, c=ZA
Date: 2017.03.15 14:41:21 +0200

Signature of the Chairperson

2017/03/15

Date

Prof Petra
Bester

Digitally signed by Prof Petra Bester
DN: cn=Prof Petra Bester, o=HIMU,
ou=University of the Western Cape,
email=petra.bester@uwc.ac.za, c=ZA
Date: 2017.03.15 14:41:21 +0200

Signature of the Research Director

2017/03/15

Date

Decision of the Ethics Committee:

Full review	☒	Motivate:
Expedited	☐	
Exempted	☐	

Signature of the Chairperson of the Ethics Committee

Date

APPENDIX B: ETHICS APPROVAL CERTIFICATE



Institutional Research Ethics Regulatory Committee

Tel: +27 18 299 4849
Email: Ethics@nwu.ac.za

ETHICS APPROVAL CERTIFICATE OF STUDY

Based on approval by **Health Research Ethics Committee (HREC)** on **12/07/2017** after being reviewed at the meeting held on **19/04/2017**, the North-West University Institutional Research Ethics Regulatory Committee (NWU-IRERC) hereby **approves** your study **with conditions** as indicated below. This implies that the NWU-IRERC grants its permission that provided the special conditions specified below are met and pending any other authorisation that may be necessary, the study may be initiated, using the ethics number below.

Study title: Exploring the relationship between selected internal consumer behaviour variables and the emotional response to the sensory properties of chocolate														
Study Leader/Supervisor: Dr A Mielman														
Student: I Taljaard-27570169														
Ethics number:														
N	W	U	-	0	0	0	2	9	-	1	7	-	A	1
Institution			Study Number					Year			Status			
Status: S = Submission; R = Re-Submission; P = Provisional Authorisation; A = Authorisation														
Application Type: Single study														
Commencement date: 2017-07-12														
Risk: Minimal														
Continuation of the study is dependent on receipt of the annual (or as otherwise stipulated) monitoring report and the concomitant issuing of a letter of continuation.														

Special conditions of the approval (if applicable):

- Please provide the HREC with the final list of descriptors once it has been reviewed by the expert panel for approval before it is implemented.
- Please provide the HREC with the final list of chocolate samples that will be tested by the participants.

General conditions:

While this ethics approval is subject to all declarations, undertakings and agreements incorporated and signed in the application form, please note the following:

- The study leader (principle investigator) must report in the prescribed format to the NWU-IRERC via HREC:
 - annually (or as otherwise requested) on the monitoring of the study, and upon completion of the study
 - without any delay in case of any adverse event or incident (or any matter that interrupts sound ethical principles) during the course of the study.
- Annually a number of studies may be randomly selected for an external audit.
- The approval applies strictly to the proposal as stipulated in the application form. Would any changes to the proposal be deemed necessary during the course of the study, the study leader must apply for approval of these amendments at the HREC, prior to implementation. Would there be deviation from the study proposal without the necessary approval of such amendments, the ethics approval is immediately and automatically forfeited.
- The date of approval indicates the first date that the study may be started.
- In the interest of ethical responsibility the NWU-IRERC and HREC retains the right to:
 - request access to any information or data at any time during the course or after completion of the study;
 - to ask further questions, seek additional information, require further modification or monitor the conduct of your research or the informed consent process.
 - withdraw or postpone approval if:
 - any unethical principles or practices of the study are revealed or suspected,
 - it becomes apparent that any relevant information was withheld from the HREC or that information has been false or misrepresented,
 - the required amendments, annual (or otherwise stipulated) report and reporting of adverse events or incidents was not done in a timely manner and accurately,
 - new institutional rules, national legislation or international conventions deem it necessary.
- HREC can be contacted for further information or any report templates via Ethics-HRECApply@nwu.ac.za or 018 299 1206.

The IRERC would like to remain at your service as scientist and researcher, and wishes you well with your study. Please do not hesitate to contact the IRERC or HREC for any further enquiries or requests for assistance.

Yours sincerely

Linda du Plessis
Digitally signed by Linda du Plessis
DN: cn=Linda du Plessis, o=NWU,
ou=Vaal Triangle Campus,
email=linda.duplessis@nwu.ac.za,
c=ZA
Date: 2017.07.31 13:02:50 +02'00'

Prof Linda du Plessis

Chair NWU Institutional Research Ethics Regulatory Committee (IRERC)

APPENDIX C: PERMISSION LETTER FROM WITS BUSINESS SCHOOL



NORTH-WEST UNIVERSITY
YUNIBESITHI YA BOKONE-BOPHIRIMA
NOORDWES-UNIVERSITEIT
POTCHEFSTROOM CAMPUS

PERMISSION LETTER
UNIVERSITY OF THE WITWATERSRAND

To the head of the MBA program: Mr Conrad Viedge

I am currently reading a PhD in Consumer Sciences at the North-West University Potchefstroom campus. The aim of my study is to explore the relationship between selected internal consumer behaviour variables and the emotional response to the sensory properties of chocolate. Students from the WITS Business School have been identified to represent the population for this study. This letter hereby invites students to represent the targeted population for this study. Permission is required by the head of the study programs in order for students to be able to partake in this study. By completing this form you will be providing permission for the researcher to include students in this study. By providing permission you agree to enable:

- The researcher to conduct an information session with the students to explain the study
- The researcher to distribute electronic emails containing the electronic questionnaire links, by using the class list of each class
- The researcher to electronically collect and analyse data that students completed.
- The researcher to provide students feedback regarding the results of this research study.

The researcher agrees to the following terms:

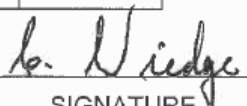
- The researcher will not reveal any personal information of students.
- The researcher will not include the name of the University name as part of the results.
- The researcher will collect and analyse data without interfering with students work.

* The consent form is attached if any other information is required regarding the research study.

A. Head of program

Name: Mr. Conrad Viedge
Department: Graduate School for Business Administration
Tel nr & e-mail: 011 717 3585 / 083 777 3116 / conrad.viedge@unsw.ac.za

Approved ☒	Rejected ☐


SIGNATURE

18/2/17
DATE

APPENDIX D: PERMISSION LETTER FROM FIRMENICH



MARCH 2017

PERMISSION LETTER

TO: NORTH WEST UNIVERSITY

RE: INVOLVEMENT OF TRAINED SENSORY PANEL AND USE OF FACILITIES
FOR PHD STUDY

I, Andre Ferreira, General Manager of Firmenich South Africa, hereby grant permission to Innike Taljaard to work with the sensory panel of Firmenich Flavours Division (Karien Bezuidenhout, Ayman Hebaish, Anna Mursalo, Lerato Mokoena, Makhanane Mokwebo & Siphiwe Chabalala) for the purposes of profiling various chocolate brands for her study entitled: "Exploring the relationship between selected internal consumer behaviour variables and the emotional response to the sensory properties of chocolate".

Furthermore I grant permission for the laboratory to be used as a sample preparation area for the study.

A handwritten signature in black ink, appearing to read "Andre Ferreira".

Signed: Andre Ferreira

General Manager

Firmenich (Pty) Ltd

Reg No 1972/009944/07

Pharmaceutical Street | Midrand | South Africa |

Private Bag X113 | Halfway House 1685 | South Africa |

Tel: +27 (11) 653 0700 Fax: +27 (11) 653 0726 | www.firmenich.co.za

Directors: A. Bacheller (French) | G. Chaw (Australian) | S. Sanghavi (Indian) | T. Larsen (Chairman - Danish) | A. Ferreira (Managing - South African)

APPENDIX E: STATISTICAL CONSULTATION REGISTRATION

All Clients	Faculty/Institution*	PC - Health Sciences - School of Physiology, Nutrition and Cons			
	Type of study /Project*	PhD-degree			
	Person responsible for payment of the account	Type	Supervisor	Surname*	Mielmann
		Title	Dr	Contact number*	(018) 299-2474
		Initials	A	Email*	Annchen.Mielmann@nwu.ac.za
	Account address*	Type	Account address		
		AUTHeR, NWU, Potchefstroom campus			
		Postal code			
	Payment category	E - NWU personnel	Consultant	Dr SM (Suria) Ellis	
	Is this study/project to the benefit of a private company?	No			
	Do you plan to publish the results of this study project?	Yes			
	Would you consider co-authorship?	Yes			
	Are you a new SCS client?	Yes			
	I accept the Terms and Conditions as stipulated in this SLA document.				
	Date*	26/08/2016			
Signature of Client*	Annchen Mielmann		Digitally signed by Annchen Mielmann Date: 2016.08.26 13:33:37 +02'00'		

Submit

Client Registration

Please complete the following form if you wish to make use of our services. **Note that the compulsory information required is indicated by an ***.

All Clients	Title	Ms	Initials	I	Surname*	Taljaard
	Preferred name*	Innike			Email*	innike@gmail.com
	Primary contact number*	(083) 398-9639			Alternative number	(072) 247-9659
	ID / Personnel number (if NWU staff member) / Student number *					27570169
	Physical address*	4 Willow Place				
		Kelvin Sandton				
	Postal address	Type*	Same as physical address			
		Postal code				
	Project description/ Title of study*	Exploring the impact of attitude, mood and familiarity on the emotional response to the sensory properties of chocolate.				
Students Only	How did you become aware of this service?			Supervisor		ander
	Are you a student?*			Yes		
	Please provide your supervisor or promoter's details if you are a student of the NWU					
	Details of Supervisor/ Promoter	Title	Dr	Surname*	Mielmann	
Name		Annchen	Email*	Annchen.Mielmann@nwu.ac.za		
Initials		A	Contact number*	(018) 299-2474		
NWU campus/Other?	NWU Potchefstroom Campus					
Would you consider the consultant as a co-/assistant supervisor?	No					
					Ethics number	

APPENDIX F: CONSENT FORM



INFORMED CONSENT DOCUMENTATION FOR PARTICIPANTS IN CHOCOLATE RESEARCH STUDY

TITLE OF THE RESEARCH STUDY: Exploring the relationship between selected internal consumer behaviour variables and the emotional response to the sensory properties of chocolate

ETHICS REFERENCE NUMBER: NWU-00029-17-S1

PRINCIPAL INVESTIGATOR: Dr. Annchen Mielmann (PhD Food Science)

POST GRADUATE STUDENT: Innike Taljaard (M. Consumer Science)

ADDRESS: North-West University, Potchefstroom Campus, Hoffman Street 11, Potchefstroom, 2531

CONTACT DETAIL: 083 398 9639 / innike@gmail.com

You are being invited to take part in a **research study** that forms part of my PhD degree. Please take some time to read the information presented here, which will explain the details of this study. Please ask the researcher any questions about any part of this study that you do not fully understand. It is very important that you are fully satisfied that you clearly understand what this research is about and how you might be involved. Also, your participation is **entirely voluntary** and you are free to choose not to participate. If you say no, this will not affect you negatively in any way whatsoever. You are also free to withdraw from the study at any point, even if you do agree to take part now, without explanation or prejudice.

What is this research study all about?

We are investigating what types of chocolate people eat and how often, what their opinion is of chocolate, and how people feel after they eat chocolates that look, smell or taste different from one another.

Why have you been invited to participate?

- We are looking for people who eat chocolate, are 18 years or older, reside in the Johannesburg municipal area, and have completed at least matric, and who are articulate and can easily grasp various concepts. Thus we are approaching students from the WITS Business School.
- You will not be able to take part in this research if you are allergic to any of the ingredients of chocolate, if you smoke regularly, if you have specific dietary requirements that do not allow the consumption of chocolate, if you suffer from gum disease, wear dentures, if you are on any medication, or if you strongly dislike chocolate.
- In total, a maximum of 220 consumers will be included in this study.

What will be expected of you?

This study will be conducted online (on Survey Monkey) and can be completed in the comfort of your home. It will involve (all during the month of November and December 2017):

- a) Reviewing a consent form provided to you after the information session should you be interested in participation, and signing this consent form electronically, which can take up to 20 minutes.
- b) Completing a screening questionnaire which will take a maximum of 5 minutes.
- c) Completing the research survey while tasting different types of chocolates which could take up to an hour to complete and needs to be completed in one sitting.

You will be notified of each research stage via e-mail, and links to each of the above will be supplied in these mails.

Will you gain anything from taking part in this research?

- You will be making a contribution to a very unique study that has never before been performed in South Africa and which will make a big contribution to the academic world, and you will be one of the first people who will see the results.
- You will be able to tell us how you experience chocolate and how it makes you feel, and maybe learn a bit more about something you eat often.

Are there risks involved in you taking part in this research and what will be done to prevent them?

The risks to you in this study are:

- a) There is a risk if you are allergic to or have sensitivity to any of the ingredients of chocolate, so if you do have any of these allergies you should not participate in the study. If you are unsure whether you are allergic to the ingredients you should also not participate in the study.
- b) You may get tired when completing the survey as it could take up to an hour to complete, but as it is not timed you can take a break at any time when you feel you need to. However, the survey needs to be completed in one sitting which means you can't do it over two days or split it between the morning and the afternoon.
- c) You need not get concerned or worried about the accuracy of your answers as there are no right or wrong answers. We just want your honest opinion.
- There are more gains for you in joining this study than there are risks.

How will we protect your confidentiality and who will see your findings?

- Anonymity of your findings will be protected by not recording your name on any of the documentation from the online survey (only on the consent form), but we will ask for your e-mail address in order to communicate with you and to identify you if you do want to withdraw your answers from the research.
- Your privacy will be respected throughout the study and your results will be kept confidential by all those involved in the research project as only the researcher, her supervisor and those involved in analysing the data will see the answers to the questions and will be able to review the findings.
- Furthermore, the HREC (Health Research Ethics Committee of the Faculty of Health Sciences of the North-West University) may inspect the results.
- Findings will be kept safe by storing data electronically, password protected, on the computer of the researcher and Dr Annchen Mielmann. Data will be stored locally for 7 years.

What will happen with the findings?

The data that will be collected will only be used for this study. After the survey has been completed by all the respondents, the data will be compiled, analysed and the results or parts of the results will be published in various journals and presented at local and hopefully international conferences.....and of course....to you!

How will you know about the results of this research?

We will present you with the results of this research when all analysis and summaries have been completed. You will be informed of any new relevant findings after this presentation via e-mail.

Will you be paid to participate or will it cost you anything?

- You will not be paid to complete the survey; however you will be able to keep the cooler bag in which you will receive your samples.
- You will also be entered into a draw to win one of three shopping vouchers to the value of R500, R400 or R300.
- To complete the consent form, screening questionnaire, and the survey you will have to access the internet (Survey Monkey) and you may incur minimal data charges.

Who are the researchers and what are they responsible for?

The researcher is responsible for all elements of the study, including the planning and execution of all stages of the study, including design of the questionnaires, collection of the data, and analysis and reporting of the data.

PRINCIPAL INVESTIGATOR: Dr. Annchen Mielmann (PhD Food Science)

POST GRADUATE STUDENT: Innike Taljaard (M. Consumer Science), PhD Student at the North-West University

Is there anything else that you should know or do?

- This study has been approved by the Health Research Ethics Committee (HREC) of the Faculty of Health Sciences of the North-West University (NWU-00029-17-S1) and will be conducted according to the ethical guidelines and principles of Ethics in Health Research: Principles, Processes and Structures (DoH, 2015) and other international ethical guidelines applicable to this study. As a result, it may be necessary for the research ethics committee members or other relevant people to inspect the research records.
- This study is supported by AUTHeR at the North-West University
- You need not be concerned or worried about the accuracy of your answers as there are no right or wrong answers. We just want your honest opinion.
- You can contact the researcher, Innike Taljaard at chocolatestudy2017@gmail.com if you have any further questions or have any problems. You can also contact the Health

Research Ethics Committee via Mrs Carolien van Zyl at 018 299 1206 or carolien.vanzyl@nwu.ac.za, if you have any concerns that were not answered about the research or if you have complaints about the research.

- You have received a copy of the consent form for your own purposes, which also contain most of this information.
- As there are a limited number of spaces available to participate and more respondents are being invited than spaces available, you may not be able to participate if the maximum number of respondents has been reached even if you are successfully screened.

Declaration by participant (via electronic signature)

By signing below, I (*e-mail address of respondent*) agree to take part in the research study entitled: exploring the relationship between selected internal consumer behaviour variables and the emotional response to the sensory properties of chocolate.

I (*name*) (*electronically inserted*) declare that:

- I have read this information/it was explained to me by a trusted person in a language with which I am fluent and comfortable.
- The research was clearly explained to me.
- I have had a chance to ask questions to both the person getting the consent from me, as well as the researcher and all my questions have been answered.
- I understand that taking part in this study is **voluntary** and I have not been pressurised to take part.
- I may choose to leave the study at any time and will not be penalised in any way if I do so.
- I may be asked to leave the study before it has finished, if the researcher feels it is in the best interest of myself or of the study, or if I do not follow the study plan, as agreed to.
- I may not be invited to participate should a sufficient quota have been reached of participants by the time that I complete the screening questionnaire.

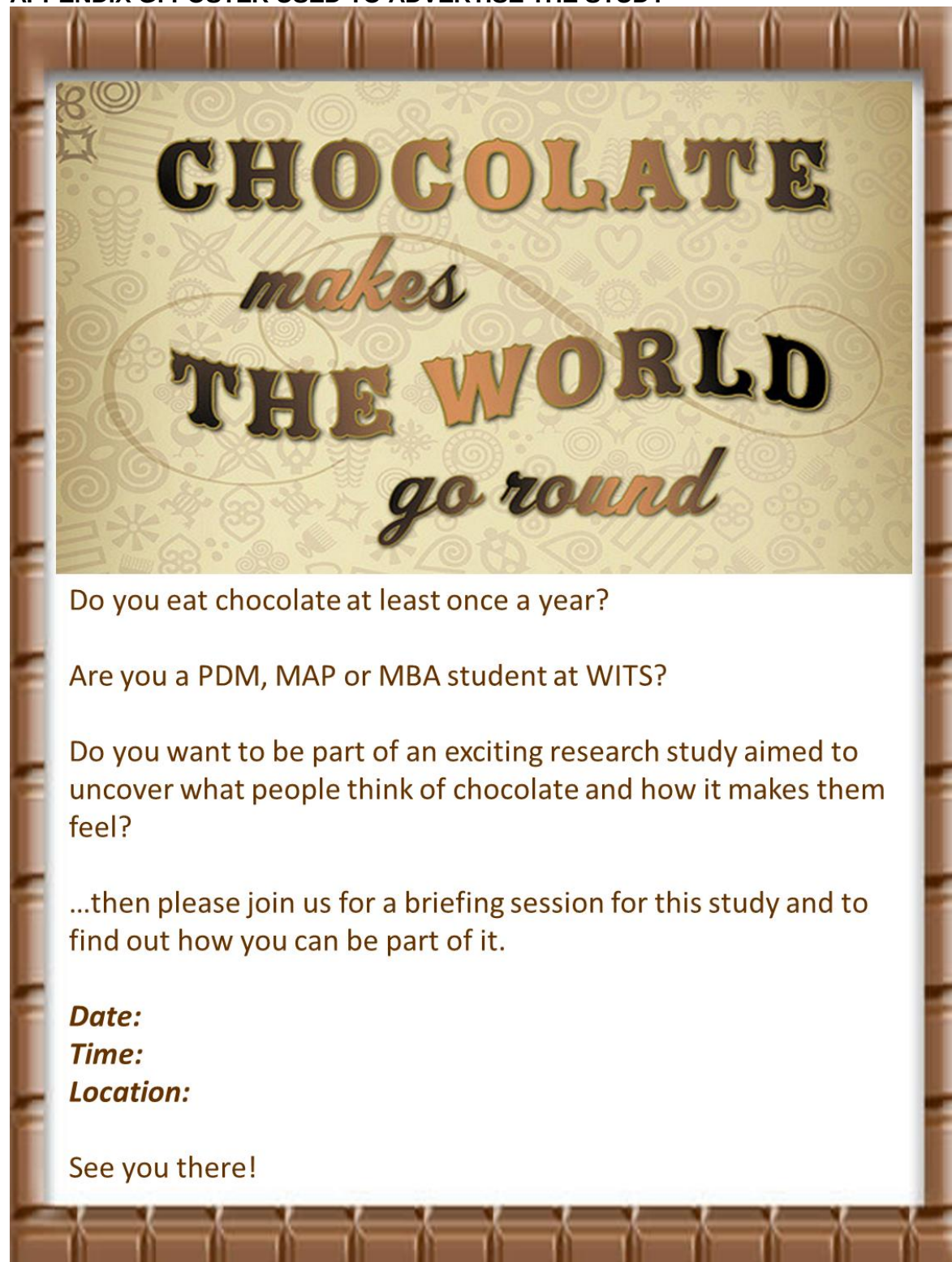
Signed at (*place*) (*insert electronically*) on (*date*) (*insert electronically*) 2017

Declaration by participant (via clicking a consent box)

(*Box clicked*).

Consent of participant

APPENDIX G: POSTER USED TO ADVERTISE THE STUDY



CHOCOLATE
makes
THE WORLD
go round

Do you eat chocolate at least once a year?

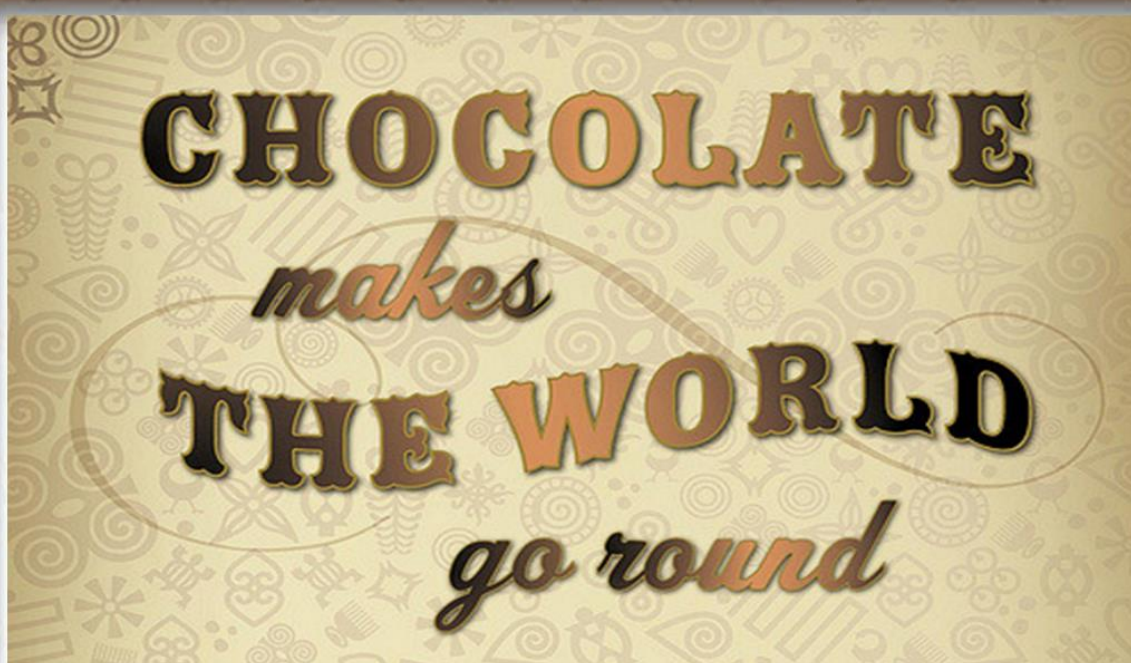
Are you a PDM, MAP or MBA student at WITS?

Do you want to be part of an exciting research study aimed to uncover what people think of chocolate and how it makes them feel?

...then please join us for a briefing session for this study and to find out how you can be part of it.

Date:
Time:
Location:

See you there!



DEAR STUDENT

You are being invited to take part in a **research study** that forms part of my PhD degree. Please take some time to read the information presented here, which will explain the details of this study. Please ask me any questions about any part of this study that you do not fully understand. It is very important that you are fully satisfied that you clearly understand what this research is about and how you might be involved.

Your participation is **entirely voluntary** and you are free to choose not to participate. If you say no, this will not affect you negatively in any way whatsoever. You are also free to withdraw from the study at any point, even if you do agree to take part now, without explanation or prejudice.

1. What is this research study all about?

We are investigating what types of chocolate people eat and how often, what their opinion is of chocolate, and how people feel after they eat chocolates that look, smell or taste different from one another.

2. Who is being invited to participate?

- In short, we are looking for people who eat chocolate, are 18 years or older, reside in the Johannesburg Municipal area, and have completed at least matric, and who are articulate and can easily grasp various concepts. Thus we are approaching students from the WITS Business School.
- You will not be able to take part in this research if you are allergic to any of the ingredients of chocolate, if you smoke regularly, if you have specific dietary requirements that does not allow the consumption of chocolate, if you suffer from gum disease, wear dentures, if you are on any medication or if you strongly dislike chocolate.
- In total, a maximum of 220 consumers will be included in this study.

3. What will be expected of you?

This study will be conducted online and can be completed in the comfort of your home. It will involve (all during December 2017):

- Reviewing a consent form provided to you after the information session should you be interested in participation, and signing this consent form electronically, which can take up to 20 minutes
- Completing a screening questionnaire which will take a maximum of 5 minutes
- Completing the research survey whilst tasting different types of chocolates which could take up to an hour to complete and needs to be completed in one sitting.

You will be notified of each research stage via e-mail, and links to each of the above will be supplied in these mails.

4. Will you gain anything from taking part in this study?

- You will be making a contribution to a very unique study that has never before been performed in South Africa and which will make a big contribution to the academic world, and you will be one of the first people who will see the results; and
- You will be able to tell us how you experience chocolate and how it makes you feel, and maybe learn a bit more about something you eat often.

5. Will you be paid to participate or will it cost you anything?

- You will not be paid to complete the survey; however you will be able to keep the cooler bag in which you will receive your samples.
- You will also be entered into a draw to win one of three shopping vouchers to the value of R500, R400 or R300.
- To complete the consent form, screening questionnaire, and the survey you will have to access the internet (Survey Monkey) and you may incur minimal data charges.

6. What will happen with the findings?

The data that will be collected will only be used for this study. After the survey has been completed by all the respondents, the data will be compiled, analysed and the results or parts of the results will be published in various journals and presented at local and hopefully international conferences.....and of course....to you!

7. How will you get to know about the results of this research?

We will present you with the results of this research when all analysis and summaries have been completed. You will be informed of any new relevant findings after this by e-mail.

8. How will we protect your confidentiality and who will see your findings?

- Anonymity of your findings will be protected by not recording your name on any of the documentation from the online survey (only on the consent form), but we will ask for your e-mail address in order to communicate with you and to identify you if you do want to withdraw your answers from the research.
- Your privacy will be respected throughout the study and your results will be kept confidential by all those involved in the research project as only the researcher, her supervisor and those involved in analysing the data will see the answers to the questions and will be able to review the findings.
- Furthermore, the HREC (Health Research Ethics Committee of the Faculty of Health Sciences of the North-West University) may inspect the results.
- Findings will be kept safe by storing data electronically, password protected, on the computer of the researcher and Dr Annchen Mielmann from NWU. Data will be stored locally for 7 years.

9. The fine print....Are there risks involved in you taking part in this research, and what will be done to prevent them?

a) There is a risk if you are allergic to or have sensitivity to any of the ingredients of chocolate, so if you do have any of these allergies you should not participate in the study. If you are unsure whether you are allergic to the ingredients you should also not participate in the study.

b) You may get tired when completing the survey as it could take up to an hour to complete, but as it is not timed you can take a break at any time when you feel you need to. However, the survey needs to be completed in one sitting which means you can't do it over two days or split it between the morning and the afternoon.

10. Who are the researchers and what are they responsible for?

PRINCIPAL INVESTIGATOR: Dr. Annchen Mielmann (PhD Food Science, NWU)

POST GRADUATE STUDENT: Innike Taljaard (M. Consumer Science), PhD Student at North-West University.

The researcher is responsible for all elements of the study, including the planning and execution of all stages of the study, including design of the questionnaires, collection of the data, and analysis and reporting of the data.

11. Is there anything else that you should know?

This study has been approved by the Health Research Ethics Committee of the Faculty of Health Sciences of the North-West University (NWU-00029-17-S1) and will be conducted according to the ethical guidelines and principles of Ethics in Health Research: Principles, Processes and Structures (DoH, 2015) and other international ethical guidelines applicable to this study. As a result, it may be necessary for the research ethics committee members or other relevant people to inspect the research records.

This study is supported by AUTHeR at the North-West University.

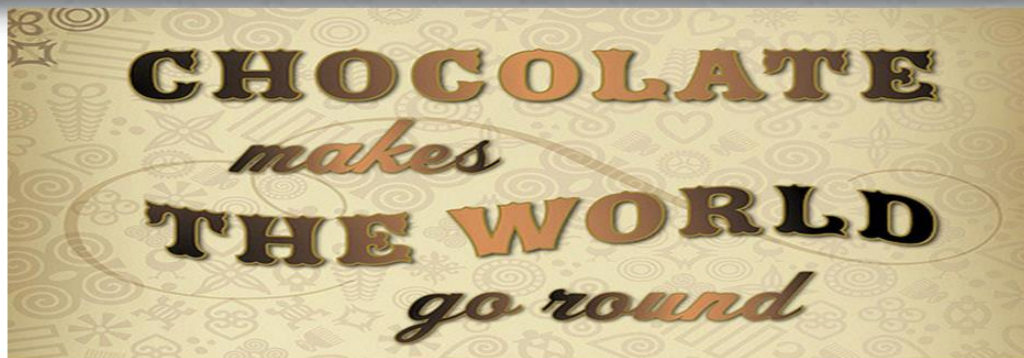
You need not be concerned or worried about the accuracy of your answers as there are no right or wrong answers. We just want your honest opinion.

You can contact the researcher, Innike Taljaard at chocolatestudy2017@gmail.com if you have any further questions or have any problems. You can also contact the Health Research Ethics Committee via Mrs Carolien van Zyl at 018 299 1206 or carolien.vanzyl@nwu.ac.za if you have any concerns that were not answered about the research or if you have complaints about the research.

You have received a copy of the consent form for your own purposes, which also contain all of this information.

As there are a limited number of spaces available to participate and more respondents are being invited than spaces available, you may not be able to participate if the maximum number of respondents has been reached even if you are successfully screened.

APPENDIX I: E-MAIL TO STUDENTS REGARDING CONSENT FORM



From: [SurveyMonkey](#)

To: WITS student database

Dear student

Thank you for your interest in this study . Before you complete the screening questionnaire and survey, you need to provide consent to participate. The link below contains all the study information, all of which have been shared with you before in the information session, and are all captured in the consent form given to you at this session. Please review it in detail and If you agree to the conditions of the study, you can consent with an electronic signature.

After you have completed the consent form, you will receive further e-mails containing all the necessary information regarding a) the screening questionnaire, b)the collection of your research samples and c) the link to the online survey.

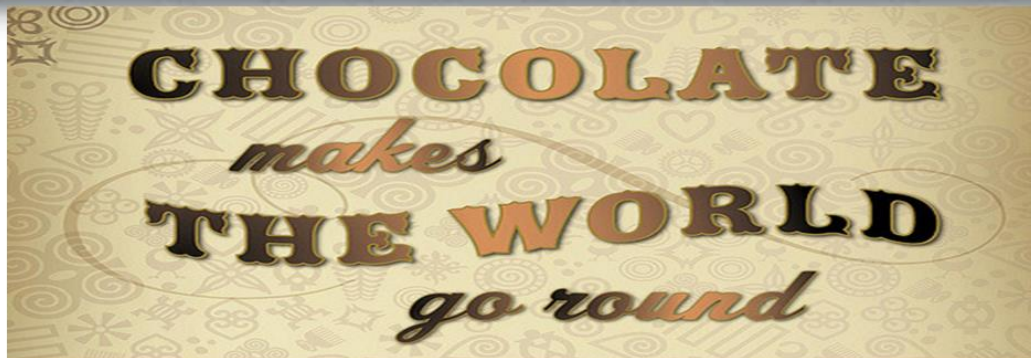
LINK

If you have any questions, comments or concerns, you may contact the researcher at: chocolatestudy2017@gmail.com. You can also contact the Health Research Ethics Committee via Mrs Carolien van Zyl at 018 299 1206 or carolien.vanzyl@nwu.ac.za if you have any concerns that were not answered about the research , or if you have complaints about the research.

Regards

The Research Team

APPENDIX J: E-MAIL TO STUDENTS REGARDING SCREENING QUESTIONNAIRE



From: chocolatestudy2017@gmail.com

To: WITS student database

Dear student

Thank you for providing consent to participate in the study. As was explained to you and pointed out in the pamphlet about this research, there are specific criteria for participants.

In order to ascertain whether you comply with these, please complete the questionnaire in the below link, after which you will receive an email regarding your participation should you comply with the inclusion criteria and should there still be spaces available. This e-mail will contain further information regarding the next steps of the study.

LINK

If you have any questions, comments or concerns, you may contact me at: chocolatestudy2017@gmail.com. You can also contact the Health Research Ethics Committee via Mrs Carolien van Zyl at 018 299 1206 or carolien.vanzyl@nwu.ac.za if you have any concerns that were not answered about the research, or if you have complaints about the research.

Regards

Innike Taljaard

APPENDIX K: SCREENING QUESTIONNAIRE

Please answer the below questions truthfully to determine whether you qualify to participate:		
S1	What is your age?	
	Under 18 years of age	END
	Over 18 years of age	CONTINUE
S2	What is your highest level of education?	
	Grade 11 and below	END
	Grade 12 and higher	CONTINUE
S3	Which municipal area do you reside in? (Respondents will be presented with a map of the 7 regions of Johannesburg to ensure they reside in one of these)	
	Other	END
	Johannesburg	CONTINUE
S4	Do you smoke regularly?	
	Yes	END
	No	CONTINUE
S5	Do you have allergies or sensitivities to any of the following ingredients?	
	Yes	PROBE FURTHER. IF ALLERGIES OR SENSITIVITIES FOR INGREDIENTS EXIST, END (REFER TO INGREDIENT LIST ATTACHED)
	No	CONTINUE
S6	Do you have any dietary requirements? (such as vegan, halaal, banting, low glycemic index, diabetic etc.)	
	Yes	END
	No	CONTINUE
S7	Are you currently on any medication?	
	Yes	END
	No	CONTINUE
	Unsure	END
S8	Do you suffer from gum disease or do you wear dentures?	
	Yes	END
	No	CONTINUE
S9	Are you currently, or suspect that you may be pregnant?	
	Yes	END
	No	CONTINUE
S10	How often do you consume chocolate?	
	Daily	
	Weekly	
	Monthly	
	At least once a year	
	Never	END
S11	Do you strongly dislike chocolate?	
	Yes	END
	No	CONTINUE

APPENDIX L: CHOCOLATE INGREDIENT LIST

CANDEREL

Ingredients: Sweetener (Maltitol), Inulin (Fibre), Milk Powder (Cow's Milk), Cocoa Butter, Cocoa Mass, Concentrated Butter (Cow's Milk), Emulsifier (Soy), Aspartame* (non-Nutritive Sweetener), Flavouring.

Other information:

Cocoa solids: 32% min. Milk solids: 23% min.

May contain peanuts and other tree nuts and gluten.

Nutritional information:

	Per 100g	Per 30g single serving
Energy	2047kJ	614kJ
Protein	7.4g	2.2g
Carbohydrate	38g	11g
- of which total sugar	9.3g	2.8g
Total fat	33.4g	10g
- of which saturated fat	20.8g	6.2g
Dietary fibre	19.2g	5.8g
Sodium	39mg	12mg

LINDT

Ingredients: Sugar, cocoa butter, whole milk powder, cocoa mass, anhydrous milk fat, lactose (cow's milk), skimmed milk powder, barley malt extract (gluten), emulsifier (soya lecithin), flavouring (vanilla).

Other information:

Contains: Cocoa solids 30% min., Milk solids 20% min.

Contains: Cow's milk, barley (gluten) and soya.

May contain wheat (gluten), sesame seeds and tree nuts.

Nutritional information:

	Per 100g	Per 30g single serving
Energy	2387kJ	716kJ
Protein	6.4g	1.92g
Carbohydrate	51g	15.3g
- of which total sugar	50g	15g
Total fat	37g	11.1g
- of which saturated fat	23g	6.9g
Dietary fibre	2.4g	0.7g
Sodium	114mg	34.2mg

NESTLÉ

Ingredients: Cane sugar, Full Cream Milk Powder, Cocoa Mass, Vegetable fat (palm fruit, shea nut, illipe seed), Cocoa butter, Whey powder, Emulsifiers (soya lecithin E322, E476), Flavouring.

Other information:

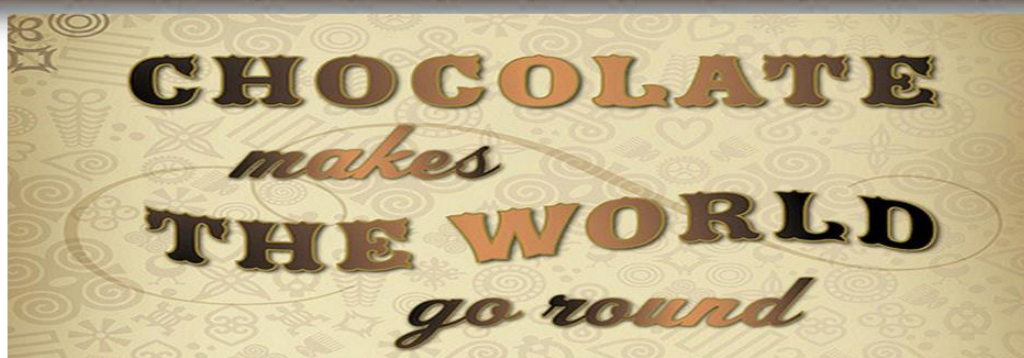
Allergens: Contains cow's milk and soya

May contain tree nuts, peanuts and gluten

Nutritional information:

	Per 100g	Per 30g single serving
Energy	2203kJ	507kJ
Protein	4.6g	1.1g
Carbohydrate	56g	13g
- of which total sugar	51.1g	11.8g
Total fat	32.6g	7.5g
- of which saturated fat	19.4g	4.5g
Dietary fibre	2.1g	0.5g
Sodium	125mg	29mg

APPENDIX M: E-MAIL TO STUDENTS REGARDING COLLECTION OF SAMPLE PACKS



From: chocolatestudy2017@gmail.com

To: WITS student database

Dear student

The time has come....and the study will take place over the weekend of 1 December 2017 – 3 December 2017. You will only be able to access the survey on these dates, so please ensure that you will be able to set an hour aside to complete it. You can collect your samples at the cafeteria of the WITS Business School on any of the below dates during the indicated time slot: Monday 27 Nov 4pm-5pm; Tuesday 28 Nov 1pm-2pm; Wednesday 29 Nov 1pm-2pm; Thursday 30 Nov 4pm-5pm; Friday 1 Dec 1pm-2pm; Saturday 2 Dec: 10am-11am.

These will be sealed and packaged in a cooler bag along with storage instructions. If you will not be attending class on this date, kindly inform me to make alternate arrangements. You will receive an e-mail containing the link to the study 48 hours before it starts, so please keep an eye out for it.

If you have any questions, comments or concerns, you may contact me at: chocolatestudy2017@gmail.com. You can also contact the Health Research Ethics Committee via Mrs Carolien van Zyl at 018 299 1206 or carolien.vanzyl@nwu.ac.za if you have any concerns that were not answered about the research, or if you have complaints about the research.

Regards

Innike Taljaard

APPENDIX N: STEPS IN THE PREPARATION OF THE SAMPLE PACKS

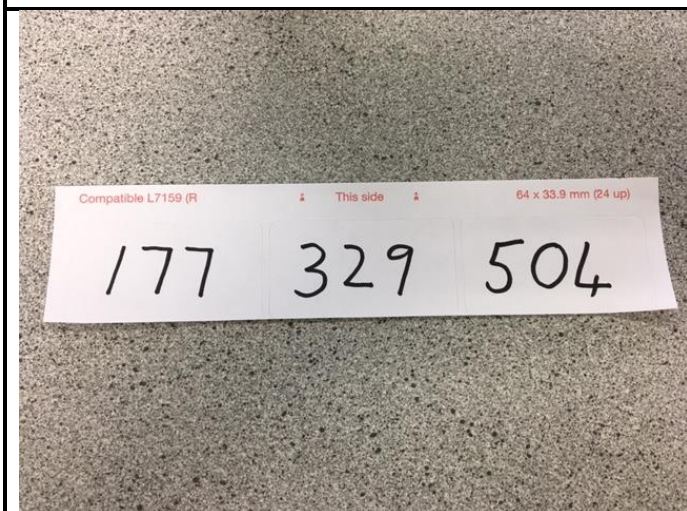
	• Sample preparation took place in a sterile laboratory at the premises of Firmenich South Africa (www.firmenich.com). • Non-latex gloves were worn at all times during preparation.
	• Most chocolates in tablet format in South Africa have branding imprinted on the surface. As this is a non-branded (blind) study, the branding had to be removed.
	• To remove the branding, a hot spoon was placed on the surface which slightly melts the chocolate. • The spoon was heated with the use of boiling water – the spoon end was simply submerged in a container of boiling water for approximately 10 seconds. • All equipment used was thoroughly cleaned before and during use.



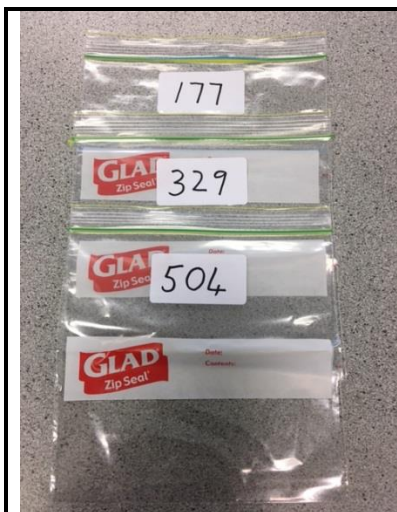
- The spoon was held to the surface of the chocolate for 5 seconds and then removed.



- The sample was then left to harden at room temperature for 2 hours.



- Each sample was labeled with a three digit random code. Each of the three samples had only one code allocated to it that was used throughout the study and was provided to all students.
- These were written in permanent ink to ensure they did not wipe or rub off.



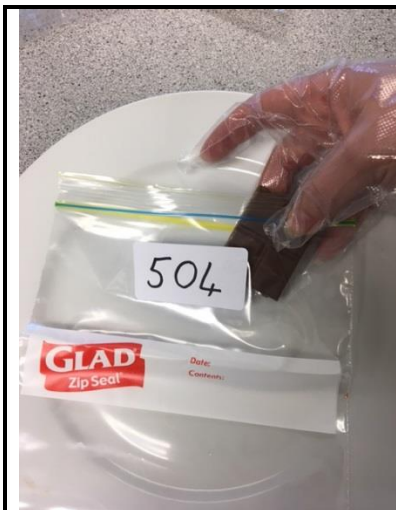
- The labels were stuck on each of the zip-lock bags in which the samples were placed. They were large and clearly visible.



- Respondents were also provided with water biscuits for palate cleansing (before consuming each sample). Thus three water biscuits were placed inside a zip-lock bag.



- Any air in the packet was pushed out and it was sealed.



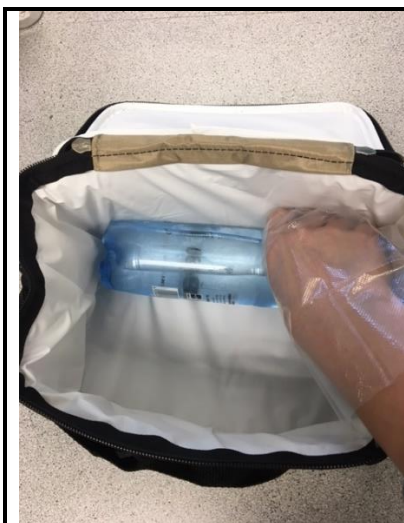
- Four blocks of each chocolate (of which the branding was removed) included in the study was placed in a zip-lock bag with the correlating code.



- Any air in the packet was pushed out and it was sealed.



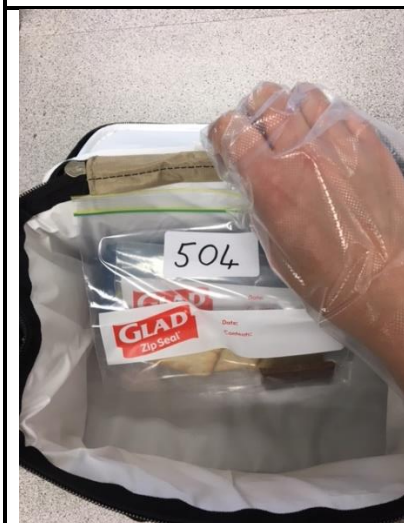
- Three sample packs of chocolate was prepared.
- One chocolate was prepared at a time and only once all 220 packs of the one chocolate was completed did the preparation of the next one commence to avoid any possible contamination.
- All equipment used was thoroughly cleaned before the next sample was prepared.



- Once all the samples were packed, the cooler bag was prepared.
- The water bottles were all washed and thoroughly dried in the laboratory to remove any outside dirt that may have accumulated during transport and sale before it was placed in the bag.
- Firstly a bottle of still water was placed inside the bag. The water was at room temperature to ensure it did not affect the water biscuits or the crackers.



- Secondly the crackers were placed in the cooler bag.



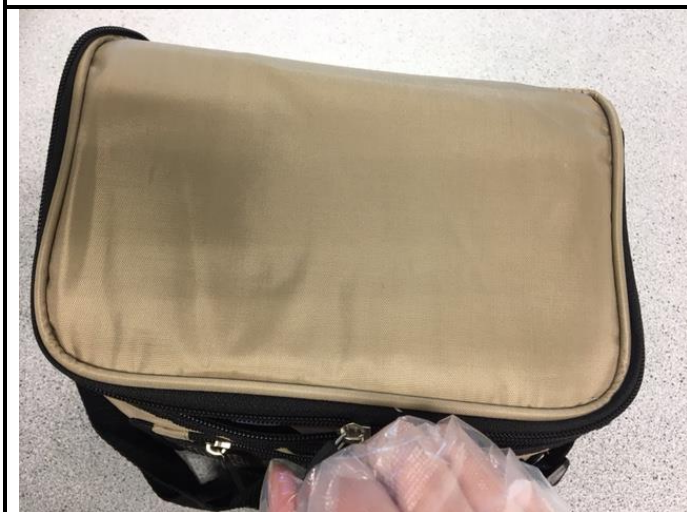
- Thirdly the chocolate samples were placed in the bag, one at a time.



- The second sample was placed.

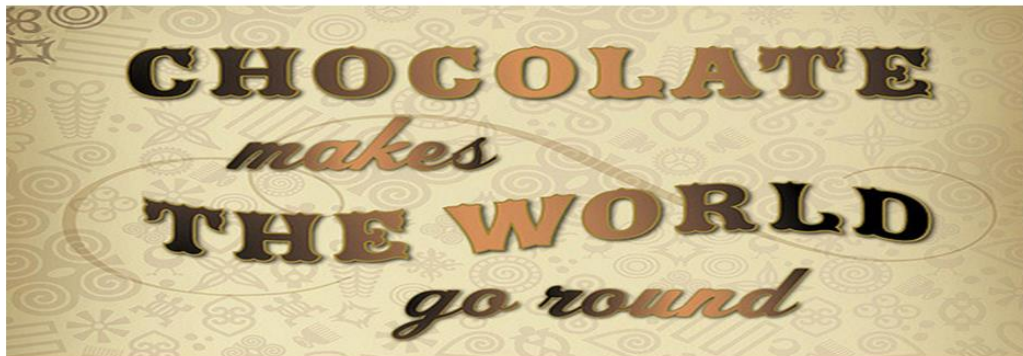


- The third sample was placed, and it was verified that all three codes are in the bag and that there were no duplicates.



- The bag was sealed.

APPENDIX O: STORAGE INSTRUCTIONS



STORAGE INSTRUCTIONS

1. Place the cooler bag in a cool, dry area, ensuring it is not in direct sunlight or exposed to any other source of heat.
2. Leave the samples inside the cooler bags within the sealed plastic packets until you consume them.
3. DO NOT refrigerate or freeze the samples. Store it at room temperature.
4. Do not put anything else in the cooler bag with the samples as chocolate easily picks up the smell of other foods.

APPENDIX P: QUESTIONNAIRE INSTRUCTIONS

QUESTIONNAIRE INSTRUCTIONS – IMPORTANT – PLEASE READ

1. Please attempt to complete the questionnaire in one sitting – if you need to take breaks please do but please do not exit the survey until it is completed.
 2. You do not have to consume all the chocolate to complete the survey – more is provided than what you need. Also please note there are three sections to complete for each chocolate sample, thus please do not finish all of the chocolate during the first question.
 3. Please take note of the code on each sample pack and ensure it matches the code on the questionnaire when you are answering the questions.
 4. You will see that the surface of two of the three samples of the chocolate will look distorted. This is as brand names have been removed by melting the surface. All handling of chocolates and other items in your bag took place in a laboratory and gloves and hairnets were used by those handling it.
 5. You will have to answer every question in each section before the survey will allow you to move on to the next section.
 6. Please ensure that, before you taste each chocolate, you cleanse your palate by eating a biscuit and drinking some water (even before the first chocolate).
 7. Please ensure you record your e-mail address at the end of the survey – and please use the same e-mail address provided for the screening questionnaire.
-
- Once all responses have been recorded the winners of the vouchers will be drawn and they will be notified via e-mail.
 - When the study has been completed, results will be shared with everyone who participated.
 - If you have any queries or concerns before, during or after the survey – please send an e-mail to the study e-mail address from which you received the link to the survey.

APPENDIX Q: SURVEY SCALES

SURVEY SCALES

You may at times, depending on the device that you are using, find that the scale of the question disappears at the top of the screen as you scroll down to the bottom. In case this happens, please refer to below scales for each question:

Question 1

Not at all	Slightly	Moderately	Very	Extremely

Question 6

Daily	Weekly	Monthly	Once a year/Rarely	Never

Question 10 & 11 & 12

Not at all	Slightly	Moderately	Very	Extremely

Question 13 & 14 & 15

Not at all	Slightly	Moderately	Very	Extremely

Question 16

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

APPENDIX R: E-MAIL TO STUDENTS WITH LINK TO SURVEY



From: chocolatestudy2017@gmail.com

To: WITS student database

Dear student

By now you will have received your samples. Please ensure that they are stored according to the storage instructions until you complete the survey. Below is the link to access the survey. Please remember:

1. The survey must be completed during this coming weekend (thus between 6am on Friday 1 December 2017 and 12pm on Sunday 3 December 2017).
2. Please complete the survey when and where you would usually eat chocolate, for example, if you usually have chocolate after dinner on a Saturday, please complete the survey around the same time and in the same location. If you do not have a specific time and place you can complete it anywhere and at any time.
3. Please follow the instructions provided in the survey, as it will explain how to assess each sample, cleanse your palate etc. It is very important that you do not deviate from the instructions.
4. Please complete the survey by yourself, without any assistance or the opinion of others.
5. The survey needs to be completed in one sitting, however you can take breaks if you feel tired.

LINK

If you have any questions, comments or concerns, you may contact me at: chocolatestudy2017@gmail.com. You can also contact the Health Research Ethics Committee via Mrs Carolien van Zyl at 018 299 1206 or carolien.vanzyl@nwu.ac.za if you have any concerns that were not answered about the research, or if you have complaints about the research.

Regards

Innike Taljaard

APPENDIX S: MOOD QUESTIONNAIRE (MAIN QUESTIONNAIRE SECTION A)

A. Please complete the below questionnaire by ticking the appropriate box for each adjective, to give an indication of your mood at the moment. Please work quickly and do not think too long about the answer.						
		0 Not at all	1 Slightly	2 Moderately	3 Very	4 Extremely
A1	Wide awake					
A2	Relaxed					
A3	Depressed					
A4	Friendly					
A5	Anxious					
A6	Clumsy					
A7	Cheerful					
A8	Drowsy					
A9	Aggressive					
A10	Clear-headed					
A11	Well-coordinated					
A12	Confused					

APPENDIX T: DEMOGRAPHIC QUESTIONNAIRE (MAIN QUESTIONNAIRE SECTION B)

B. Please answer the questions below by selecting the correct option:		
B1	What is your gender?	
	Male	
	Female	
B2	What is your age?	
	18-29 years	
	30-39	
	40-49	
	50-59	
	60 years and older	
B3	What is your highest level of education achieved?	
	Grade 12	
	Certificate/Diploma	
	Degree	
	Post-graduate degree	
B4	What is your ethnicity?	
	Black	
	White	
	Coloured	
	Indian	
	Asian	
	Not prepared to answer	

APPENDIX U: FAMILIARITY QUESTIONNAIRE (MAIN QUESTIONNAIRE SECTION C)

C. Please indicate how often you consume the following types of chocolates:							
	Segment	Examples	Daily	Weekly	Monthly	Once a year/ Rarely	Never
C1	Alfajores (Sandwich biscuit with chocolate centre or covered biscuits)	• Arnott's Tim Tam Chocolate Coated Biscuits • Bakers Choc Kits Biscuits • Bakers Romany Cream Biscuits • Cadbury Fabulous Fingers					
C2	Bagged selflines/softlines (Small identical items such as chocolate buttons)	• Cadbury Astros • Cadbury Tumbles • Cadbury Whispers • M&Ms • Nestlé Smarties					
C3	Standard boxed assortments (Bite size chocolates, often with fillings)	• Beacon Heavenly Selection • Ferrero Roche Pralines • Lindt Assortment Mini Pralines • Nestlé Quality Street • Regent Street Assortment					
C4	Twist wrapped miniatures (Miniature versions of chocolate bars, wrapped)	• Mars Bounty mini's • Mars Snickers mini's • Nestlé Kit Kat Fun Bag • Nestlé Passions					
C5	Chocolates with toys	• Disney Cars Egg Surprise • Ferrero Kinder Joy					
C6	Countlines (Chocolate bars)	• Beacon Inside Story • Cadbury Crunchie • Cadbury Flake • Nestlé Kit Kat • Nestlé Peppermint Crisp					
C7	Seasonal chocolate	• Chocolate Advent Calendars • Hollow chocolate easter eggs • Lindt Easter Bunny					
C8	Filled tablets (slabs) (With a soft filling or hard pieces such as biscuits, nuts, mint)	• Cadbury Dairy Milk Cashew & Coconut slab • Beacon Fruit & Nut slab • Beacon Turkish Delight slab • Nestlé Rolo slab					
C9	Plain dark tablets (slabs)	• Beacon Midnight Velvet slab • Cadbury Bournville slab					
C10	Plain milk tablets (slabs)	• Nestlé Aero slab • Beacon milk chocolate slab • Cadbury Dairy Milk Bubbly slab • Cadbury Dairy Milk slab					
C11	Plain white tablets (slabs)	• Beacon Ivory Cream slab • Nestlé Milky Bar					
C12	Other Chocolate E.g. Chocolate lollipops *Please specify:						

**APPENDIX V: FOOD ACCEPTABILITY QUESTIONNAIRE (MAIN QUESTIONNAIRE
SECTION D)**

D. Please indicate which below statement you agree with for each sample (select one):	
D1: Sample 501	
I would eat this chocolate every opportunity I had	
I would eat this very often	
I would frequently eat this	
I like this and would eat it now and then	
I would eat this if available but would not go out of my way	
I don't like it but would eat it on occasion	
I would hardly ever eat this	
I would eat this only if there were no other food choices	
I would eat this only if I were forced to	
D2: Sample 230	
I would eat this chocolate every opportunity I had	
I would eat this very often	
I would frequently eat this	
I like this and would eat it now and then	
I would eat this if available but would not go out of my way	
I don't like it but would eat it on occasion	
I would hardly ever eat this	
I would eat this only if there were no other food choices	
I would eat this only if I were forced to	
D3: Sample 864	
I would eat this chocolate every opportunity I had	
I would eat this very often	
I would frequently eat this	
I like this and would eat it now and then	
I would eat this if available but would not go out of my way	
I don't like it but would eat it on occasion	
I would hardly ever eat this	
I would eat this only if there were no other food choices	
I would eat this only if I were forced to	

APPENDIX W:

WORKING ARTICLE PREPARED FOR FOOD QUALITY AND PREFERENCE

*Please note: As this chapter was prepared for submission to the Journal Food Quality and Preference, repetition from previous chapters will be noted. Language and style used in this working article are in accordance with the requirements of the Journal Food Quality and Preference. This article is also still in draft.

APPLYING TRAINED PANEL DATA TO REFINE A SENSORY DESCRIPTOR LIST AND SELECT PRODUCTS FOR A CONSUMER-CENTRIC STUDY

Innike Taljaard^a, Annchen Mielmann^a, Neoline le Roux^a

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ABSTRACT

The aim of this study was to prepare a list of sensory descriptors and select chocolate products through the application of trained panel evaluation data for inclusion in a consumer study. Six panelists evaluated 12 milk chocolates in slab (tablet) format using a questionnaire consisting of 49 sensory descriptors. The questionnaire was compiled specifically for this study and was designed for completion by consumers and thus included the descriptors, definitions and reference products. Data collected through the evaluation of the chocolates were reviewed on various levels, including total scores assigned to all chocolates, to individual chocolates, to sensory descriptor-sub-group and at an individual attribute level to assess panelist performance. Panelist sensitivity was also determined. Ability of the sensory descriptors to discriminate between the samples was subsequently considered. In order to select chocolates for inclusion in the consumer study, factor analysis was performed to group the descriptors. Through this process the list of descriptors was reduced to 15 and three chocolates were selected for inclusion in the consumer study.

KEYWORDS

- Sensory evaluation
- Trained panel
- Consumer panel
- Sensory descriptors
- Chocolate

1. Introduction

Sensory evaluation can be divided into two categories, namely objective and subjective testing. In objective testing, the sensory attributes of a product are evaluated by a trained panel. In subjective testing, the reactions of consumers to the sensory properties of products are measured (Kemp *et al.*, 2011). Trained sensory panels are often used in numerous portions of sensory studies. In many instances, these panels are involved in early stages of a project to gain fast sensory knowledge (Delarue, 2014). They are most often employed to conduct sensory descriptive analysis or sensory profiling which involves the discrimination (determining whether there are sensory differences between samples) and description (identifying the nature of sensory differences and/or the magnitude of these differences) of the sensory attributes of products (Murray *et al.*, 2001; Meilgaard *et al.*, 2006). Descriptive sensory analysis has remained one of the most powerful, sophisticated and most extensively used tools in sensory science (Varela & Ares, 2012), as it pinpoints differences among products (Yang & Lee, 2019).

In both industrial and academic fields, descriptive sensory analysis or profiling is used specifically to serve as the link between product properties or characteristics and consumer reaction or perception (King & Meiselman, 2010), most often in terms of acceptability or liking. This is based on historic thinking, that trained panels are required for sensory profiles and to perform analytical tests (as above, either discriminative and descriptive) (Stone & Sidel, 2004), and consumers are required for affective tests and hedonic profiles only (Worch *et al.*, 2010). There is however evidence that consumers can not only indicate acceptability, but also provide accurate information about the sensory properties of products, which in many situations is similar to that provided by trained assessors (Moskowitz, 1996; Husson *et al.*, 2001; Dooley *et al.*, 2010; Moussaoui & Varela, 2010; Worch *et al.*, 2010; Ares *et al.*, 2011a). Based on this, the interest in consumer-based methodologies has increased, and has also motivated the need to directly include consumer input in new product development processes (Valentin *et al.*, 2012; Varela & Ares, 2012). Including consumers in sensory analysis studies allows for quantitative characterisation of product attributes, as consumers directly assess stimuli for researchers to comprehend the sensory dimensions that discriminate amongst the stimuli (Lê *et al.*, 2016). Therefore, descriptive sensory analysis or profiling is increasingly conducted with consumer panels, as it identifies the sensory drivers essential for consumer acceptance and marketing of products (Reinbach *et al.*, 2014). In response to this evolution in thinking, many new tools (e.g. check-all-that-apply or rate-all-that-apply, and descriptive sensory analysis) have emerged as complementary tools to sensory and consumer science that can be applied to gather product

descriptions directly from consumers, with the added benefit of having direct feedback from them, and sometimes even with their own vocabulary (Moussaoui & Varela, 2010).

Despite this, many companies are still looking to trained panels to accurately profile products as trained assessors perform well for analytical (discriminative and descriptive) sensory tests and sensory profiles (Stone & Sidel, 2004; Lawless & Heymann, 2010; Worch *et al.*, 2010). From a data validity point of view, a trained panel offers:

- a) Lower variability in results, as it has been reported that the results of consumers who are not trained show more variability in results vs. a trained panel (Worch *et al.*, 2010). This consensus makes it possible to see actual product variances vs. rating variances;
- b) Better discrimination between samples (Barcenas *et al.*, 2004) which can assist in selecting the correct intrinsic characteristics which can lead to better discrimination in a consumer panel (Niimi *et al.*, 2018); and
- c) Ability to rate not only intensity of sensory attributes but also indicate presence of such attributes in products. Giacalone *et al.* (2013) found that with a trained panel, the RATA scale resulted in good reproducibility at panel level, with a high level of agreement between product maps obtained from individual replicates. It also showed good reproducibility for individual attributes. This allows for the elimination of attributes that are possibly not relevant to the products being assessed.

Although it has been widely accepted that trained assessors outperform consumers, their superiority seems to be mainly related to their familiarity with the experimental procedures used for sample evaluation (Ishii *et al.*, 2007), as well as their ability to describe their perception (Chollet & Valentin, 2001). An argument which has been put forward against the use of consumers for analytical tasks has been related to the fact that consumer attribute information is not reliable because they face several difficulties in understanding product attributes and scales (Munoz, 1997; Stone & Sidel, 2004). However, this direct comparison is not fair, as trained assessors use a common and standardized vocabulary, previously learnt evaluation protocols, and are thoroughly trained to rate the intensity of sensory attributes using scales with clearly defined references (Lawless & Heymann, 2010). On the other hand, when consumers are asked to evaluate specific sensory attributes they are not usually given precise instructions about how to evaluate or rate the products.

The panel process usually involves vocabulary development, including eliminating synonymous or redundant descriptors, in order to reduce the number of descriptors. In some instances, vocabulary is not developed, but the panel will use an existing attribute list or lexicon (Rogers, 2017). References are often included to reduce panelist variability in the interpretation of the descriptors (Kilcast & Subramaniam, 2011). This is followed by intensity measurement (Kilcast & Subramaniam, 2011). Trained panels are thus deeply entrenched in the generation and measurement process, while as stated above, consumers are often provided with the output of the panel process which could be difficult for them to interpret.

In this study, a trained panel was employed to describe and discriminate between 12 chocolates available in the South African retail space, using a questionnaire that was designed ultimately for a consumer panel. Connecting the data from a trained panel to a consumer test for a common set of products is a very powerful development tool (Jog *et al.*, 2012) and in this study the aim was to generate and connect data with the least amount of variability between the trained panel and a consumer panel assessment as outlined above.

It was recognized that a trained panel is better at discriminating between samples, which was crucial to the first stage of this project, as the objective was to reduce the number of attributes from a pre-defined list based on their relevance and intensity. This was done through a multidimensional approach which enabled the evaluation and indication of the relative importance and contribution of descriptors in products' differentiation (Belović *et al.*, 2012). It was furthermore done to select from the set of chocolates those which best represent the variation in intensity of the sensory properties as identified by the trained panel.

The questionnaire that was used for the evaluation was designed through the review of various studies regarding the sensory attributes of chocolate, and included attribute descriptors, definitions, reference products and a measurement scale. Unlike other studies where both a trained and consumer panel assembled product profiles of samples according to the vocabulary chosen by the trained panelists (Loso *et al.*, 2012), in this study, both panels would receive the same vocabulary. Furthermore sample preparation and evaluation was conducted in the same manner, where as it is often treated differently in analytical tests with trained panels (Vidal *et al.*, 2016). Through this process, three chocolates were selected which were representative of the variety of the sensory experience of chocolates available in the retail space. The list of sensory descriptors to be reviewed were also reduced from 49 to 15 descriptors which best describe the

samples and the variances between the samples in the market, which is also a number which is considered to be more manageable with a consumer panel.

It has been said that ratings and insights from trained panels are often used to make various project and product decisions (Mayhew *et al.*, 2018), and in this study, the trained panel was used as a tool to refine the materials for the consumer panel (both the list of sensory attributes and the product samples to be included). This is unlike many other studies where consumers are presented with the output from a trained panel which often includes the attribute or descriptor generation and measurement, as here, the trained panel evaluations were entrenched in the consumer research study. The consumer panel portion which would follow that of the trained panel is an extension of the experimental procedure with trained assessors (Ares *et al.*, 2011b) – thus there was complete alignment. This article outlines the methodology to generate, analyse and apply the data generated by a trained panel regarding the sensory properties of chocolate in order to refine the sensory attribute list and inform sample selection for the portion of the study where the ‘untrained’ consumer panel would conduct the sensory evaluation of chocolate. This article will indicate how the strengths and benefits of a trained panel can be leveraged in a consumer-centric study to ensure internal validity regarding sample and sensory descriptor selection, approached in a manner aligned with a consumer panel study.

2. Materials and methods

2.1 Questionnaire design

Questionnaires and thus sensory descriptors must be specific to the products being measured, as it has been found that product specific questionnaires are expected to be more discriminating in comparison to a standardised questionnaire (Ng *et al.*, 2013). A questionnaire was thus specifically designed for this study in order to capture the response of consumers to the sensory properties of chocolate which the trained panel used to evaluate the chocolate samples. This was done to ensure that the evaluation of the samples would be conducted in the same manner with no variation so that the results would be comparable as it was collected with the same research tool. It was furthermore approached this way in order to validate the tool, as this ‘untested’ questionnaire was to be provided to respondents without any prior training in attribute recognition or quantification. It offered an opportunity to review clarity of descriptors and definitions, discriminability of the scale, applicability of the sensory descriptors, as well as possible redundancies in the list of sensory descriptors. The following sections outline the

process which was followed to design the questionnaire which included the sensory descriptors, definitions of the descriptor, reference product examples and the scale.

2.1.1 Creating a list of all potential sensory descriptors

Varela and Ares (2012) stated that sensory terms could be selected for studies by reviewing results from previous qualitative or quantitative consumer studies, and this approach was applied in this study. As a starting point, a list of sensory descriptors for chocolate was compiled by reviewing the sensory descriptor lists generated in 13 different applicable studies focusing on chocolate (Viaene & Januszcwaska, 1997; Ziegler *et al.*, 2001; Sune *et al.*, 2002; Golob *et al.*, 2004; Lasekan *et al.*, 2007; de Melo *et al.*, 2009; Kennedy & Heymann, 2009; Nightingale, 2009; Thamke *et al.*, 2009; Thomson *et al.*, 2010; Leite *et al.*, 2013; Norhayati & Ayob, 2014). In addition, the Blommer chocolate wheel of flavour was also consulted (BlommerChocolateCompany, 2009). The initial list consisted of 49 descriptors.

2.1.2 Generating definitions for all descriptors

Definitions of descriptors are commonly used with trained panels, and is applied to achieve concept alignment (Giboreau *et al.*, 2007). Defining words mean that others can better understand what is being said, and could provide consistency in consumer comprehension and interpretation. A review of food sensory science books and research articles highlights the importance of descriptor definitions: “they serve as a guide for the subjects during testing to minimise confusion over the meaning of each attribute” and “linking the attributes with definitions enables the subjects to proceed rapidly and misunderstandings are minimised” (Stone & Sidel, 2004). For the purposes of this study, a definition of each sensory descriptor was generated through a review of past sensory studies, as well as by consulting dictionaries, and finding consumer definitions and interpretations on various websites on the internet. The definitions of the descriptors which were generated were checked against the basic principles list of creating definitions which was created by a lexicographer to ensure correct interpretation by consumers (Landau, 1989).

2.1.3 Inclusion of reference products

In addition to providing a definition for each descriptor, when possible, a reference product was also provided, as another linguistic device can be to state a reference to a product, i.e., giving an object example to define the descriptor such as “old butter taste” to define rancid (in dessert creams) (Giboreau *et al.*, 2007).

2.1.4 Selecting the measurement tool and scale

The RATA (rate-all-that-apply) measurement tool, a variation of check-all-that-apply (CATA) was applied to record respondent response. It was designed more recently to measure the presence and intensity of sensory properties of food products. RATA is more focused on intensity and is useful for in-depth characterisation (Meiselman, 2015), and is thus a more suitable technique for certain samples compared to CATA, especially when the intensity of terms is the main difference (Schouteten *et al.*, 2015), as these questions make it possible to obtain reliable scores for the intensity of sensory properties (Husson *et al.*, 2001; Worch *et al.*, 2010; Ares *et al.*, 2011a). As respondents are asked to not only select but also rate all the words from a list that apply to the product being evaluated, RATA is likely to trigger a more analytical mind-set in respondents. RATA does however often lead to lower responses compared to other techniques due to the focus intensity it requires from respondents (Schouteten *et al.*, 2015). A major benefit of RATA is that it does not lead to consumer bias when performing concurrent hedonic evaluation (Jaeger & Ares, 2015), and it improves hedonic discrimination between samples (Ares *et al.*, 2014; Jaeger *et al.*, 2015) as well as opens up more opportunities for statistical analysis (Ng, 2013). RATA questions have the advantage of using a similar approach to CATA questions and therefore also enable quick and easy data collection from large consumer samples (Schouteten *et al.*, 2015). RATA was employed to measure the intensity of sensory properties through the use of a 5-point unipolar verbal scale based on all abovementioned reasons.

2.2 Products which were evaluated

Twelve products available in the South African retail space were included in the study including: *Beacon* Milk Chocolate, *Belgian Harvest* Milk Chocolate, *Cadbury* Dairy Milk Chocolate, *Canderel* Milk Chocolate, *Clicks Smartbite* Milk Chocolate, *Cote D'Or* Milk Chocolate, *Lindt* Extra Creamy Milk Chocolate, *Lindt Swiss Classic* Milk Chocolate, *Milka* Milk Chocolate, *Nestlé* Milk Chocolate, *Wawel* Milk Chocolate, and *Woolworths Organic* Milk Chocolate.

2.3 Data collection procedure

A trained sensory panel was employed to evaluate the twelve products with the questionnaire designed for the study. This panel, consisting of six people, who had all been trained to assess and measure the intensity of the sensory properties of chocolate, were all employees of Flavour & Fragrance manufacturer, *Firmenich* (www.firmenich.com), a large international supplier to many international and local manufacturers. They had been exposed to multiple food product

categories and thus had extensive exposure across categories, and had received specific training on the chocolate category and more specifically on the products available in South African retail.

The trained sensory panel were briefed by the researcher on the objectives of the overall study, which was to gather data to conclude on the presence and intensity of the various sensory properties within each chocolate sample. The panel were informed that the ultimate objective was to select the most applicable sensory properties and to identify the chocolates which would best represent the sensory spread (variation in intensity of the various sensory properties) of these for inclusion in the consumer study. They were also informed of when the evaluation sessions would take place, how long the sessions would last, and that they would have to consume a large quantity of chocolate over the period of the study.

Once fully informed they were then given the option to agree or decline to participate in the study. All (six) the panel members agreed to participate. After the briefing, and obtaining their agreement to participate, they received the sensory questionnaire to review and ask questions to ensure full comprehension. No alterations were made after the review as all panellists were comfortable with the questionnaire layout and content, and the panel proceeded to evaluate the samples according to this questionnaire.

The panel proceeded to assess 12 chocolate products, and the evaluation took place over six working days spanning two weeks for two hours each day as the panel evaluated one sample per hour. Sessions were conducted early morning (10.00) and late afternoon (16.00) at least two hours after the panellists consumed breakfast and lunch as testing shortly after meals and coffee breaks may introduce bias and should be avoided (Meilgaard *et al.*, 2006), and were spaced six hours apart to also reduce fatigue during evaluation. Evaluations took place within a sensory evaluation room. They consumed bottled still mineral water (Nestlé brand) and water biscuits (Carrs brand) as palate cleansers before commencing evaluations.

2.4 Data analysis

Data was subsequently captured in Excel and analysed with Microsoft Excel (2010) and IBM SPSS Statistics Version 25, Release 23.0.0. Statistical analysis performed is addressed in each of the following sub-sections. Analysis of the panel data focused on five key areas:

2.4.1 Panelist performance

The performance level of a panel (of each assessor and of the panel as a whole) and the quality of the data they provide is of paramount importance for making proper decisions (Kermit & Lengard, 2005), and therefore monitoring panel performance is crucial to optimize sensory evaluations (Romano *et al.*, 2011). A good sensory panel should provide results that are accurate, discriminating and precise (Kermit & Lengard, 2005). However, despite training the reliability of collected data may suffer from panel agreement errors and individual assessor errors due to differences in motivation, sensitivity and psychological response behaviours (Lundahl & McDaniel, 1988). Poor assessor performance will eventually lead to disagreement errors in product ratings with respect to the rest of the sensory panel. Therefore, the first step in analysis of sensory data is to identify individual assessors performing abnormally or inconsistently and have their data for the ratings of the attributes reevaluated for inclusion in the further analysis.

According to (Kermit & Lengard, 2005) there are four agreement errors within a sensory panel that can be experienced:

- a) Magnitude error: The assessor uses a broader or smaller range of the scale than the rest of the panel.
- b) Crossover error: The assessor rates a product or set of products in the opposite direction from the rest of the panel.
- c) Non-discriminator error: The assessor rates all the products in a set as similar when the rest of the panel rated them as different
- d) Non-perceiver error: The assessor does not perceive an attribute and scores all the products at '0' when the rest of the panel rated them as different.
- e) In this study, a fifth was noticed which is the opposite of non-perceiver error: Some assessors perceived an attribute and scored it above '0' when the rest of the panel did not notice the presence of this attribute.

2.4.2 Relevance (or presence) of attributes from the compiled list

As the list of potential sensory attributes was compiled based on the findings of various studies, not all would necessarily be relevant to the chocolates which were selected for the study. The various attributes which had very low overall scores were thus reviewed to ascertain:

- a) If they had '0' or very low scores, if they were at all relevant to the set of chocolates which were assessed; and

b) If they were identified by only one or two panelists and thus were related to panelist sensitivity rather than actual presence in the assessed samples.

Such attributes would be removed from the attribute list.

2.4.3 Extent to which each attribute contributed to quantifying and describing the differences between products (the level of discrimination)

Not all attributes in a study will make an equal contribution to the discrimination between a set of products that are being studied as they could not all be equally relevant and will thus not offer the opportunity to understand key differences. Each attribute was thus reviewed across the various chocolate samples and the mean score for each attribute in each chocolate was compared to see if similar scores were achieved across the chocolate samples. If a low variance between the lowest and highest score was noted (less than 1 as meaningful interval of a 5-point scale), this attribute was eliminated.

2.4.4 Select the final list of attributes via factor analysis

Factor analysis was then performed to further narrow down the list of sensory attributes, by assessing the relationship between them.

2.4.5 Select the list of chocolates to include in the study

Once the list of sensory attributes was finalized, these were reviewed across the 12 chocolates included in the study, it was then possible to also select chocolates which best represent the sensory variances which can be found in the market.

3. Results and discussion

3.1 Panelist performance

Panelist performance was reviewed on five levels: a) Sum of all mean sensory attribute ratings; b) Sum of mean scores at a product level; c) Sum of mean scores at an attribute sub-group level; d) Sum of the mean scores at an individual attribute level; and e) Panelist sensitivity.

Through descriptive statistics the mean ratings and standard deviation was calculated for each attribute in order to identify any errors. This was followed by Repeated Measures ANOVA through which the data of each panelist for each level was compared to identify significant differences between the values assigned by each panelist ($P \leq 0.05$). This was followed by two-tailed T-tests which were performed between the ratings of each panellists in pairs to identify

whether the difference in the values indicated by the panellists are significantly different ($P \leq 0.05$).

3.1.1 Sum of all mean sensory attribute ratings

When reviewing the sum of all mean scores across products as summarised in Table 1, it is clear that 2 panelists performed inconsistently in comparison to the rest of the panel – as one scored all the products significantly higher than the others (panelist five) and the other lower (panelist four), pointing to magnitude error as these assessors used a broader and smaller range of the scale than the rest of the panel.

Table 1: Sum of all mean scores at a total product set level

Chocolate brand	Panelist 1	Panelist 2	Panelist 3	Panelist 4	Panelist 5	Panelist 6	Mean $\pm$ SD	Sign. level
Total score	663 ^a	662 ^a	632 ^a	540^b	759^c	622 ^a	646 $\pm$ 64.96	($P \leq 0.01$)

Notes: Means with different superscripts (^a, ^b, ^c) in the same row indicate that these mean values differ significantly from each other ($P \leq 0.05$); Means that differ significantly from all others are indicated in bold.

3.1.2 Sum of mean scores at a product level

The inconsistency of panelist four and five can also be observed at a product level in Table 2 as these two panelists scored many of the products higher or lower than the other panelists. For Cadbury, Cote D'or, Lindt Swiss Classic, Milka and Wawel, the ratings of panelist 5 was significantly ($P \leq 0.05$) higher than the ratings of the other panelists.

Table 2: Sum of mean scores at a product level

Chocolate brand	Panelist 1	Panelist 2	Panelist 3	Panelist 4	Panelist 5	Panelist 6	Mean±SD	Sign. level
Beacon milk	59	53	52	57	52	51	54±2.94	0.837
Belgian Harvest	61	56	51	46	64	47	54±6.77	0.112
Cadbury	60 ^{ab}	55 ^{ab}	51 ^a	46 ^a	70 ^b	55 ^{ab}	56±7.51	$P\leq 0.05$
Canderel	53	56	52	53	49	48	52±2.67	0.935
Clicks Smartbite	40	52	46	33	45	47	44±5.98	0.089
Cote D'or	60 ^{ab}	62 ^{ab}	73 ^{ab}	51 ^a	78 ^b	63 ^{ab}	65±8.81	$P\leq 0.05$
Lindt Extra Creamy	53	48	43	47	64	52	51±6.62	0.121
Lindt Swiss Classic	55 ^{ab}	46 ^a	50 ^{ab}	46 ^a	71 ^b	47 ^{ab}	53±8.85	$P\leq 0.05$
Milka	56 ^a	65 ^{ab}	43 ^{ac}	36 ^{bc}	75 ^b	52 ^b	55±13.00	$P\leq 0.01$
Nestlé	54	57	55	45	54	54	53±3.80	0.615
Wawel	54 ^{ab}	53 ^{ab}	52 ^{ab}	46 ^a	68 ^b	42 ^a	53±8.12	$P\leq 0.05$
Woolworths Organic	58 ^a	59 ^a	64 ^a	34^b	69 ^a	64 ^a	58±11.33	$P\leq 0.01$

Notes: Means with different superscripts (a, b, c, ab, ac, bc) in the same row indicate that these mean values differ significantly from each other ($P\leq 0.05$); Means that differ significantly from all others are indicated in bold.

3.1.3 Sum of mean scores at an attribute sub-group level

On an attribute sub-group level indicated in Table 3, panelist three, four and five's ratings showed some disagreement with the rest of the panelists. Panelist three and four rated attributes both higher and lower than the average, while panelist five rated attributes mostly higher than the mean. Panelist 5 rated appearance and aroma significantly ($P\leq 0.05$) higher than the rest of the panel, while panellist 3 rated mouthfeel and panellist 4 flavour significantly higher than the panel.

Table 3: Sum of mean scores at an attribute sub-group level

Sensory attribute	Panelist 1	Panelist 2	Panelist 3	Panelist 4	Panelist 5	Panelist 6	Mean±SD	Sign. level
Aftertaste	37	32	40	24	25	33	32±5.81	0.162
Appearance	43 ^a	41 ^{ac}	43 ^a	33 ^c	56^b	48 ^a	44±6.98	$P \leq 0.01$
Aroma	145 ^a	141 ^{ab}	143 ^{ab}	122 ^b	181^c	147 ^a	147±17.49	$P \leq 0.01$
Flavour	197 ^a	242 ^{ab}	293 ^b	135^c	238 ^a	206 ^a	219±48.43	$P \leq 0.01$
Mouthfeel	170 ^a	156 ^{ac}	62^b	136 ^a	169 ^a	123 ^c	136±37.17	$P \leq 0.01$
Texture	71 ^a	50 ^b	51 ^b	90 ^c	90 ^c	65 ^a	70±16.26	$P \leq 0.01$

Notes: Means with different superscripts (^a, ^b, ^c, ^{ab}, ^{ac}) in the same row indicate that these mean values differ significantly from each other ($P \leq 0.05$); Means that differ significantly from all others are indicated in bold.

3.1.4 Sum of mean scores at an individual sensory attribute level

On an individual attribute level summarised in Table 4, panelist 3,4 and 5 also had a high level of disagreement with the rest of the panel with 20, 24 and 18 attributes respectively rated above or below the mean. Panelist 2 rated stale flavour significantly ($P \leq 0.05$) higher and thickness significantly lower than the other panellists. Panelist 3 rated caramel flavour, citrus flavour, floral flavour and fruity flavour significantly higher than the other panellists, and rated melting significantly lower. Panelist 4 rated bitter flavour and melting significantly higher than the other panelists, and rated milky flavour, sweet flavour, vanilla flavour, sweet aftertaste and sweet aroma significantly lower than the other panelists. Panelist 5 rated thickness and roasted aroma significantly higher than the other panelists. Panelist 6 rated buttery flavour lower than the rest of the panel.

Table 4: Sum of mean scores at an individual sensory attribute level

Sensory attribute	Panelist 1	Panelist 2	Panelist 3	Panelist 4	Panelist 5	Panelist 6	Mean±SD`	Sign. level
Adherence	19 ^a	12 ^b	11 ^b	8 ^b	24 ^a	11 ^b	14±5.52	$P \leq 0.01$
Astringency	12 ^a	6 ^b	3 ^{bc}	0 ^c	0 ^c	0 ^c	4±4.39	$P \leq 0.01$
Bitter flavour	3 ^a	5 ^a	9 ^a	21^b	9 ^a	8 ^a	9±5.73	$P \leq 0.01$
Bitter aftertaste	3 ^a	7 ^{ab}	7 ^{ab}	17 ^b	3 ^a	15 ^b	9±5.47	$P \leq 0.01$
Burning	0	0	0	1	1	0	0±0.47	0.564
Burnt flavour	5 ^{ac}	7 ^{ac}	21 ^b	1 ^a	11 ^c	4 ^a	8±6.49	$P \leq 0.01$
Buttery flavour	13 ^a	23 ^b	28 ^b	12 ^a	13 ^a	3^c	15±8.10	$P \leq 0.01$

Table 4 continued

Sensory attribute	Panelist 1	Panelist 2	Panelist 3	Panelist 4	Panelist 5	Panelist 6	Mean±SD`	Sign. level
Caramel flavour	19 ^a	21 ^a	35 ^b	2 ^c	20 ^a	7 ^c	17±10.63	$P \leq 0.01$
Chemical flavour	0	1	0	0	0	0	0±0.37	0.426
Chewiness	13 ^a	11 ^a	11 ^a	22 ^b	22 ^b	18 ^b	16±4.74	$P \leq 0.01$
Chocolate aroma	33 ^a	31 ^a	35 ^a	44 ^b	38 ^{ab}	41 ^b	37±4.51	$P \leq 0.01$
Chocolate flavour	34 ^a	33 ^a	37 ^{ab}	42 ^b	39 ^b	43 ^b	38±3.74	$P \leq 0.01$
Citrus flavour	0 ^a	0 ^a	3 ^b	0 ^a	1 ^a	0 ^a	1±1.11	$P \leq 0.05$
Coarseness	7 ^a	12 ^a	3 ^{ab}	0 ^b	3 ^{ab}	0 ^b	4±4.22	$P \leq 0.01$
Cocoa butter aroma	26 ^a	20 ^a	28 ^a	15 ^b	28 ^b	19 ^b	23±4.96	$P \leq 0.01$
Cocoa powder aroma	29 ^a	32 ^a	27 ^a	39 ^b	38 ^b	34 ^{ab}	33±4.37	$P \leq 0.01$
Cocoa powder flavour	26	32	25	26	29	35	29±3.62	0.129
Coffee flavour	1 ^a	9 ^b	8 ^b	1 ^a	16 ^b	12 ^b	8±5.46	$P \leq 0.01$
Colour	22 ^a	20 ^a	20 ^a	20 ^a	31 ^b	31 ^b	24±5.00	$P \leq 0.01$
Creaminess	25 ^a	26 ^a	5 ^b	6 ^b	26 ^a	14 ^b	17±9.13	$P \leq 0.01$
Dryness	4 ^a	16 ^b	5 ^a	8 ^{ab}	3 ^a	4 ^a	7±4.46	$P \leq 0.01$
Earthy flavour	6	3	3	5	6	0	4±2.11	0.377
Fattiness/ greasiness	16	11	14	15	7	18	14±3.60	0.165
Firmness	15 ^a	13 ^a	7 ^b	24 ^c	20 ^{ac}	13 ^a	15±5.44	$P \leq 0.01$
Floral flavour	0 ^a	0 ^a	5 ^b	0 ^a	0 ^a	0 ^a	1±1.86	$P \leq 0.05$
Fruity flavour	1 ^a	0 ^a	14 ^b	0 ^a	2 ^a	0 ^a	3±5.05	$P \leq 0.01$
Gloss	21 ^{ab}	21 ^{ab}	23 ^{ab}	13 ^b	25 ^a	17 ^b	20±3.96	$P \leq 0.01$
Hardness	19 ^a	13 ^{ab}	11 ^b	23 ^a	17 ^a	12 ^b	16±4.26	$P \leq 0.01$
Melting	23 ^a	13 ^b	5 ^d	33 ^c	25 ^{ac}	14 ^b	19±9.17	$P \leq 0.01$
Milky flavour	22 ^a	28 ^{ab}	29 ^b	9 ^c	21 ^a	19 ^a	21±6.60	$P \leq 0.01$
Mouth-coating	19 ^a	11 ^{bc}	5 ^c	14 ^b	22 ^a	13 ^b	14±5.48	$P \leq 0.01$
Nutty flavour	8 ^a	9 ^a	10 ^a	0 ^b	13 ^a	3 ^b	7±4.37	$P \leq 0.01$
Powdered milk aroma	15 ^a	16 ^a	11 ^{ab}	9 ^b	16 ^a	9 ^b	13±3.09	$P \leq 0.05$
Rancid flavour	0	4	3	0	0	0	1±1.68	0.122
Salty flavour	4 ^a	1 ^a	7 ^{ab}	2 ^a	0 ^a	10 ^b	4±3.51	$P \leq 0.01$
Smoky flavour	0	2	1	1	0	0	1±0.74	0.359

Table 4 continued

Sensory attribute	Panelist 1	Panelist 2	Panelist 3	Panelist 4	Panelist 5	Panelist 6	Mean±SD`	Sign. level
Smoothness	32 ^a	31 ^a	7 ^b	48 ^c	34 ^a	48 ^c	33±13.73	$P \leq 0.01$
Sour flavour	0	1	0	0	0	0	0±0.37	0.426
Spicy flavour	0	0	2	0	0	0	0±0.75	0.426
Stale flavour	0 ^a	3^b	1 ^a	0 ^a	0 ^a	0 ^a	1±1.11	$P \leq 0.01$
Stickiness	13 ^a	18 ^a	4 ^c	3 ^c	24 ^{ab}	1 ^c	11±8.50	$P \leq 0.01$
Sweet aftertaste	34 ^a	25 ^b	33 ^{ab}	7^c	22 ^b	18 ^b	23±9.19	$P \leq 0.01$
Sweet aroma	33 ^{ab}	31 ^{ab}	35 ^a	7^c	29 ^b	39 ^a	29±10.32	$P \leq 0.01$
Sweet flavour	33 ^a	30 ^a	35 ^a	8^c	23 ^a	40 ^{ab}	28±10.38	$P \leq 0.01$
Thickness	24 ^a	13^b	22 ^a	21 ^a	31^c	22 ^a	22±5.27	$P \leq 0.01$
Toasted aroma	9 ^a	11 ^a	7 ^a	8 ^a	32^b	5 ^a	12±9.13	$P \leq 0.01$
Toasted flavour	2 ^a	12 ^{ab}	4 ^a	2 ^a	19 ^b	3 ^a	7±6.38	$P \leq 0.01$
Vanilla flavour	20 ^a	18 ^{ab}	13 ^{ab}	3^c	16 ^a	19 ^a	15±5.76	$P \leq 0.01$

Notes: Means with different superscripts (^a, ^b, ^c, ^d, ^{ab}, ^{ac}, ^{bc}) in the same row indicate that these mean values differ significantly from each other ($P \leq 0.05$); Means that differ significantly from all others are indicated in bold.

Table 4 also indicates that panelists had certain sensitivities:

- **Aftertaste:** Panelist 1 and 4 showed disagreement with the panel for both aftertaste attributes, with panelist 1 being more sweet sensitive and possibly bitter blind, while the opposite was true for panelist 4. Panelist 5 also appears to be bitter blind, and panelist 3 sweet sensitive.
- **Appearance:** Panelist 5 found both appearance attributes to be more intense than others.
- **Aroma:** Panelist 4 experienced many aroma attributes more intensely than the rest of the panel.
- **Flavour:** Panelist 3, 4 and 5 showed the highest number of deviations from the mean scores for the various flavour sensory attributes. While some were rated higher and some lower for panelists 3 and 6, panelist 4 rated the majority of attributes lower than the mean of the panel.
 - Panelist 3 not only rated sweet aftertaste ahead of the panel average but rated various flavour attributes higher than the panel (such as burnt, buttery, caramel, floral, fruity and milky).

- Panelist 4 rated similar attributes to panelist 3 lower than the panel mean (such as burnt, caramel, coffee, milky, nutty and sweet). This panelist showed the same sensitivities during the ratings of aftertaste.
- Panelist 5 rated bitter aftertaste higher than the mean, and for flavour attributes also indicated that chocolate flavour and cocoa powder flavour was experienced very intensely in the evaluated chocolates, but this panelist also found sweet flavour to be far more intense than the other panelists.
- **Mouthfeel:** Panelist 3,4 and 5 once again showed a high amount of variation vs. the mean and other panelists ratings. Panelist 3 rated creaminess, melting, mouth-coating and smoothness as very low. Panelist 4 found creaminess and smoothness to be much higher than the rest of the panel. Panelist 5 rated the chocolates high on mouth-coating and stickiness.
- **Texture:** Panelist 3 and 4 again showed high levels of disagreement on three attributes – appearing to be more sensitive for texture properties. Panelist 3 rated chewiness, firmness, hardness much lower than the mean, while panelist 4 rated these attributes much higher.

After reviewing these results portions of the data was removed to improve data consistency, after which further data review was conducted as outlined in the following sections.

3.2 Relevance of sensory attributes to the chocolate set

After the panelist data was removed, the relevance of the various sensory attributes and their ability to discriminate between samples was investigated. This led to the removal of:

- a) Burning flavour, chemical flavour, sour flavour and spicy flavour as it had a 0 mean rating; and
- b) Citrus flavour, smoky flavour, stale flavour, floral favour, rancid flavour, earthy flavour, fruity flavour and astringent were subsequently removed as they were identified as present by either only one panelist in multiple products or by a maximum of two panelists in four or fewer products.

3.3 Ability of sensory attributes to relay the variance between the samples

Some attributes were rated as having low levels of variance between products. As the attributes were rated on a 5-point Likert scale, attributes which had a variance below 1 between the various chocolate samples were eliminated. This was done on the basis of the nature of the Likert scale which have distinct cut-off points it assumes linearity and equal intervals between various response alternatives (Ratray & Jones, 2007). With a Likert scale – a notable difference

is indicated by selecting an additional interval of 1, and should thus indicate a perceivable difference between samples. This led to the further elimination of eight attributes, namely chocolate aroma, chocolate flavour, coarseness, cocoa powder aroma, dryness, powdered milk flavour, salty flavour and thickness.

3.4 Determining the relationships between the remaining sensory attributes

Factor analysis was performed in order to simplify the list of sensory descriptors even further by extracting factors in order to reduce the individual attributes into a few dimensions that would showcase the direction and strength of the relationships that exist between them. Factor analysis included Oblimin Rotation (which converged in seven rotations) with Kaiser Normalization through which pattern matrixes were constructed for all three chocolates. The pattern matrix after rotation was constructed as this approach delivered large changes in the individual totals which eased interpretation, as this stage was conducted to identify any attributes that do not fit well within the overall set of attributes or were seen as opposed to some attributes. This was also done in order to calculate the Cronbach's Alpha's of these factors to determine the contribution of each sensory attribute to the overall factor and thus compare the relationships between variables within each factor to identify those that have a weakening effect on the Cronbach's Alpha.

The pattern matrix is summarized in Table 6. The below was observed based on this extraction:

- a) The first factor which was extracted contained mostly mouthfeel or texture attributes, and was thus named 'texture'. It contained nine texture/mouthfeel attributes and three flavour attributes. Certain attributes had a weaker contribution to the factor with lower inter-item correlation values (below 0.6), including fattiness or greasiness, buttery flavour, and stickiness. Other attributes had a negative correlation within the factor, including hardness, firmness and chewiness.
- b) The second factor contained mostly flavour attributes, as well as an aftertaste, aroma and appearance attribute. All attributes had positive inter-item correlation values. Attributes with the lowest contribution includes nutty flavour and colour.
- c) The third factor contained attributes from the various sensory groups, including appearance, flavour, aroma, and mouthfeel, all with positive inter-item correlations. Sweet aftertaste, cocoa butter flavour and caramel flavour had the weaker correlation values.

Table 6: Pattern matrix with factor extractions to group sensory attributes

Factor	1	2	3
	Texture	Bitter flavour	Sweet flavour
Creaminess	0.904		
Smoothness	0.860		
Hardness	-0.813		
Melting	0.808		
Milky flavour	0.787		
Firmness	-0.747		
Vanilla flavour	0.734		
Mouth-coating	0.713		
Chewiness	-0.635		
Fattiness/greasiness	0.586		
Buttery flavour	0.580		
Stickiness	0.580		
Coffee flavour		0.925	
Cocoa powder flavour		0.899	
Burnt flavour		0.877	
Bitter aftertaste		0.848	
Bitter flavour		0.815	
Toasted Aroma		0.770	
Nutty flavour		0.623	
Colour		0.419	
Gloss			0.863
Sweet flavour			0.818
Sweet aroma			0.812

Table 6 continued			
Factor	1	2	3
	Texture	Bitter flavour	Sweet flavour
Adherence			0.803
Sweet aftertaste			0.689
Cocoa butter flavour			0.678
Caramel flavour			0.533

Notes: *Likert scale: 0=Not at all, 1=Slightly, 2=Moderately, 3=Very, 4=Extremely*; Shaded loadings indicate items that loaded meaningful onto one factor.

After these factors were constructed, the make-up of each factor was reviewed, and the contribution of each attribute within the factor was reviewed:

- a) Within the texture factor, the attributes with negative inter-item correlation values were removed as they were opposed to items within the factor, specifically hardness, firmness and chewiness which were opposed to creaminess and smoothness, and thus appeared to measure the same construct. After these were removed, each of the attributes with the lower inter-item correlation values were systematically removed and the Cronbach's Alpha for the factor was recalculated, and through this process fattiness or greasiness, buttery flavour and stickiness were identified as attributes for which the removal improves the Cronbach's Alpha of the factor. These were subsequently eliminated from the factor.
- b) The same process was followed for the bitter factor, and through this process toasted aroma, nutty flavour and colour was removed.
- c) For the sweet factor, sweet aftertaste, cocoa butter flavour and caramel flavour was removed.

Table 7: Pattern matrix with factor extractions after elimination of low or negative inter-item correlated sensory attributes

	Texture	Bitter flavour	Sweet flavour
Creaminess	0.904		
Smoothness	0.860		
Melting	0.808		
Milky flavour	0.787		
Vanilla flavour	0.734		
Mouth-coating	0.713		
Coffee flavour		0.925	
Cocoa powder flavour		0.899	
Burnt flavour		0.877	
Bitter aftertaste		0.848	
Bitter flavour		0.815	
Gloss			0.863
Sweet flavour			0.818
Sweet aroma			0.812
Adherence			0.803
Inter-item correlation	0.660	0.734	0.612
Cronbach's Alpha	0.893	0.921	0.862
Mean factor score	1.600	1.010	2.140
Standard Deviation	0.550	0.812	0.883

Notes: *Likert scale: 0=Not at all, 1=Slightly, 2=Moderately, 3=Very, 4=Extremely*; Mean factor loading score and interpretation of means: <1.0=Not present at all, ≥1-<2.0=Slightly present, ≥2.0-<3.0=Moderately present, ≥3.0-<4.0=very present and 4.0=Extremely present; Cronbach's Alpha: α≥0.5=accepted with caution, α≥0.7=Acceptable, α≥0.8=Good; Shaded loadings indicate items that loaded meaningful on one factor.

3.5 Selecting the chocolates to include in the study

When the objective is to assess or measure sensory properties, it is important that samples presented to respondents stretch the spectrum of the sensory space that is being assessed with no redundancy (Chaya *et al.*, 2015). This narrowed down list of sensory attributes was then applied as inputs to select the chocolates for the study, as the selected attributes are both valid and drive differentiation, and subsequently the chocolates selected should represent these sensory attributes best. This will ensure that consumers will be presented with samples that are both representative of the sensory attributes of the products in the market but will also be varied in their sensory attributes to ensure that they can differentiate olfactively (and potentially emotionally) between samples.

3.5.1 Determining the ranking of the chocolates based on factor ranking

Firstly, the average ratings for each of the three components extracted through factor analysis components was calculated for each chocolate in order to identify chocolates that are either lower or higher or on average vs. the rest of the samples for each component by preparing a ranking for each chocolate based on this average (in descending order). Products which fell into the top, middle or bottom of the rankings for two or three of the components were shortlisted.

Table 8: Ranking of the twelve chocolate samples based on the means calculated based on extracted factors

Chocolate	Texture		Bitter		Sweet	
	Mean value	Ranking	Mean value	Ranking	Mean value	Ranking
Beacon milk chocolate	1.8	6**	0.8	2***	2.1	6**
Belgian Harvest	1.8	4	0.9	6**	2.4	10
Cadbury	2.0	8	1.1	10	2.6	12*
Canderel	1.9	7**	1.0	9	1.5	1***
Clicks Smartbite	1.3	2***	0.9	4	1.9	4
Lindt Extra Creamy	2.4	12*	0.4	1***	2.4	9
Lindt Swiss Classic	2.3	11*	0.9	6**	1.7	2***
Milka	2.2	9	0.8	2***	2.6	12*
Nestlé	1.3	1***	1.0	7	2.2	7**
Wawel	1.5	3	1.0	9	1.9	4
Cote D'or	2.3	10	1.7	11*	2.3	8
Woolworths Organic chocolate	1.8	6	1.8	12*	2.0	5

Notes: *Indicates a low (1-2) ranking and low intensity (low mean); **Indicates an average (6-7) ranking and average intensity (average mean); ***Indicates a high (11-12) ranking and high intensity (high mean); Shaded areas indicate the two highest, two lowest or two average ranked chocolates for each factor.

The chocolate which were shortlisted included Beacon Milk Chocolate (ranked as average on the sweet and texture factors and ranked low for the bitter factor), Canderel (ranked average for the texture factor and the lowest for the sweet factor), Lindt Extra Creamy (ranked the highest for the texture factor and the lowest for the bitter factor); Lindt Swiss Classic (ranked highly for the texture factor, average for the bitter factor and low for the sweet factor), Milka (ranked low for the bitter factor and highest for the sweet factor) and Nestlé (ranked the lowest for the texture factor and average for the sweet factor).

3.5.2 Reviewing the sensory attribute ratings of the chocolate shortlist

Lastly, the ratings of the specific sensory attributes of each of these shortlisted products were reviewed, and again those that were rated as the highest, lowest or closest to the mean were again highlighted.

- Beacon did not offer highest or lowest ratings for any of the sensory attributes. For eight of the sensory attributes it was rated as average;
- Canderel offered four attributes with lowest scores and two attributes with highest scores, and average values for three attributes;
- Lindt Extra Creamy had the lowest scores for five attributes and highest scores for four;
- Lindt Swiss Classic offered only one single lowest score and two highest values, with three attributes rated as average;
- Milka has the lowest scores on one attribute, the highest on four and average ratings for three; and
- Nestlé was average for four attributes, highest for two and lowest for three.

Canderel, Lindt Extra Creamy and Nestlé were identified as the chocolates which had the highest number of mean ratings of interest (either the highest, lowest or most average). The combination of these three chocolates also offered acceptable inclusion of low, average or high mean scores for many of the sensory attributes, and a good sensory spread for the remainder.

Table 9: Sensory attribute mean ratings of the chocolate shortlist

	Beacon milk chocolate	Canderel	Lindt Extra Creamy	Lindt Swiss Classic	Milka	Nestlé	Mean
Adherence	1.5	0.5*	1.5	1.0**	1.8***	1.0**	1.21
Bitter	0.3**	0.8***	0.0*	0.5	0.3**	0.3**	0.33
Bitter aftertaste	0.3**	0.5	0.0*	0.8***	0.0*	0.3**	0.29
Burnt	0.5	0.5	0.0*	0.5	0.5	0.5	0.42
Cocoa powder flavour	2.3**	2.5	1.5*	2.3**	2.3**	2.8***	2.25
Coffee	0.5**	0.8	0.3*	0.5**	0.8	1.0***	0.63
Creaminess	1.8	2.3**	3.0***	2.5	2.3**	1.3*	2.17
Gloss	1.8	1.0*	2.0	1.0*	2.5***	1.5**	1.63
Melting	1.8	1.5**	2.0***	1.8	1.8	1.0*	1.63
Milky	1.5	1.5	3.0***	2.8	2.8	1.3*	2.13
Mouth-coating	1.5**	1.0	1.7	1.5**	1.8***	0.8*	1.36
Smoothness	3.0**	3.5***	3.3**	3.5***	3.3**	2.5*	3.17
Sweet Aroma	2.8**	2.3*	3.0	2.5	3.0	3.3***	2.79
Sweet Flavour	2.5**	2.3*	3.0***	2.3*	3.0***	3.0***	2.67
Vanilla	1.3	1.5**	1.8	2.0***	1.5**	0.8*	1.46

Notes: *Indicates that the rating for this attribute is the lowest amongst the chocolates;

Indicates that the rating for this attribute is closest to the mean; *Indicates that the rating for this attribute is the highest amongst the chocolates.

4. Conclusion

The list of sensory descriptors was reduced to a shortened list which best describe the samples evaluated:

- Firstly four sensory attributes were removed which had a mean value of 0 across all samples (burning flavour, chemical flavour, sour flavour and spicy flavour);
- Subsequently sensory attributes with very low mean scores which were not present in all samples and thus not relevant to describing the differences between the samples were eliminated, including citrus flavour, smoky flavour, stale flavour, floral favour, rancid flavour, earthy flavour, fruity flavour and astringent;
- Determining the level of discrimination between chocolates for the remaining sensory descriptors allowed for the elimination of a further eight attributes (chocolate aroma, chocolate flavour, coarseness, cocoa powder aroma, dryness, powdered milk flavour, salty flavour and

thickness) as for all these there was variation in scores between the samples below 1 in terms of the maximum and minimum value attributed to any of the chocolates in the evaluation set;

d) Factor analysis to determine the underlying relationships between the remaining sensory attributes, which resulted in the removal of a further 12 attributes as they were not found to be highly correlated with the other sensory descriptors within the extracted factors. The chocolates were selected by firstly determining the ranking of the chocolates based on factor and then by individual factor ranking. Through these various steps a sensory descriptors list was reduced from 49 to 15 attributes, and three chocolates were selected from a list of 12 which stretched the spectrum of the sensory space.

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APPENDIX X: SENSORY PROPERTIES QUESTIONNAIRE – TRAINED PANEL

Please taste sample xxx and then review below descriptors and definitions of the properties of the product you have just tasted. Please indicate how intensely you experienced each sensory property in the product.							
APPEARANCE							
Descriptor	Definition	Reference	0 Not at all	1 Slightly	2 Moderately	3 Very	4 Extremely
Colour	Darkness	N/A					
Gloss	The amount of light reflected from the surface	N/A					
AROMA							
Descriptor	Definition	Reference	0 Not at all	1 Slightly	2 Moderately	3 Very	4 Extremely
Chocolate	Aroma characteristic of chocolate products	Chocolate, chocolate cake, chocolate milk, etc.					
Cocoa powder	Brown, sweet, often bitter aroma	Cocoa beans, cocoa powder					
Cocoa butter	Aroma typical of cocoa butter or coconut	Cocoa butter or coconut					
Powdered milk	Aroma typical of powdered milk	Powdered milk					
Sweet	Aroma characteristic of sweet products	Confectionary and sweets					
Toasted	Aroma associated with toasted products	Toasted bread, toasted grains					
FLAVOUR							
Descriptor	Definition	Reference	0 Not at all	1 Slightly	2 Moderately	3 Very	4 Extremely
Bitter	Taste of aloe, caffeine and hop bitters	Coffee, aloe juice, tonic water					
Burnt	Flavour of overheated or scorched starch or sugar	Burnt sugar, burnt toast					
Buttery	Flavour of butter that is not rancid	High fat cream, butter					
Caramel	Flavour of caramelised sugar or starch	Caramelised sugar					
Chemical	Flavour of household cleaning solutions or laboratory products	Methanol, Acetone, Benzene					
Chocolate	Flavour of chocolate and chocolate products	Chocolate, chocolate cake, chocolate milk etc.					
Citrus	Flavour of citrus fruit	Tangerine, orange, lemon					
Cocoa powder	Brown, sweet often bitter flavour	Cocoa beans, cocoa powder					
Coffee	Flavour of coffee and coffee beans	Coffee power, coffee beans					
Earthy	Flavour of earth	Sand, dust, soil					
Floral	Flavour that reminds one of flowers	Various flowers					
Fruity	Flavour of various fruits	Various fruits					
Milky	Flavour associated with milk and milk products	Milk and cultured dairy products					
Nutty	Flavour of various nuts	Peanuts, almonds, pecan nuts etc.					
Rancid	Flavour associated with oxidised oils	Fishy, old butter, old oil					
Salty	Salty taste	Table salt					
Smoky	Flavour of smoke	Smoked products, smoke from fire					
Sour	Taste delivered by acids, often sharp and pungent	Vinegar, lemon juice					

Spicy	Flavour of various aromatic spices	Cinnamon, clove, nutmeg etc.					
Stale	Stale or mouldy flavour	Stale bread, stale biscuits					
Sweet	Taste delivered by sugar	Sucrose, fructose, artificial sweeteners					
Toasted	Flavour of with toasted products	Toasted bread, toasted grains					
Vanilla	Flavour of vanilla	Vanilla pods, vanilla essence					
TEXTURE							
Descriptor	Definition	Reference	0 Not at all	1 Slightly	2 Moderately	3 Very	4 Extremely
Chewiness	The amount of chewing needed	N/A					
Firmness	The amount of effort needed to chew	N/A					
Hardness	The force required to bite through with the front teeth	N/A					
Thickness	The viscosity when melted in the mouth	N/A					
MOUTHFEEL							
Descriptor	Definition	Reference	0 Not at all	1 Slightly	2 Moderately	3 Very	4 Extremely
Adherence	The amount that sticks to tooth surfaces	N/A					
Astringency	Puckering of the tongue surface and contraction of mucus	Green fruit such as apples, cranberries					
Burning	Burning sensation in the mouth	Chilli, pepper, certain spices					
Coarseness	The presence of gritty or grainy particles upon melting	N/A					
Creaminess	Resembles the consistency of cream	N/A					
Dryness	Has a drying sensation in the mouth	Black tea					
Fattiness/greasiness	Feeling fatty, slipper or oily	Oil, margarine, lard or fat					
Melting	The length of time for it to melt in the mouth	N/A					
Mouth-coating	The amount of film or coating left on mouth surfaces	N/A					
Smoothness	The absence of gritty or grainy particles upon melting	N/A					
Stickiness	Adhesion and 'pulling' between the particles of a product	N/A					
AFTERTASTE							
Descriptor	Definition	Reference	0 Not at all	1 Slightly	2 Moderately	3 Very	4 Extremely
Bitter aftertaste	Aftertaste delivered by substances such as quinine, caffeine and hop bitters	Coffee, aloe juice, tonic water					
Sweet aftertaste	Aftertaste delivered by sugar	Sucrose, fructose, artificial sweeteners					

APPENDIX Y : SENSORY PROPERTIES QUESTIONNAIRE (MAIN QUESTIONNAIRE SECTION E)

E. In the cooler bag you will find (three) samples of chocolate. Each sample is marked with a 3-digit code. Please ensure that the code on the sample matches the code on the survey when answering the questions. Please cleanse your palate before you start and in between each sample by drinking some of the water and eating one of the biscuits provided.

Please taste sample xxx and then review below descriptors and definitions of the properties of the product you have just tasted. Please indicate how intensely you experienced each sensory property in the product.

APPEARANCE							
Descriptor	Definition	Reference	0 Not at all	1 Slightly	2 Moderately	3 Very	4 Extremely
Gloss	The amount of light reflected from the surface	N/A					

AROMA							
Descriptor	Definition	Reference	0 Not at all	1 Slightly	2 Moderately	3 Very	4 Extremely
Sweet	Aroma characteristic of sweet products	Confectionary and sweets					

FLAVOUR							
Descriptor	Definition	Reference	0 Not at all	1 Slightly	2 Moderately	3 Very	4 Extremely
Bitter	Taste of aloe, caffeine and hop bitters	Coffee, aloe juice, tonic water					
Burnt	Flavour of overheated or scorched starch or sugar	Burnt sugar, burnt toast					
Cocoa powder	Brown, sweet often bitter flavour	Cocoa beans, cocoa powder					
Coffee	Flavour of coffee and coffee beans	Coffee power, coffee beans					
Milky	Flavour associated with milk and milk products	Milk and cultured dairy products					
Sweet	Taste delivered by sugar	Sucrose, fructose, artificial sweeteners					
Vanilla	Flavour of vanilla	Vanilla pods, vanilla essence					

MOUTHFEEL							
Descriptor	Definition	Reference	0 Not at all	1 Slightly	2 Moderately	3 Very	4 Extremely
Adherence	The amount that sticks to tooth surfaces	N/A					
Creaminess	Resembles the consistency of cream	N/A					
Melting	The length of time for it to melt in the mouth	N/A					
Mouth-coating	The amount of film or coating left on mouth surfaces	N/A					

AFTERTASTE							
Descriptor	Definition	Reference	0 Not at all	1 Slightly	2 Moderately	3 Very	4 Extremely
Bitter aftertaste	Aftertaste delivered by substances such as quinine, caffeine and hop bitters	Coffee, aloe juice, tonic water					

**APPENDIX Z: EMOTIONAL RESPONSE QUESTIONNAIRE (MAIN QUESTIONNAIRE
SECTION F)**

F. Please taste sample xxx and then review below descriptors of how the product makes you feel. Please rate how intensely you experience these emotions when eating the product.					
Descriptor	0 Not at all	1 Slightly	2 Moderately	3 Very	4 Extremely
Active					
Adventurous					
Aggressive					
Bored					
Calm					
Disgusted					
Enthusiastic					
Free					
Good					
Good-natured					
Guilty					
Happy					
Interested					
Joyful					
Loving					
Mild					
Nostalgic					
Pleasant					
Satisfied					
Secure					
Tame					
Understanding					
Warm					
Wild					
Worried					

APPENDIX AA: CATEGORY ATTITUDE QUESTIONNAIRE (MAIN QUESTIONNAIRE SECTION G)

G. Please indicate how much you agree or disagree with the below statements about chocolate in general:					
Descriptor	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I eat chocolate to cheer me up when I am down					
My desire for chocolate often seems overpowering					
I feel unattractive after I have eaten chocolate					
I often feel sick after eating chocolate					
I eat chocolate as a reward when everything is going really well for me					
I am often on one kind of diet or another					
The thought of chocolate often distracts me from what I am doing (e.g. watching TV)					
I usually find myself wanting chocolate during the afternoon					
I consider chocolate to be high in fat and of poor nutritional value					
After eating chocolate I often wish I hadn't					
I feel guilty after eating chocolate					
I eat chocolate only when I am hungry					
Chocolate often preys on my mind					
I feel unhealthy after I have eaten chocolate					
I always look at the kilojoule value of a chocolate snack before I eat it					
If I resist the temptation to eat chocolate I feel more in control of my life					
Nothing else but chocolate will satisfy my chocolate cravings					
Even when I do not really want any more chocolate I will often carry on eating it					
I eat chocolate to keep my energy levels up when I am doing physical exercise					
I eat more chocolate in the winter when it is colder					
I often go into a shop for something else and end up buying chocolate					
I feel depressed and dissatisfied with life after eating chocolate					
I often eat chocolate when I am bored					
I like to indulge in chocolate					

APPENDIX AB: DESCRIPTIVE TABLES

Table 1: Overall demographic profile of the study population (N=149)

Variable	Frequency (n)	Percentage %
Age		
18-29	34	23%
30-39	55	37%
40-49	38	26%
50-59	14	9%
60 years and older	8	5%
Age		
Male	38	26%
Female	111	75%
Ethnicity		
Black	20	13%
White	92	62%
Coloured	11	7%
Indian	23	15%
Asian	3	2%
Not prepared to answer	0	0%
Highest level of education		
Grade 12	19	13%
Certificate/Diploma	49	33%
Degree	32	22%
Post-graduate degree	49	33%

*Due to rounding of percentages, some of the totals might not add up to 100%.

APPENDIX AC: PROOF OF ARTICLE SUBMISSION TO FOOD QUALITY & PREFERENCE

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APPENDIX AD: PROOF OF LANGUAGE EDITING OF THESIS

MRS NELMA ERASMUS

(MA: LANGUAGE PRACTICE)

ACCREDITED LANGUAGE PRACTITIONER - GEAKKREDITEERDE TAALPRAKTIJSYN

(Afrikaans/English; English/Afrikaans)

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nelmaerasmus@gmail.com

15 November 2019

Dear Ms Taljaard

LANGUAGE EDITING

This is to confirm that I edited the following sections of your dissertation and that I indicated the necessary grammatical corrections for these sections:

Abstract

Chapter 1: Introduction

Chapter 2: Literature review

Chapter 3: Research methodology

Chapter 4: The sensory profile of chocolate

Chapter 5: The emotional profile of chocolate

Chapter 6: The relationship between the sensory properties and the emotional response to chocolate

Chapter 7: The relationship between the sensory properties of emotional response to and consumer behaviour towards chocolate – a structural equation model

Chapter 8: Food quality and preference: the relationship between the sensory properties of, emotional response to and consumer behaviour towards chocolate – a structural equation model

Chapter 9: summary and conclusion

Yours sincerely

NM Erasmus

APPENDIX AE: TURN IT IN REPORT (AN EXTRACT FROM THE TURNITIN
'ORIGINALITY REPORT')

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