



HAL
open science

Influence of the difference between expectation & perception on affective judgment : from consumers' memory to product design : how to deal with variability among individuals' expectations?

Sabine Rizzo

► To cite this version:

Sabine Rizzo. Influence of the difference between expectation & perception on affective judgment : from consumers' memory to product design : how to deal with variability among individuals' expectations?. Cognitive Sciences. Université de Lyon, 2016. English. NNT : 2016LYSE1262 . tel-01535554

HAL Id: tel-01535554

<https://theses.hal.science/tel-01535554>

Submitted on 9 Jun 2017

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



THESE de DOCTORAT DE L'UNIVERSITE DE LYON
opérée au sein de
l'Université Claude Bernard Lyon 1

Ecole Doctorale N° 476
(Ecole doctorale Neurosciences et Cognition)

Spécialité de doctorat :
Sciences Cognitives

Soutenue le 05/12/2016, par :
Sabine RIZZO

**Influence of the difference between
expectation & perception
on affective judgment**

- From consumers' memory to product design: how to deal with
variability among individuals' expectations? -

Devant le jury composé de :

Pr Gervais, Rémy
Dr Chollet, Sylvie, HDR
Dr Schifferstein, N.J.Hendrik
Dr Giboreau, Agnès, HDR
Dr Boesen-Mariani, Sabine

Président du jury
Rapporteur
Rapporteur
Directrice de thèse
Membre invité

THESE DE DOCTORAT EN SCIENCES COGNITIVES

Ecole Doctorale N° 476 Neurosciences et Cognition

**Influence of the difference between expectation &
perception on affective judgment**

- From consumers' memory to product design: how to deal with
variability among individuals' expectations? -

Sabine RIZZO

Soutenu le 05 décembre 2016 devant le jury composé de :

Dr Chollet, Sylvie, HDR	Rapporteur
Dr Schifferstein, N.J.Hendrik	Rapporteur
Pr Gervais, Rémy	Examineur
Dr Giboreau, Agnès, HDR	Directrice de thèse
Dr Boesen-Mariani, Sabine	Membre invité

UNIVERSITE CLAUDE BERNARD - LYON 1

Président de l'Université

Président du Conseil Académique

Vice-président du Conseil d'Administration

Vice-président du Conseil Formation et Vie Universitaire

Vice-président de la Commission Recherche

Directeur Général des Services

M. le Professeur Frédéric FLEURY

M. le Professeur Hamda BEN HADID

M. le Professeur Didier REVEL

M. le Professeur Philippe CHEVALIER

M. Fabrice VALLÉE

M. Alain HELLEU

COMPOSANTES SANTE

Faculté de Médecine Lyon Est – Claude Bernard

Directeur : M. le Professeur J. ETIENNE

Faculté de Médecine et de Maïeutique Lyon Sud – Charles
Mérieux

Directeur : Mme la Professeure C. BURILLON

Faculté d'Odontologie

Directeur : M. le Professeur D. BOURGEOIS

Institut des Sciences Pharmaceutiques et Biologiques

Directeur : Mme la Professeure C.
VINCIGUERRA

Institut des Sciences et Techniques de la Réadaptation

Directeur : M. le Professeur Y. MATILLON

Département de formation et Centre de Recherche en
Biologie Humaine

Directeur : Mme la Professeure A-M. SCHOTT

COMPOSANTES ET DEPARTEMENTS DE SCIENCES ET TECHNOLOGIE

Faculté des Sciences et Technologies

Directeur : M. F. DE MARCHI

Département Biologie

Directeur : M. le Professeur F. THEVENARD

Département Chimie Biochimie

Directeur : Mme C. FELIX

Département GEP

Directeur : M. Hassan HAMMOURI

Département Informatique

Directeur : M. le Professeur S. AKKOUCHE

Département Mathématiques

Directeur : M. le Professeur G. TOMANOV

Département Mécanique

Directeur : M. le Professeur H. BEN HADID

Département Physique

Directeur : M. le Professeur J-C PLENET

UFR Sciences et Techniques des Activités Physiques et Sportives

Directeur : M. Y.VANPOULLE

Observatoire des Sciences de l'Univers de Lyon

Directeur : M. B. GUIDERDONI

Polytech Lyon

Directeur : M. le Professeur E.PERRIN

Ecole Supérieure de Chimie Physique Electronique

Directeur : M. G. PIGNAULT

Institut Universitaire de Technologie de Lyon 1

Directeur : M. le Professeur C. VITON

Ecole Supérieure du Professorat et de l'Education

Directeur : M. le Professeur A. MOUGNIOTTE

Institut de Science Financière et d'Assurances

Directeur : M. N. LEBOISNE

Summary

One challenge when dealing with the launching of new products is to understand consumers' expectations towards the product experience. Many innovations fail because they do not address the right expectations, for the right consumers, and for the right product.

Theories in cognitive psychology allow us to improve current methodologies of consumer tests and to design food products based on the knowledge of consumers. The objective of this research is to better understand the influence of the discrepancy between consumers' expectations and perceptions on the affective judgment in the context of food consumption. Within the framework of Grounded and Embodied cognition, we use theories developed on Perceptual Symbol System assuming a strong relationship between concepts and sensory perceptions. Three studies were conducted on familiar and non-familiar product ranges. Results allow us to conclude that consumers' expectations are defined as ad-hoc categories dependent on a situation of consumption, i.e. a motivation to consume the product in a determined context of consumption. Properties of the category define cognitive expectations and sensory expectations of the product. Thus, we provide evidence that concepts and sensory perceptions are strongly related through retrieval of categories.

The results of this thesis also provide methodological improvements to elicit consumers' expectations through categorization tasks and to screen samples fitting the best with consumers' expectations through affective judgment.

Key words

Categorization, Expectations, Food, Sensory Disconfirmation of Expectations, Affective Judgment

Résumé

Le lancement d'un nouveau produit sur le marché est une étape à risque pour l'entreprise qui peut se conclure par un échec. Une raison partielle de cet échec est que le produit ne correspond pas aux attentes des consommateurs. L'enjeu consiste donc à mieux comprendre et intégrer dans le design de produits les attentes des consommateurs.

Les théories contemporaines en psychologie cognitive nous permettent d'améliorer les méthodologies actuelles de tests consommateurs et à concevoir les produits sur la base des connaissances des consommateurs. L'objectif de cette recherche est de mieux comprendre l'influence d'une adéquation entre les attentes des consommateurs et leurs perceptions sur leurs jugements affectifs dans le contexte de consommation alimentaire. Dans le champ de la cognition incarnée et située, nous avons utilisé la théorie du Perceptual Symbol System qui suppose une forte relation entre les concepts et les propriétés sensorielles. Trois études ont été menées sur des gammes de produits familiers et non familiers. Les résultats nous permettent de conclure que les attentes des consommateurs sont des catégories ad-hoc dépendantes d'une situation de consommation, c'est-à-dire une motivation à consommer le produit dans un contexte de consommation donné. Les propriétés de la catégorie définissent les attentes de type concepts et les propriétés sensorielles attendues du produit. Ainsi, nous avons mis en évidence que les concepts et les propriétés sensorielles sont associées à travers les catégories réactivées en mémoire.

Les résultats de cette thèse ont aussi permis de proposer des améliorations aux méthodologies de tests consommateurs. Plus particulièrement, ces méthodologies permettent d'une part d'explicitier les attentes des consommateurs à travers une tâche de catégorisation et d'autre part de sélectionner les produits les plus adéquats aux attentes des consommateurs à travers l'évaluation de leurs jugements affectifs.

Mots-clés

Catégorisation, Attentes, Aliment, Disconfirmation sensorielle des attentes, Jugement Affectif

Remerciements

De nombreuses personnes ont participé à la réalisation de ce travail. La première raison étant que durant mon parcours d'ingénieur je m'étais posé la question de savoir si je souhaitais faire une thèse par la suite. La réponse avait été aisée. Je ne le souhaitais pas. Si j'ai aujourd'hui terminé ce travail de plus de trois ans je le dois donc à la participation de mon entourage qui a su me donner goût à la recherche, me soutenir et me montrer l'intérêt de réaliser un doctorat. La seconde raison est que l'exercice est particulièrement difficile et requiert des compétences de rigueur scientifique, de remise en question, d'équilibre entre sa vie professionnelle et familiale. Ces compétences ne faisaient pas partie au début de cette thèse de mes principales qualités. Je suis donc encore plus redevable à ces personnes pour ce qu'elles m'ont apporté, leur soutien, et la foi qu'elles ont placée en moi.

Je tiens tout d'abord à remercier les membres du jury pour avoir accepté de remettre en question mes apports scientifiques, et l'éclairage qu'ils leur ont donné. Aux Docteur Chollet, Docteur Schifferstein et Professeur Gervais, je vous remercie d'avoir lu mes travaux, de m'avoir accordé du temps pour les questionner et m'écouter durant ma soutenance. Je remercierai aussi tout spécialement le docteur Schifferstein pour les discussions que nous avons pu avoir et qui m'ont permis de mûrir encore ma réflexion sur ma recherche.

Je tiens ensuite à remercier tout spécialement Agnès, ma directrice de thèse qui m'a permis de réaliser ma recherche au sein de l'Institut Paul Bocuse. A Agnès, je tiens à te faire part de toute ma reconnaissance pour ton soutien constant durant ces quatre années ensemble, depuis la préparation du dossier CIFRE jusqu'à la soutenance de cette thèse, et même encore aujourd'hui. Je pense que j'ai été extrêmement chanceuse de bénéficier de tes conseils. Tu m'as aidé à m'épanouir professionnellement, à être plus sûre de moi et à mieux comprendre ce que j'étais capable de réaliser. Tu es quelqu'un de très compréhensif, qui a toujours su prendre en compte et comprendre mes contraintes personnelles. Pour toutes ces raisons et bien d'autres pour lesquelles il me faudrait encore sûrement une page supplémentaire merci de tout cœur.

A Michel, expert en sciences du consommateur et sensorielles chez Danone, je tiens à exprimer toute ma gratitude. Tu es à l'origine de mon envie de faire une thèse. Merci d'avoir cru en moi quand je n'étais qu'une petite stagiaire au sein de SBS. Merci d'avoir pris de ton temps et énergie pour mettre au jour ce projet et pour le suivre durant toutes ces années. Tu as aussi continuellement challengé mes résultats et mes méthodes me permettant ainsi de m'améliorer. Merci donc de m'avoir permis de réaliser cette thèse. Si je suis docteur aujourd'hui je te le dois en grande partie.

A Sabine, sensory and consumer manager au sein de SBS chez Danone, qui a été mon manager durant ces trois années, je tiens à te remercier pour tout ce que tu m'as apporté. Ce fût quelque part une première pour nous deux en tant que doctorante et manager et je tiens à dire que tu as parfaitement remplie ton rôle. Tu m'as aidé à construire ce long projet, à le rendre d'intérêt pour Danone. Merci d'avoir été à l'écoute, d'avoir répondu à mes doutes et de m'avoir fait prendre du recul sur ce travail et son importance, ce qui est le plus dur quand on est en thèse. Pour tout cela, je te suis reconnaissante. Merci d'avoir été un manager présent. Tout simplement.

A Cécile, group leader au sein de SBS chez Danone, tu as été une véritable « maman » pour moi. On pourrait entendre ce mot d'une manière péjorative, cependant il a une réelle importance pour moi et je le formule avec tout ce qu'il implique. Tu m'as véritablement aidée à me construire chez Danone, en me donnant toujours des retours très avisés sur ma place au sein de l'entreprise, ce que j'apportais, mes qualités et mes points à améliorer. Tu m'as aidé à mettre en valeur mon travail. Je tiens à te remercier pour tout ce que cette relation a impliqué pour moi. Toi seule sauras en comprendre toute l'importance.

Il serait difficile de continuer à remercier une par une toutes les personnes qui m'ont accompagné sans y consacrer des dizaines de pages, aussi vais-je devoir synthétiser.

Je souhaite remercier tout d'abord toute l'équipe de l'Institut Paul Bocuse et plus précisément le centre de recherche pour m'avoir accueilli durant ces longs mois de labeur. Dans ce cadre magnifique et grâce à l'équipe, le travail a tout de suite été plus agréable. Je tiens donc à remercier d'une part les grands, Laure, Jérémie, Chelo, Estelle, Anne-Cécile, Olga mais aussi les petits, merci à Camille, Gaétan, Anastasia, Jérémy, Sonia, Adriana pour la vie qu'ils mettent dans l'open space.

Merci tout spécialement aux anciennes de l'Institut, aujourd'hui docteurs, qui ont été une grande source d'inspiration, et de joie au quotidien ! Merci à celle qui est et restera toujours Yoda, celle qui est et restera toujours la compagne des grandes étapes, Laura, celle qui restera ma meilleure compagne de chambre étudiante, Céline, Carole et Julie. Merci de même à Rémy pour ton aide au quotidien quand à mes pauvres facultés en technologies diverses et variées. Merci enfin à Paul pour sa joyeuse compagnie !

Je souhaite remercier également toute l'équipe SBS chez Danone, qui m'a accueilli chaleureusement depuis ma sortie toute neuve de l'école et m'a soutenu durant toutes ces années. Je regrouperai dans cette section toute personne ayant eu un jour son bureau en D1 Nord. Merci donc tout spécialement aux membres du steering Sophie, Muriel, Marie-Agnès, Claire, Anne-Sophie, Jamie, et Nathalie. Merci de même aux membres très privatif du club des fumeurs, Sandrine, Cédric, Jérémie qui m'ont inlassablement écouté et conseillé durant ces temps de pauses nécessaires. Merci à mes précédentes managers, Nicole et Julie, pour votre gentillesse et vos conseils. Merci à mes compagnons de pâquerette, toujours disponibles et de bonne humeur, faisant ainsi de mon bureau un endroit privilégié pour travailler Denis, Louis, Pauline, Elodie, Carol-Anne. Merci à la personne qui a ensoleillé mes journées avec son sourire et sa patience à toute épreuve, Elodie. Merci également à Marthe pour ton extrême gentillesse et tous les instants passés à compter les voitures dans les bouchons. Merci à Alex, Laure, Florence, Priscila, Marion pour les sorties. Merci à Marie-Claude, Perrine, Isabelle, Emma, Marie, Laurence, Pierrick, Isabelle.B, Véronique pour m'avoir aidé depuis mon arrivée. Je tiens à remercier tout spécialement celle qui prend la relève avec brio et à qui je souhaite la plus belle des réussites, Julie.P.

Je tiens à remercier plus généralement toutes les personnes de l'aile D1 Nord que j'ai côtoyées au quotidien. Je citerai notamment Jean-Phi, merci pour ta bonne humeur/humour, ta gentillesse, ton soutien !

Je tiens à remercier aussi tout spécialement Docteur Bressoud, Professeur Versace et Professeur Dacremont pour leur aide et leur participation à mes comités de thèse.

Je terminerai ces remerciements par ma famille, soutien à toute épreuve, vous avez été là sans relâche, vous m'avez encouragé, aidé. Merci tout spécialement à ma sœur, Ségolène, qui comprendra l'implication de ces mots: merci pour tout.

Je tiens finalement à dédier ce travail à ma fille, Sixtine, qui à 5 ans ne veut toujours pas faire une thèse. Un jour tu changeras peut-être d'avis. En attendant, ces derniers mots sont pour toi : le travail a été dur, j'ai fait beaucoup de sacrifices mais cela en valait la peine. Je n'ai jamais lâché grâce à toutes ces personnes et aujourd'hui j'y suis arrivée.

Publications

Peer-reviewed Journal

- Rizzo S., Boesen-Mariani S., Rogeaux M., Giboreau A. What can consumers really do in a sorting task of strawberry fresh dairy products? Submitted to Food Quality and Preference.

Oral Communications

- Rizzo S., Giboreau A. (2014). A study of free-sorting variability between and within subjects. *In Summer school - Food & Hospitality research: From preparation to consumption*, 3-4 juillet, Lyon, France.
- Meiselman H.L., van Zyl H., Spinelli S., Cunha L.M., Giboreau A., Rizzo S., Lassallete C.P. (2014). Translation of emotion terms among (European) languages. *In Eurosense- A Sense of life – 6th European conference*, 7-10 september, Copenhagen, Denmark.

Proceedings

- Rizzo S., Boesen-Mariani S., Rogeaux M., Giboreau A. (2014). Espace perceptif des yaourts à la fraise avec et sans information. *In Journée du Sensolier*, 14 octobre, Paris, France.
- Rizzo S., Boesen-Mariani S., Rogeaux M., Giboreau A. (2015). From categorization to expectations: a study of individual variability. *In Two days of cross disciplinary workshop Social Science, Cognitive Science, Economics*, 21-22 September 2015, France.

Poster

- Rizzo S., Boesen-Mariani S., Rogeaux M., Giboreau A. (2015). A study on perception and expectations variability among consumers. *Poster presented In Journée de l'Ecole Doctorale Lyon 1*, 29 April 2015, Lyon, France.
- Rizzo S., Boesen-Mariani S., Rogeaux M., Giboreau A. (2015). Dealing with innovation: a new approach based on free sorting to evaluate expectations for an unfamiliar product. *Poster presented In 11th Pangborn Sensory Science Symposium*, 23-27 August 2015, Gothenburg, Sweden.

Table of Contents

Summary.....	4
Key words.....	4
Résumé.....	5
Mots-clés.....	5
Remerciements.....	6
Publications.....	9
Figures.....	13
Chapter 1: Introduction.....	15
Chapter 2: Bibliographical Review.....	19
1. From perception to expectations, a categorization-based process.....	21
1.1. Perception.....	21
1.2. Memory.....	28
1.3. Expectations.....	34
2. From expectations to affective judgment.....	39
2.1. Cognitive dissonance and categorization.....	40
2.2. Effect of sensory disconfirmation of expectations on hedonic judgment.....	41
Chapter 3: Research question.....	50
Chapter 4: From cognitive associations to sensory expectations through ad-hoc categories.....	55
Introduction.....	56
1. Study 1A: Cognitive associations induce sensory expectations.....	57
1.1. Research question.....	57
1.2. Methodology.....	57
1.3. Results.....	61
1.4. Main conclusions.....	63
1.5. Methodological limits.....	63
1.6. New proposal of study based on insights.....	65
2. Study 1B: Expectations are framed by ad-hoc categories depending on contexts and subjects.....	66
2.1. Research question and hypothesis.....	66
2.2. Methodology.....	67

	2.3.
Results.....	6
	8
2.4. Main results	70
2.5. Methodological limits	70
2.5.1. New proposal of study based on insights.....	72
3. Discussion	73
Chapter 5: From sensory perceptions to cognitive expectations; variability among subjects.....	76
Introduction	77
1. Study 2A: influence of sensory perceptions on cognitive expectations	78
1.1. Research question.....	78
1.2. Methodology	78
1.3. Results.....	85
1.4. Main results	97
1.5. Methodological limits	97
3.1. New proposal of study based on insights	99
2. Study 2B: diversity of cognitive expectations induced by sensory perception between subjects.....	100
2.1. Research question.....	100
2.2. Methodology	101
2.3. Results.....	103
2.4. Main conclusions	108
2.5. Methodological limits	108
3. Discussion	110
Chapter 6: Influence of sensory disconfirmation of expectations on affective judgment.....	113
Introduction	114
1. Study 3A: understanding the link between ad-hoc categories and sensory disconfirmation of expectations.....	115
1.1. Research question.....	115
1.2. Methodology	115
1.3. Results.....	117
1.4. Main conclusions	119

2. Study 3B: Influence of a sensory disconfirmation of expectations on affective judgments.....	119
2.1. Research question.....	119
2.2. Methodology	120
2.3. Results.....	126
2.4. Main conclusions	137
2.5. Methodological limits	137
4. Discussion	140
Chapter 7: Conclusions	143
Chapter 8: General discussion	149
Going further with sorting task in a food product design	153
Inter-individual differences taken into account in methodologies.....	155
Expectations: a dynamic process over time	157
Bibliography.....	159
Appendices.....	175

Figures

Figure 1: Scheme of modal symbol system from perceptual states (source: Barsalou, 1999)	277
Figure 2: Theories of disconfirmation of expectations (source: Schifferstein et al, 1999)	422
Figure 3: Theoretical background of research.....	52
Figure 4 : Experimental background of research	53
Figure 5 : Research scheme of Chapter 4.....	58
Figure 6: Photos of the range of strawberry fresh dairy products selected for the study	60
Figure 7 : Configuration of products without tasting obtained with the MDS and grouped with HAC.....	64
Figure 8: Configuration obtained with MDS in “percept” condition.....	70
Figure 9 : Configuration obtained with MDS in concept condition.....	71
Figure 10: Research Scheme of Chapter 5	80
Figure 11: Cold tea drinks product presented for tasting	82
Figure 12: Methodology for the comparative condition.....	83
Figure 13: Methodology for the monadic condition.....	84
Figure 14: Boards of cognitive expectations defined by the consumers through collages	85
Figure 15: Mappings representing products configuration and dendograms based on HAC	90
Figure 16: Repartition of the number of descriptors between the two conditions	91
Figure 17: Verbatim elicited for the two conditions and grouped under 5 themes	92
Figure 18: Percentages of elicitation for each thematic descriptor for standardized data	93
Figure 19: Frequency of elicitation for the two conditions for Little Miracles and Nestea.....	95
Figure 20: The frequency of elicitation for the two conditions for Honest Tea and Volvic Mint Tea	96
Figure 21: Research aims of studies 2A and 2B	101
Figure 22: Mapping obtained with MDS and projection of sensory descriptors for the four clusters	105
Figure 23: Mapping obtained with MDS and projection of associated boards for clusters of subjects ...	109
Figure 24 : Research scheme of chapter 6	116
Figure 25: Procedure in two steps. Before consumption / After consumption	115
Figure 26: 1/ Frequency of elicitation of verbatim before (concept) and after (tasting) consumption....	121
Figure 27: Procedure of assessment (repeated for the 4 samples)	124
Figure 28: Boards of pictures illustrating the benefits fitting with the motivation and the context.....	125
Figure 29: Boards of pictures illustrating two false negative benefits	126
Figure 30: Means of assessment of fitting with expectations for each product for each cluster	129
Figure 31: Means of assessment of surprise for each product for each cluster	129
Figure 32: Means of assessment of overall liking for each product for each cluster	131
Figure 33: Means of assessment of affective items for each product for cluster 1	132
Figure 34: Percentage of elicitations of the reasons why the product does not fit with expectations	134
Figure 35: Means of assessment of fitting with benefits for each product for cluster 1	135
Figure 36: Means of assessment of themes of characterization between clusters	138
Figure 37 : Final theoretical model of the research.....	148
Figure 38: Overview of the research	154
Figure 39: Configuration of products for group 1 of subjects (Kruskral’s stress = 0.045)	180
Figure 40: Configuration of products for group 2 of subjects (Kruskral’s stress = 0.045)	181

Figure 41: Description of each EGD.....	182
Figure 42 : Ten products presented for the tasting session	183
Figure 43 : Sensory perception of consumers for each product among three main sensory modalities .	185
Figure 44: Frequency of associations for each board of expectation and product	191
Figure 45: Steps followed during the focus-group	196
Figure 46: Means of assessment of affective items for each product for cluster 2.....	211
Figure 47: Means of assessment of affective items for each product for cluster 3	213
Figure 48: Percentage of elicitations of the reasons why the product does not fit with expectations	214
Figure 49: Percentage of elicitations of the reasons why the product does not fit with expectations	215
Figure 50: Means of assessment of fitting with benefits for each product for cluster 2	215
Figure 51: Means of assessment of fitting with benefits for each product for cluster 3	216

Tables

Table 1: Categorization of affective states.....	46
Table 2 : The structure of verbatim in cognitive and sensory associations	63
Table 3: Frequencies of elicitation of descriptors for the two conditions)	94
Table 4: Frequencies of elicitation of descriptors for the two conditions	96
Table 5: A summary of the descriptors most elicited and discriminating samples among the conditions	94
Table 6: Comparison of distribution between comparative and monadic conditions	98
Table 7: Significant associations with situation of consumption for each product in the two conditions	99
Table 8: Table of ARV coefficients	106
Table 9: Items significantly differentiating clusters of consumers (10%)	110
Table 10: Description of the assessment of the three items	119
Table 11: Description of the assessment of the three sensory items	120
Table 12: Description of products	125
Table 13: Number of subjects per cluster obtained with HAC	128
Table 14: Frequencies of check for each product and each context for cluster 1.	136
Table 15: Summary of the results for each cluster	137
Table 16: Table of ARV coefficients between configurations for each cluster and the whole set (global)	180
Table 17: Description of the nature of sensory disconfirmation of expectations	198
Table 18: List of affective items induced by a sensory disconfirmation of expectations	201
Table 19 : Frequencies of check for each product and each context for cluster 2	213216
Table 20: Frequencies of check for each product and each context for cluster 3.	217

Chapter 1: Introduction

The main standard action used to pilot food design and take the decision to launch a product on the market is consumers liking. However around 76% of FMCG (Fast Moving Consumer Goods) innovations launched on the Western Europe market fail (Nielsen, 2014). This data provides strong evidence that prediction tools based on liking assessment are no longer sufficient. Indeed, these failures can partly be explained by the fact that the product does not meet consumers' expectations (Buck, 2007). In line with the current stream of research, companies want to go beyond liking assessment and study how to improve consumer tests and measures in order to get a better prediction of a successful product (Edwards et al., 2013; Gutjar et al., 2015; Meiselman, 2013; Thomson, 2010; Thomson and Crocker, 2015).

To be successful, a product needs to be repeatedly purchased and integrated into consumers' habits. This can be viewed as determined partly by consumers' expectations. Indeed, the confirmation or disconfirmation of his/her expectations toward the product induces either the rejection of a product, or his/her potential repeated use of it (Anderson, 1973; Brunel and Gallen, 2012; Caporale and Monteleone, 2004; Deliza and MacFie, 1996). Therefore, the purchase of a product is highly correlated to product experience and thus, dependent on many factors related to the consumer, the product and the context of consumption (Jaeger, 2006; Meiselman, 2013; Rozin and Tuorila, 1993).

One of the factors determining product experience is the consumer's expectations. Before even tasting the product, the consumer expects to experience several key product characteristics, benefits, and feelings based on available information at the time of purchase (Olson and Jacob, 1972; Steenkamp, 1990). Our research is focused on better understanding the expectations as an individual cognitive process impacting on food perception. This knowledge will then be integrated into the food product design process of industries such as Danone.

Moreover, consumers' expectations and perceptions are related to the whole product experience and to the congruence between its components. In other words product characteristics, i.e. the recipe, the brand and packaging combined, should ensure that the expectations and perceptions of the consumers are met, leading to its repeated use and therefore to a successful launch of the product (Thomson and Crocker, 2015).

Product renovation and innovation are mainly driven by the marketing or through technical improvements proposed by research and development teams. In most cases, the consumer target is already determined through sociodemographic criteria such as gender, age, and profession, together with consumption habits. Prototypes, internally selected by the team, are then tested with

consumers through laboratory trials with the objective of screening the proposed products based on liking assessments. The prototype obtaining the highest score is then launched on the market.

As many research studies have shown (Boutrolle et al., 2007; Delarue and Boutrolle, 2010; Köster et al., 2003), assessment of liking with a Central Location Test is not really predictive of the consumers' experience. Some improvements have already been proposed, namely:

- to ensure more accurate predictability regarding the context of consumption, methodologies such as Home-Use-Tests have been developed to assess the performance of products at consumers' homes in their "usual" situation of consumption (Boutrolle, 2007),
- to assess the congruency between components of the full product experience, tests have been realized in branded conditions and additional criteria, such as emotions or benefits, complement the overall liking scores (Jaeger, 2006; Meiselman; Piqueras-Fiszman and Jaeger; Thomson et al., 2010),
- to take the variability of perception into account, inter-individual effects have been integrated with predictive tools of Preference Mapping, basing the results on a clusterisation of consumers on liking assessment (Rivière, 2007).

In the stream of improving consumer tests, we propose to better understand how expectations are involved in consumer judgment and more specifically, to focus on one variable not so often taken into account: the memory of consumers (Köster, 2009, 2006). Indeed, we consider memory as an important factor inducing the definition of expectations, impacting perceptual process and furthermore highlighting differences among individuals.

In the framework of the research, we therefore aim at better understanding memory as a cognitive process influencing consumers' expectations and perceptions and how this influences their affective judgments. This understanding will be used to support an explanation of the potential limits of current methodologies of consumers tests, and how to improve them with the final objective of allowing food product design based on protocols integrating theories of cognitive psychology.

In other words, our research aim is to study the influence of relations between expectations, memory and perceptions on the affective judgments of consumers in a food context.

To reach this objective, our research is realized in connection between three domains:

- Cognitive psychology allowing the use of theoretical models of memory and perception processes. Knowledge on the structure of memory and interactions between perception

and memory will be used to support the research and the design of studies. Knowledge relating to alternative measures of feelings induced by the adequacy between expectations and perception will be gathered to improve the standard hedonic protocols used in food process design.

- Marketing research allowing a deeper understanding of the effects of expectations on the full product experience, especially in relation to the brand. Research conducted in this area will not only provide much information on the affective states related to food consumption, but also to the role of the memory in relation to expectations and food perception.
- Food science allowing us to take into account the sensory properties of the product in the methodologies of assessment of expectations and perceptions.

To sum-up, this research has a business issue: integrating consumers' expectations as a key driver in food product design. This issue will be solved based on research insights in cognitive psychology and marketing and specific studies aimed at better understanding the role of memory in expectation and perception processes. Finally, this work will be used to improve current methodologies of consumer tests.

Chapter 2: Bibliographical Review

Our research objective focuses on the relation between expectation, memory, perception and affective judgment. We aim at using theories in cognitive psychology to design consumer tests integrating knowledge acquired during these cognitive processes. This bibliographical review is based on a literature in cognitive psychology but also includes food sciences and marketing research to define main concepts used in our studies.

Considering consumer expectations is necessary to ensure the success of a new product launch on the market (Cardello, 2007). Indeed failings are partly due to a mismatch between what consumers expect from the product before consuming it and once they have consumed it. Therefore, designing a product based on what consumers really expect lowers the risk of product failure on the market by diminishing the risk that the product will not be recognized by the consumers (Tuorila et al., 1998) or not made it their own (Gallen and Pantin-Sohier, 2012; Gallen and Sirieix, 2011).

It is difficult for food industries to foresee consumer expectations because they rely on the relation between external information available on the product and internal information, i.e. knowledge, built on previous experiences by the subject (Cardello, 1995). In other words, consumers expectations are established during the integration of newly-presented cues about the food regarding existing knowledge based on previous experiences (Piqueras-Fiszman and Spence, 2015). Some external information can be misleading for the consumers and result in a disparity between expectation and perception. The phenomenon of mismatch relates to the fact that consumers may have different perceptions, partly because of different knowledge acquired through their experiences.

Moreover, variability among consumers has to be taken into account in product design as well as in the evaluation of product expectation and experience. Indeed product experience takes into account experiences referring to all human-product interactions (Hekkert and Schifferstein, 2008). It involves the characteristics of the user, those of the product and of the context framing the interaction (physical, economic and social) (Desmet and Hekkert, 2007). Different factors are involved in the variability of perception and choice of consumers: psychological, sociocultural, physiological factors (Köster, 2009). Amongst these factors, psychological factors (especially memory) are often omitted when studying consumers expectations and perceptions (Köster, 2003).

Therefore, we think that avoiding a mismatch between consumer expectation and perception should be possible by ensuring that the right product has been proposed to meet to the

consumers' expectations. This is an essential condition to avoid a possible failure of a product on the market.

Expectations have been studied a lot in food sciences by investigating the influence of external information on consumer perception and judgment towards food (Caporale et al., 2006; Cardello, 2003; Cardello and Sawyer, 1992; Lenglet, 2014; Di Monaco et al., 2004; Siegrist and Cousin, 2009). These studies focused on the effect of mismatch between perception and expectations mainly by comparing experimental factors such as brand, manufacturing process, origin of products, or written information on sensory characteristics. They did not specifically assess the role of consumer memory which is our purpose. Better understanding the relationship between memory and expectation and how this link can affect perception and consumer judgment is our main question in this research.

This bibliographical review aims at defining how the following main concepts relate to each other: expectations, perception, memory and affective judgment. The first section is dedicated to defining the cognitive processes underlying perception, memory and expectation. The second section is dedicated to the analysis of existing knowledge on the relationship between expectation and product experience, and to a better understanding of how perception and specifically the congruence or mismatch between expectation and perception induce different affective judgments for the consumers.

1. From perception to expectations, a categorization-based process

This chapter is dedicated to a review in cognitive psychology and is divided into three parts. Firstly we define perception to better understand how a product is perceived by subjects. The second part defines memory and leads to its description as a categorization-based process. The third part is dedicated to the definition of expectation and its relationship with memory and perception.

1.1. Perception

1.1.1. Perception: an interpretation of stimulus

Perception is defined as *“the faculty by which an organism becomes aware of his environment based on information collected by the senses”* (Houdé et al., 2004). Subjects are

confronted by many sources of information while they evolve in their environment. This information helps them adapt their behavior.

Perception is activated through a stimulus that is apprehended by the subject, consciously or not. This element of the environment arouses a response from the subject (Masmoudi, 2010). Physico-chemical characteristics of the stimulus activate a stimulation pattern on the senses. These characteristics include for example a pattern of light, a gradient of chemical molecules, or the temperature. All sensory systems are involved in food perception: vision, audition, trigeminal, touch, smell and taste (Depledt, 2009; Giboreau and Body, 2007). The physico-chemical characteristics stimulate the senses through a conversion of physical or chemicals signals in nervous influx translated by the cortex (Bertrand and Garnier, 2005).

Physical and chemical information collected by sensory receptors is various and perception is multimodal, meaning that the pattern of activation of a given stimulus involves different sensory systems (Auvray and Spence, 2008). One example is the McGurk effect: a subject is looking at a video showing a man pronouncing the phoneme /ga/ while the soundtrack is broadcasting the phoneme /ba/. The subject will hear a third phoneme /da/ (McGurk and Macdonald, 1976). Regarding food perception, there are many examples which highlight this multimodality of perception. Sensory integration does not only concern in-mouth perception. For example dining in the dark with no visual cues, induces a decrease of taste and smell perception (Spence, 2012) and the color of a food is a well-known factor influencing odor perception (Morrot et al., 2001), or taste perception (Zampini et al., 2008). For instance: odors can elicit changes in perceived sweetness (Stevenson et al., 1999); increasing the level of sucrose or citric acid decreases the perceived viscosity of a solution (Christensen, 1980); increasing the level of sucrose in a chewing-gum can increase the perception of mint-flavor (Davidson et al., 1999); olfactory compounds such as butyl acetate induce a fruit odor and also activity in trigeminal nerve (Cain, 1974).

Sensory signals collected by the senses converge to a single meaning, giving congruent information to identify the stimuli. This automatic process is the integration of all sources of sensory information. It improves timeliness and efficiency of perception (Spence and Deroy, 2013).

At product level cross-modalities between senses are not only induced by the recipe itself, but also by interactions with the packaging among other things. The surface texture (the roughness or granulosity) of a container not only has an impact on the perceived texture (the crunchiness or thickness) of the recipe by the subjects (Piqueras-Fiszman and Spence, 2012) but also has an

impact on the taste (Becker et al., 2011). The color of the packaging has also been demonstrated as an impact factor on taste perception (Piqueras-Fiszman and Spence, 2011). These crossmodal correspondences are not only induced during recipe tasting but also through the experience involving the environment, i.e. the context of consumption¹.

Therefore the combination of sensory information through perception induces an estimation of the properties of the object close to reality and also depends on the weight given to each sensory variables by the subject (Driver and Spence, 2000).

Indeed, perception leads to a percept : “*an accessible, subjective, reportable experience that takes the form of an activation of a certain category in mind*” (Brosch et al., 2010). This percept is an individual representation of the perceived object at a given moment, not the general concept but the combination of all available information at the considered instant of perception. Physical characteristics are not translated and integrated in the same way by different subjects and at different stages of perception.

To sum-up, perception is a cognitive process integrating multimodal sensory sources leading to an individual percept. Therefore, we aim at integrating individual differences of perception.

1.1.2. Grounded cognition: perception relates to previous experiences

Differences between subjects are not only noticeable at the physiological level but also through associations between sensory modalities and knowledge. For example, a lemon drink is faster and more easily identified if the color is yellow rather than green (Zampini et al., 2008). This combination of sensory information induces the emergence of knowledge stored in the subject’s memory depending on previous experiences (Versace et al., 2009). Two kinds of processes are defined by the literature:

- Bottom-up processes, driven by information from the environment, leading to a code that is universal for all subjects. In other words, the output is the same independently of the individual (Lemaire, 1999; Marr, 1982; Marr and Nishihara, 1978).

¹ Contextual effects on perception are develop later through the categorization

- Top-down processes, driven by individual knowledge, giving an individual interpretation, a meaning to perceptual information (Firestone and Scholl, 2015; Lemaire, 1999; Versace et al., 2014).

Therefore individual mechanisms, such as attention or memory, are involved in perception and influence the way an object is perceived through the integration of sensory information and the interpretation of the physical characteristics.

In cognitive psychology, different theories of relation between memory and perception have been defined in the literature. Research in food science has proved the importance of the context on the product experience, i.e. the environment in which the product is consumed (Boutrolle et al., 2005; Cardello, 1995; Meiselman, 2013; Piqueras-Fiszman and Jaeger, 2014; Rozin and Tuorila, 1993a). Regarding theories in cognitive psychology, our approach will be based in the background of Grounded Cognition. This theory stipulates that cognition relates to the previous experiences of the subject and is situated (Barsalou, 2008). In other words, cognition is strongly related to interactions between a subject and his environment (Wilson, 2002). Grounded Cognition relates to Embodied Cognition which places the body at the center of the cognition (Varela et al., 1992) and emphasizes the role of the situation in the relation with cognitive processes (Pecher and Zwaan, 2005). It comes from the ecological theory of perception (Chemero, 2011) led by Gibson proposing that the environment plays a central role in a subject's perception (Gibson, 1979). In other words perception is action-oriented and guides behavior to adapt to the environment. Understanding of sentences and texts need to be situated for example (Clark and Marshall, 1981). Thus, Grounded Cognition postulates strong interactions between memory, perception and action related to the situation

Three different principles underlie Grounded Cognition. The first one relates to the relation between perception and memory. This theory moves away from the computational model (Neisser, 1967). Perception is no longer seen as a sequential treatment where sensory information is treated by perceptive mechanism (bottom-up process) and then influenced by a feedback of long-term memory on the perceptive treatment of sensory information (top-down process) (Versace et al., 2014). Embodied Cognition and Grounded Cognition argue that cognition is a dynamical system defined as *“a set of quantitative variables changing continually, concurrently, and interdependently over time”* (Chemero, 2011). In other words these processes are not fixed entities but dynamic ones depending on the situation (Versace et al., 2009). In this way, prior learning and action reduce the level of information integrated by the subject by selecting only the pertinent one through the environment, brain or body (Glenberg et al., 2013; Wilson, 2002;

Wilson and Golonka, 2013). Memory and perception and action are no longer considered as separated systems (Barsalou, 2008).

The second one relates to the structure of cognitive processes. Standard theories of cognition separate semantic memory from episodic memory (Tulving, 1985). It assumes that representation built from bottom-up processes during subjects' experiences are then transduced into amodal conceptual knowledge in semantic memory (Barsalou et al., 2003). In Embodied and Grounded Cognitions, long-term memory is a single system updated through the subjects' experiences (Versace et al., 2009). Knowledge is grounded, i.e. representations are integrated across the sensory-motors modalities of the experience (Barsalou, 2008).

The third one relates to the knowledge retrieval during perceptive process. The theory stipulates that subjects simulate possible interactions with the environment, therefore inducing a retrieval of knowledge dependent of the situation (Barsalou et al., 2003). Due to the role of the interaction with the body, re-enactment of knowledge during perception is based on sensory-motors properties constrained by these possible interactions: the simulation recreates a partial experience referring to the full experience that has been stored (Barsalou, 2008).

To sum-up, perception is a grounded (i.e. related to sensory –motor properties) and situated (i.e. related to a context) cognitive process. Memory is integrated with perception as a retrieval of knowledge related to previous experiences.

1.1.3. The Perceptual Symbol System

The theory of Embodied and Grounded Cognition gives a frame to the link between memory and perception related to the interaction between the subjects and their environment, i.e. the situation. This theory also redefines memory in its nature and the process of retrieval during perceptive process. Thus, it has an impact on the definition of representation, knowledge and concepts regarding perceptual storage.

Knowledge stored in memory is composed of units; i.e. concepts (Barsalou et al., 2003). In classical theories of cognitive psychology, concepts are defined as mental states having semantic properties and explaining behavior and cognitive processes of subjects. Concepts are also mental representations (Machery, 2004).

Perceptual Symbol System (PSS) is the main theory illustrating Grounded Cognition and defining the nature of knowledge in this perspective. This theory has been defended by Barsalou (Barsalou, 1999). Knowledge is retrieved from simulations of past experiences and grounded in motor-sensory properties as defined in the Grounded Cognition model. Barsalou defines the notion of the perceptive symbol as: perceptual knowledge arising during simulation of perceptive states and constituting the representations retrieved during perception. In other words, these perceptive symbols are concepts stored in the memory and related to perceptive (i.e. sensory-motor) states.

Two principles underlie the definition of perceptive symbols: knowledge is modal and analogical (*Figure 1*). The modal aspect is due to the fact that the simulation of each concept is inducing the retrieval of the pattern of sensory-motor modalities encoded during past experiences of this concept. The analogical aspect is defined by the activation of the same neuronal pattern and the same regions of the brain as the one activated during related past experiences (Barsalou et al., 2003; Wu and Barsalou, 2009). Thus the representation of one object is a combination of different perceptive symbols. Concepts are then characterized by perceptual properties (Goldstone and Barsalou, 1998); not only semantic ones.

For example many patterns of the sensory-motor information of a chair are stored in the memory related to different past experiences. Each pattern relates a situation, a concept and sensory-motor properties. Thus conceptualizing, for example, sitting in a living room chair feeling relaxed, induces the simulation of settings, i.e. the living room, the action, i.e. sitting, and the benefit, i.e. feeling relaxed. These concepts are components of an overall representation of the chair related to specific sensory-motor modalities simulated for this situation (Yeh and Barsalou, 2006). This theory can also be applied to less detailed concepts, namely representations that are not related to a specific context by activating a pattern of less specific sensory information. In other words information can be coded by neurons in a more qualitative way without details (for example a vertical edge without precision on the length) leading to the activation of a generic image (Barsalou, 1999).

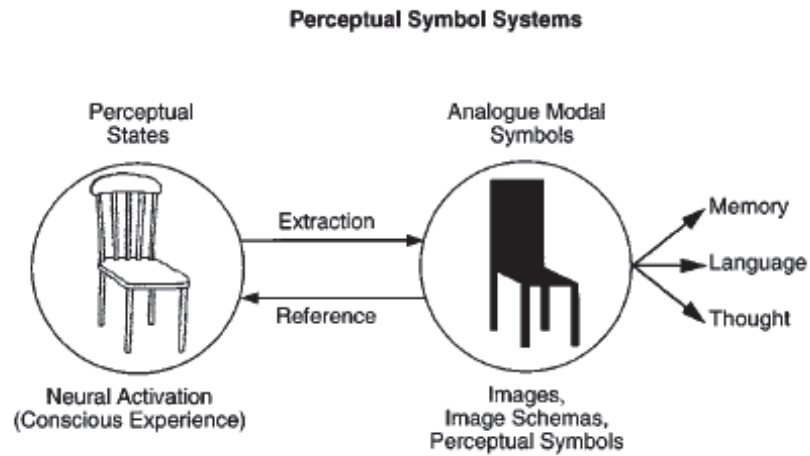


Figure 1: Scheme of modal symbol system from perceptual states (source: Barsalou, 1999)

In other words, Perceptual Symbol Systems as an illustration of memory process in Grounded Cognition considers a strong relation between the situation, the involved sensory-motors modalities and the concepts. It is worth noting that this is a dynamical system updated on experiences of the subject leading to an update of associations between perceptual states and concepts.

Conceptualization is thus the process of creating a mental representation related to a defined pattern of sensory-motor information named percept and inducing an affective reaction (Carey, 2011).

To sum-up, Perceptual Symbol System defines knowledge as a simulation of a perceptual state, i.e. sensory-motor properties related to a concept in a given situation.

1.1.4. *Reminder: perception is multisensorial, situated and involves top-down processes*

Perception is an integrative multimodal process influenced by attention and memory leading from a grounded stimulus in a given situation to an individual percept. Integrating top-down processes induces an interpretation of the stimulus according to the context of perception. Attention is involved in the perceptive process by first selecting the sensory information taken into account. Memory is solicited throughout the perceptive process by ensuring a retrieval of knowledge related to concepts associated to this information; this retrieval being strongly dependent of the context.

We consider the Perceptual Symbol System as a reference model for perceptive processes. To develop the use of the symbolic side of the perception, we need to better understand memory and, more precisely, how concepts are organized in the subjects' knowledge.

1.2. Memory

Knowledge is organized in categories (Lemaire, 1999). *“Categorization is a fundamental process whereby variables perceptual inputs are reduced progressively to a small number of equivalence classes, called “categories” whose memory representations called “concept” mediate thinking and adaptive action”* (Schyns, 1997). A category is defined as a group of objects sharing similar criteria (Reed, 1972). A stimulus is therefore always categorized and identified on specific modalities: *“That thing is round and nubby and orange in color... therefore it must be an orange”* (Bruner, 1957). Different theories of categorization have been proposed based on different properties sharing the same two fundamental principles.

1.2.1. *Theories of concept and categorization*

Various theories of concepts related to different rules of categorization have been detailed in the literature. By assuming the background of Grounded Cognition, the definition of concept differs from the classical theories and rules used to categorize. More precisely, the logic applied to group objects under the same category is not the same.

The aim of this paragraph is to describe the specificity of the definition of concept in the framework of Grounded Cognition compared to classical theories in cognitive psychology. Thus we will not make a detailed review of theories of concepts and categorizations².

- In the classical theory a concept of a category of objects is a definition. In other words the concept of the category is defined as the set of properties that are sufficient and necessary for membership within the category (Machery, 2004; Margolis, 1994; Murphy, 2004). Therefore, objects are grouped under the same category because they are the only ones to share the whole same set of attributes (Margolis, 1994). Categories are defined by a set of properties which values are discrete (Bruner, 1957). A specific hierarchisation of these categories allows making inferences between categories (Collins and Quillian, 1969). For example, according to Collins and Quillian, “canary” relates to “birds” that relates to “animal”. The main criticism of this theory is that not all the members are equivalent in a defined category depending on the situation of the subject.
- In the probabilistic theories three main examples of concepts are defined: prototype, exemplars and the explanation-based approach. The prototype and exemplars theories of concepts are based on the assessment of the typicality of the members of the category. Typicality measures the level of representativeness of an object as a member of the category. The more typical the member is, the more representative it is (Rosch, 1978; Rosch and Mervis, 1975). This theory also infers that categories are less structured and more labile. Indeed, the more typical a member is, the more properties it shares with other members, but it can also own some specific attributes not shared by the other members. Typicality of a member relies on the measure of “family resemblance”, namely the number of properties shared with other members of the group. One principle of this theory relates to probability of associations between properties. Some associations are much rarer and therefore are used less to build categories.
 - Prototypical theory: concepts are defined as prototypes, i.e. a concept of a category of objects is a prototype (Hampton, 1979; Rosch and Mervis, 1975). In other words, a concept is a set of statistical knowledge of properties that must be owned by membership within a category (Machery, 2004). Objects grouped under the same category are not equivalent, meaning that one member illustrates all the properties of the category best and is therefore used as a referent of this category (Posner et al., 1967; Reed, 1972). The prototype is a central and abstract object of the category. It is

² For detailed reviews, refer to (Lelièvre, 2010; Machery, 2004; Murphy, 2004)

the most typical member of the category (Rosch and Mervis, 1975). The categorization process is therefore based on the closer similarities between the object and the prototype of the category. In this case the properties considered to assess the proximity between the two members are selected. This also infers that at some point the properties do not have the same weight in the definition of the category. Reed has shown that the predominant strategy to categorize new exemplars is based on the distance between the object and the prototypes of the closest categories (Reed, 1972). Differences of categorization are dependent on the previous experiences of the subjects. In other words, how they are able to extract the more relevant information and use it as criteria of categorization to identify an exemplar as a member of a category. As not all the members are equivalent or organized by their proximity to the prototype of the category, therefore, properties are no longer discrete values.

- Exemplar theory, developed by Medin and Schaffer, refutes the organization of categories around a central, ideal member of the category (Medin and Schaffer, 1978). Categories are shaped by different exemplars stored in memory. Exemplars are defined as objects following the rules defining the category. The process of categorization is thus not the same, which means that the similarity is assessed by comparing objects to the whole set of the category members rather than to the prototype. All the exemplars are associated with points on a multidimensional space. The process is a calculation of the proximity of the object to other points on the space (Reed, 1972). The contextual effect is also taken into account as properties relating to all the members are stored with all their own criteria. Thus analogical process is also related to the criteria stored in memory based on previous experiences. Medin and Shafer gave the following examples : if the size is more relevant than the domesticity criteria to distinguish a cat from a dog, learning only about size would not be efficient for later experiences; indeed learning about domesticity as a property of the dog category can help to distinguish it from a wolf (Medin and Schaffer, 1978).
- Explanation-based theory, developed by Murphy and Medin, defines a concept as a group of objects sharing explanations about properties owned by the members (Machery, 2004; Murphy and Medin, 1985). Concept is not only a description of properties but knowledge about the function of each property shared by the members of the category, for example the coat of dogs to protect them from the cold. Based on these three main probabilistic theories, some hybrid models of concept have been developed. As the concept of schemes that is a hybrid theory between exemplars and

prototype. In other words, this theory of schemes assumes that organization in categories is made around a central member, but it can also regroup specific members less typical of, but still related to, this category because of past experiences (Smith et al., 1988) Another model considers the prototype as an ideal. The ideal is not the member owning most of the properties of the category, but the one owning the properties that a perfect member of the category should have (Machery, 2004).

- In the theory of perceptual states, based in the framework of the Grounded Cognition and Perceptual Symbol System, the definition of concept changes. Concepts are defined as perceptual states (Barsalou, 1999; Barsalou et al., 2003; Prinz, 2002). Retrieving a concept from memory induces a simulation of the properties encoded during previous experiences related to this concept. Sensory modalities are related to the concept encoded during subject's experience (Goldstone and Barsalou, 1998). For example, thinking about a property owned by an object induces visualizing the object. Concepts are defined as the representation of a category that is dynamic among contexts (Prinz, 2002). These categories are called "ad-hoc categories" (Barsalou, 1983).

To sum-up, in the framework of Grounded Cognition concepts are defined as perceptual states, meaning representations of dynamic categories depending on the context. This theory differs from classical theories as the members share necessarily goal-derived properties and do not refer to statistical inferences but to previous experiences.

1.2.2. "Ad-hoc" categories in food consumption

Based on Grounded Cognition, perception is a cognitive process helping the subject to identify and simulate hypothesis in order to interact with objects in the most efficient way with the environment. A concept cannot be dissociated from its context, meaning that categories stored in the memory are retrieved depending on the situation and therefore on the motivation of the subject. Within this framework, Barsalou has developed "Ad-hoc" categories (Barsalou, 1983). Members of the category share the main following properties: they all fit within a goal defined by the subjects. One example given by Barsalou is the category of "objects to take in case of fire" that will group together "children", "photos", "jewels" and "papers". These members shared few structural properties but all met the same motivation which defined the category.

In common with any action, food consumption is associated with a context and also the motivation to drink or eat a product. Motivation is an individual state aroused by a need and leading to activities of consumption to the achievement of a specific goal (Arnould et al., 2004; Hanna, 1980)³. In a given context, this goal is achieved through the definition of the desired consequences of the food consumption, i.e. the benefits⁴ (Gutman, 1982). The consequences can be defined as functional (“food to support my immunity”, “drink to quench my thirst”), or as emotional (“food to feel happy”, “food to feel serene”) (Thomson, 2007). Affective dimensions are taken into account in goal definition because they shape the context of consumption (Niedenthal et al., 1999). Previous experiences are better stored in memory when associated with a high affective arousal (Baumgartner et al., 1992). Thus ad-hoc categories can relate to a motivation defined by affective reaction. Niedenthal et al give as an example the following situations which can be categorized together as fear-based reactions: “the sound of an air attack”, “a snake on the road” and “admonition from a manager”.

These categories are dependent on the individual as they rely on shared motivational aspects. Consumer implication for example is a function of the motivation associated with food consumption (Arnould et al., 2004). Implication is mainly defined in marketing research related to the brand, but it can also relate to the category of the product (Gutman, 1982; Thomson, 2007). Involvement of consumers for specific benefits related to the product can influence their perception (Ares et al., 2010). Implication is also defined through the usage of the product. A study realized by Medin and Lynch showed that depending on the implication of the subjects with the objects, categorization is not the same (Medin et al., 1997). Different types of tree experts (taxonomists, maintenance workers and landscape workers) were asked to sort trees. Results showed that sorting was different among experts. Indeed landscape workers sort trees among goal-derived criteria, i.e. functional criteria, whereas taxonomists and maintenance workers differed in using different morphological features. Expertise referring also to sensory abilities or professional knowledge induces variability among subjects (Ballester et al., 2008; Chollet and Valentin, 2000; Faye et al., 2013; Lelièvre, 2010). Faye compared the categorization of wine glasses made by different groups of subjects with several levels of experiences in wine. Results showed differences of categorization and description between naïve subjects and connoisseurs (Faye et al., 2013). Furthermore in a product experience framework, expertise also relates to the knowledge acquired about the brand as loyalty, familiarity, objective and perceived, i.e subjective,

³ The purpose is not to make a classification of individual needs but define motivation and its translation in a food consumption context

⁴ Benefits are defined in the section Expectations

knowledge (Cho, 2011; Korchia, 2001). In studies related to brand category, categorization of a novel product is also different among subjects depending on their implication to the brand (Kreuzbauer and Malter, 2005). Thus, we consider that these various factors relate to familiarity. It is define more broadly by “how much a person thinks she/he knows about the product” or “how much a person knows about the product” (Park and Lessig, 1981). Taking into account all the components of the product experiences: recipe, packaging, brand and context of consumption, we extend familiarity to a reference to usage, conceptual knowledge and implication inducing a variability in the construct of ad-hoc categories.

Furthermore, these categories are also context-dependent. Context is defined with all the parameters that are noticeable in the environment to define an event (time, location, social etc) (Cardello, 1995). In cognitive psychology, situation is defined initially by spatial and temporal parameters (Yeh and Barsalou, 2006). More precisely, a situation can be defined from an entire physical setting to an adjacent stimulus. In other words, by context, we do not only mean physical environment, but also the level of sensory information available on the product through the different objects next to the target object. Some studies have shown the impact of: environmental parameters (Barsalou, 1982; Boutrolle, 2007; Joubert, 2008); information on brand or on the packaging (Becker et al., 2011; Di Monaco et al., 2004; Varela et al., 2010); and on the diversity of sensory information (Bech-Larsen and Nielsen, 1999; Breivik and Supphellen, 2003).

Ad-hoc categories follow the fundamental principles of categorization shared by classical theories. For example, some members of the category can be more typical than others. Two fundamental principles underlie categorization: “*to provide maximum information with the least cognitive effort*” and assert through the categories that “*the perceived world come as structured information rather than as arbitrary*” (Rosch, 1978). The first principle is about cognitive economy, meaning that categorizing allows extracting more information with the least cognitive effort. Indeed, identifying the stimulus is always related to a specific purpose. In this case, the level of categorization, or the number of attributes taken into account in the mechanism, will be the chosen function of the goal of the subject to adapt his behavior. The second principle is about combining the attributes in order to be as close as possible to the reality of perception. The structure of the world is an empirical link based on our senses. This congruency of associations between attributes is dependent on many factors such as species, culture, context, etc.

Categorizing a stimulus is activating the inductive aspects that define the category, namely the sufficient criteria to define the category. These attributes allow associating the stimulus to the given category. For example, the sufficient or inductive criteria for the category of “birds” are

“wings”. Categorizing is also activating deductive attributes, namely attributes of the category that will be associated to the stimulus. For example, a deductive criterion of the category “birds” is “flying”.

To sum-up, concepts are representation of knowledge stored in memory and structured into ad-hoc categories. The latter are defined by a sharing of goal-derived properties. In food consumption these properties are called situation of consumption, i.e. a motivation to consume the product in a given context of consumption.

1.2.3. Reminder: memory is organized in ad-hoc categories

Categorization is a process of identification structuring memory into groups of objects sharing similar criteria. Different theories have been proposed to explain how a subject can identify an object and categorize it. The common theme to all these theories is the sharing of properties between members and an inference of the properties of the category to the object. When focusing on food consumption, motivation and the context of consumption play a significant role, thus, “ad-hoc” categories seem to be the most efficient way to study the role of memory in the perceptive process. Categorization is made under a specific situation of consumption, i.e. a motivation to consume the product in a given context of consumption.

1.3. Expectations

This section on expectations is mainly based on food science literature. The objective is to highlight the discrepancy between actual theories developed in cognitive psychology regarding perception and memory, and the state of food science regarding expectations.

In common with all actions, food consumption is always related to a motive. If the subject chooses to eat or drink some food, then he expects the precise attributes of the food experience to fulfill his expectations. For example, if someone wants to drink because he feels thirsty, then he will search for a product that he imagines is refreshing, liquid, transparent and not sweet. The consumers’ expectations (before consumption) influence the way the product is perceived and

then the judgment of the product. Therefore understanding what expectations are, and how they are processed, is key to understand food perception.

1.3.1. Definition of expectations

Defining expectations depends on the domain of research (psychology, sociology, food science, and marketing) and the factor of assessment (judgment, choice, quality assessment, behavior).

Olson and Dover proposed to define expectations as “*pretrial beliefs about the product [...] the subjective probability of association between two concepts such as a product and an attribute*” (Olson and Dover, 1979). Defining expectations as a believe is related to Anderson’s definition of expectations as hypothesis formulated by the consumers on the product (Anderson, 1973). Therefore, expectations are viewed as a set of hypothetic attributes than can be associated to the product the subject is going to consume. These definitions have no link with the future or possible action after hypothesizing about the product. Deliza and MacFie proposed a definition of expectations that completed previous definitions: “*the action of mentally looking for something to take place; anticipation*” (Deliza and Macfie, 1996). Expectations are therefore not only viewed as wishes or hopes about the product, but as hypothesis influencing the way the subject is going to assess or use the product.

In cognitive psychology, expectations are defined as the prior knowledge that is integrated into the perception process (Bruner, 1957). This knowledge is inferenced from previous experiences and external cues gathered by the subjects. Thus, subject built hypothesis before consumption on the product. This knowledge is quite large in nature and relates among others things, to concepts, sensations, and emotions.

This diversity is also seen in various studies focused on expectations : expected quality of a product (Cardello, 1995; Siret and Issanchou, 2000), expected sensations (Piqueras-Fizman and Spence, 2015; Puumalainen et al., 2002), expected pleasure (Schifferstein et al., 1999; Siegrist and Cousin, 2009) or expected performance (Schifferstein et al., 1999). Expectations relate to a high number of attributes that emerge from the subject’s memory before food consumption.

To sum-up, expectations are defined as hypothesis built by the subject inferenced from previous experiences and external cues in a define situation of consumption, i.e. a motivation to achieve by consuming the product and the context of consumption associated.

1.3.2. Conceptual and perceptual expectations

In food science expectations relate to different characteristics that can help identify the product.

Expectations based on the sensory characteristics of the products are named perceptual expectations (Lange et al., 1998; Schifferstein et al., 1999). In other words they are sensory characteristics that the consumers expects to perceive while consuming the product (Deliza et al., 2003): intensity of lemon aroma, texture in mouth, sweet lasting, strawberry smell etc. These characteristics are immediately assessed during consumption by the consumers (Grunert, 2002).

Expectations related to the benefits associated with the products are named conceptual expectations (Lange et al., 1998). A benefit is defined as a desired consequence relating to the food consumption (Gutman, 1982). It addresses functional aspect, meaning it illustrates a specific function of the product (easy to digest, diet food) or it is associated with a social representation (ecological, environmentally friendly, ethical) (Grunert et al., 2001) or correlated to affective aspects (pleasure, fun) (Thomson, 2007). Hypothesis on these characteristics cannot be assessed during or just after consumption. They are based on external information such as publicity, labels on packaging, social context, etc... They are therefore closely related to the confidence of the consumers in the communication of this external information (Grunert et al., 2000). These expectations are also based on previous experiences especially for familiar products because consumers have already identified the consequences of the consumption (Grunert, 2002).

Even if conceptual and perceptual expectations have two different definitions, they are correlated. Indeed, as previously stated with PSS theory, every concept is linked to a specific pattern of sensory characteristics (see § 1.1.3.). Therefore, each conceptual expectation relates to a specific pattern of sensory expectations depending on individuals. These associations relate to associations in memory and are thus variable among subjects.

Another component of expectations refers to hedonic assessment and is defined as the hedonic experience the consumer expects to have while consuming this food (Schifferstein et al., 1999). This is the belief that the subject has that the product will be appreciated to a certain degree (Deliza et al., 2003).

To sum-up, expectations can be sorted into two groups: conceptual expectations based on concept retrieved from subjects' memory, and sensory expectations based on sensory characteristics perceived by subjects. Taking into account the theory of Perceptual Symbol System, conceptual and sensory expectations should be related.

1.3.3. Expectations are partly based on external information influencing knowledge retrieval

Consumers' expectations are induced by a motivation. Expectations related to an object are defined through a process involving searching for information about the object. Firstly information is assimilated from previous experiences with the object or a similar one. If not enough information is gathered by the subject, then information provided by the environment of the product is integrated (Rozin and Tuorila, 1993a). The expectations of consumers are therefore formed from two different sources of information: memory, namely internal information (see §1.2.), and environment, namely external information (Cardello, 1995).

Regarding external information, three sources of information involved in the construction of expectations are identified (Steenkamp, 1989):

- **Descriptive:** this is the most analytical source of information. Sensory characteristics of the product are induced from direct observation before consumption. For example, the specification of specific aroma "minty", "strawberry" will induce expectations regarding the flavor of the product. "Strong mint" or "added sugars" influence the intensity of the taste.
- **Inferential:** available indirectly about the product. It is derived from the deductions that the subject draws based on descriptive information on the product. For example, the brand is a form of insurance of the quality expected by many consumers (DeVecchio, 2001). This information not only comes from labels but also from the visual characteristics of the packaging. Becker et al. (2011) have shown that the shape and color of the packaging has an effect on the expectations of the consumer (Becker et al., 2011). Thus, indirectly these characteristics guide the expectations of the consumer: angular packaging for example will have the effect of creating a high expectation of intensity of taste. Finally, nutrition or quality labels as 'GMO-free' or 'Red Label' influence the expectations of the consumer vis a vis the benefits and quality of the product. Siret and Issanchou (2000) have shown that information provided about a traditional process raised high expectations of quality (Siret and Issanchou, 2000). Sabbe et al. (2009) have studied the impact of a health

claim on the attitude of consumers towards unfamiliar fruit juices. The results show that the information about the health aspect of the product engages increased appreciation, nutritional and health value assessment (Sabbe et al., 2009). Finally, Cardello (2003) has shown the influence of information about the technology used to develop the product on the expectations of the consumer, specifically those who feel concerned by this effect (Cardello, 2003). This information is mostly related to previous experiences and also induces association between concepts. Steenkamp gives the example of “this car has been made in Germany” that may lead to “this car is reliable” depending on the experience of the subjects.

- **Informational:** based on communications on the product. The source can be the media such as advertising on the radio, the television, but also the subject’s environment such as friends, colleagues or family, the Government, the producer, and consumer organizations (Schifferstein et al., 1999). In this case, a cue provides direct information about a property of the product, which is accepted or not by the consumer. This type of information is very delicate because it is dependent on the confidence the subject has in the information sourcing (Grunert et al., 2000). Specificity of this type of information is also that it will be never ascertained during or just after consumption of the product (Grunert et al., 2000). For example, many health effects primed by brands on the packaging of a product can’t be immediately ascertained. The subject should therefore trust the informant (Grunert et al, 2000). Siegrist et al. (2009) showed that a person’s experience of a wine and the expectations on product consumption could be modified by the opinions of experts in oenology (Siegrist and Cousin, 2009).

To sum-up, expectations are based on internal information, i.e. knowledge stored in memory but also on external information. The latter is defined by three sources relating to all the components of the product (recipe, packaging and brand). Depending on the nature of this information, knowledge retrieved from memory is not the same.

1.3.4. Reminder: expectations relate to categories retrieved before consumption

Expectations are pretrial hypothesis on the product sensory expectation or conceptual expectations, i.e. expected benefits and contexts of consumption associated with the product. Consumers' expectations are formed from internal information (i.e. memory) and external information (i.e. external cues provided by different sourcing from packaging to social communication). A balance between internal information and external information induces the categorization of the product depending on the motivation of the subject and the context of consumption. In the framework of Grounded Cognition, we will consider that conceptual and sensory expectations are strongly related and build on the category retrieved before consumption.

To sum-up, perception, memory and expectation are interdependent processes. In the framework of Grounded Cognition, memory is integrated at the first step of perception through the categorization process. Perceptual Symbol System assumes that concepts and sensory properties are strongly related based on previous experiences of the subjects. Concepts are representation of ad-hoc categories defined based on motivation and context of consumption. Based on these theories of cognitive psychology, we aim at studying expectations as ad-hoc categories retrieved during perception based on external information available for the subject and his/her previous experiences. Relation between these cognitive processes is thus variable among subjects.

2. From expectations to affective judgment

Before food consumption, subjects build an expectation toward a product. Once the product is tasted, expectations can be confirmed through perception or not. The subject's judgment depends partly on the fit between expectations and perception. Affective reactions can be induced by the experience of consumption. The question of interest to us is to study of discrepancy between expectation and perception. The first part is dedicated to describing the cognitive processes involved in a disconfirmation of expectations. Then, a second part aims at defining the nature of affective reactions induced by a disconfirmation of expectations.

2.1. Cognitive dissonance and categorization

2.1.1. Definition of cognitive dissonance

Food consumption can be considered through two major stages: before consumption with expectations and after consumption with perception. Final acceptability or satisfaction of the product depends on the discrepancy between expectations and perception (Anderson, 1973; Cardello and Sawyer, 1992; Cardello et al., 1985). This comparison gives rise to two possible outcomes: either the expectations of the subject are confirmed, and in this case the reaction of the subject will be referred to as "neutral", or the expectations of the subject are not confirmed by the consumption of the product inducing a disconfirmation of expectations (Anderson, 1973; Cardello, 1995; Deliza and Macfie, 1996; Olson and Dover, 1979). The latter is based on a theory by Festinger called cognitive dissonance, i.e an inconsistency between two cognitions, hereby expectations and perception, inducing a state of tension (Festinger, 1962; Harmon-Jones et al., 2009). In other words, an arousal state of the dissonance corresponding to discrepancy between expectations and perception induces psychological discomfort. This discrepancy is then reduce making it less uncomfortable through different effects on perception (Gallen and Brunel, 2014).

In summary, a disconfirmation of expectations is a specific case of cognitive dissonance aroused by a discrepancy between expectations and perceptions.

2.1.2. Relationship between cognitive dissonance and categorization

Categories associated to a product can evolve and create a cognitive dissonance if the main sensory properties are not similar to the expected ones, inducing then a sensory disconfirmation of expectations. Studies have shown that extensions of brand can create such discrepancy if the main properties of the category defining the brand are not retrieved in the extended product (Estes et al., 2012; Wänke et al., 1998a). Further investigations are needed to understand the link between expectations, categories in the mind and sensory disconfirmation of expectations.

Sensory disconfirmation of expectations is a discrepancy between expected and perceived sensory properties (Schifferstein et al., 1999). Studies have been conducted to understand the link between categories and sensory disconfirmation, especially in the case of brand extension. Indeed, in innovation cases it is important for the subject to be able to recognize and associate the new product as a brand extension, therefore recognizing the signature of the brand within the product

(Wänke et al., 1998a). However, these studies focused their research on new products and brand extensions by modifying external information (Fenko et al., 2015; Tuorila et al., 1998), looking at the visual information taken into account by subjects (Kreuzbauer and Malter, 2005), or the benefits carried by the brand (Wänke et al., 1998a).

In summary, sensory disconfirmation of expectations is defined as a discrepancy between expected and perceived sensory properties. This discrepancy is induced by a difference of categorization of the product before and after its consumption.

2.1.3. Reminder: sensory disconfirmation of expectations is a cognitive dissonance

Sensory disconfirmation of expectations is a specific case of cognitive dissonance, here induced by a discrepancy between expected and perceived sensory properties of the product. Associations between concepts and sensory properties are based on the categories retrieved from subjects' memory. A sensory disconfirmation of expectations is thus a cognitive dissonance induced by a discrepancy of categories retrieved before and after food exposure.

2.2. Effect of sensory disconfirmation of expectations on hedonic judgment

Main studies on disconfirmation of expectations have focused the research on induced hedonic judgment, i.e. to understand differences of hedonic assessment before and after food consumption, when inducing expectations based on contextual information (Cardello and Sawyer, 1992; Lenglet, 2014; Di Monaco et al., 2004).

2.2.1. Effects of disconfirmation of expectations on hedonic judgment

Early theories were developed in the marketing area. Three effects on hedonic judgment are described (Anderson, 1973; Hovland et al., 1957) (Figure 2): assimilation, contrast and assimilation-contrast.

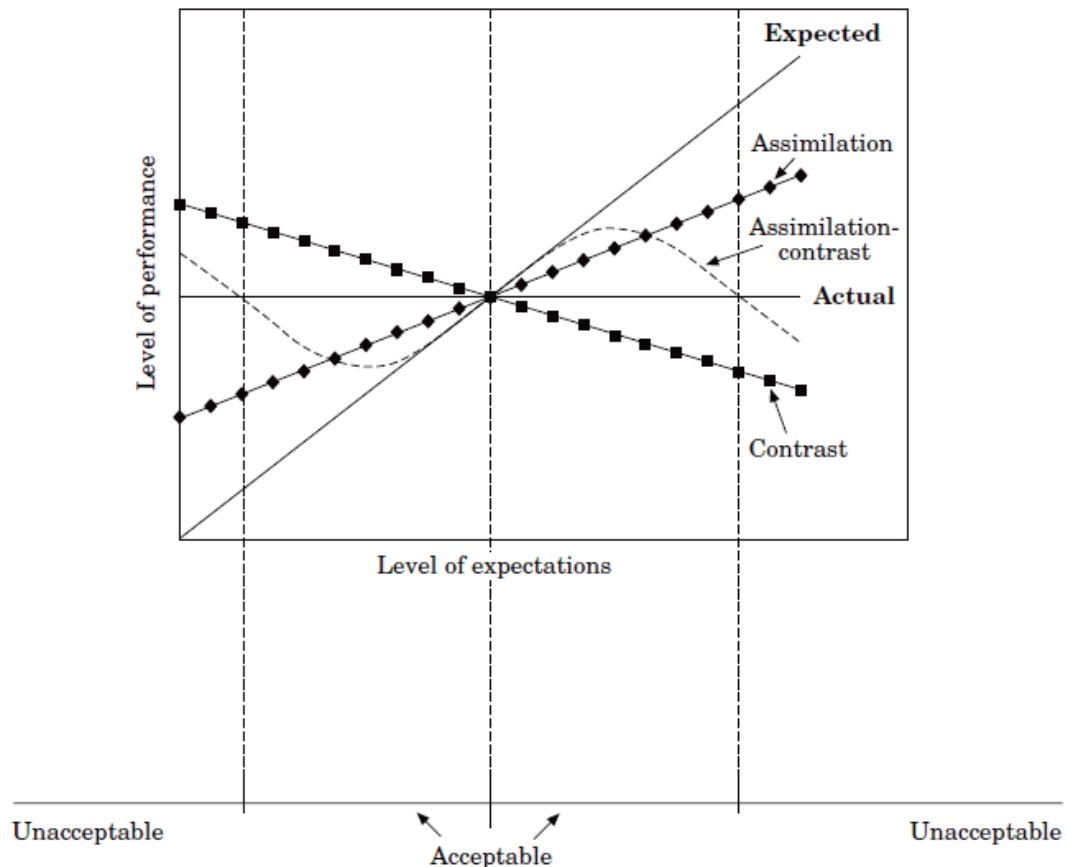


Figure 2: Theories of disconfirmation of expectations (source: Schifferstein et al, 1999)

Three hedonic judgments are measured : the product tasted in blind without any information (B), information alone before consumption (packaging information, information on the process, on nutritional values, brand...) (E), and the product tasted with the information (P) (Schifferstein et al., 1999). The three effects are described below based on these measures:

- The effect of assimilation: the consumer adjusts his/her perception to decrease the gap between expectations and percept. To reduce psychological discomfort, subjects tend to adapt their percept to their expectations (Anderson, 1973; Hovland et al., 1957; Schifferstein et al., 1999). If the subject is expecting a high performance of the product, and after consumption the performance proves to be poor, the subject will tend, in a case

of assimilation, to find the performance less poor. Regarding hedonic measures, the effect of assimilation is checked if the measure P is close to measure E, in other words if the measure of actual product is close to the expectations (Caporale and Monteleone, 2004; Caporale et al., 2006; Cardello, 2003; Siret and Issanchou, 2000; Tuorila et al., 1998). If the sign of the ratio $(P - B) / (E - B)$ is positive then the conclusion is an assimilation effect. Main studies in food science have shown that the strategy most often used is the assimilation one (Caporale and Monteleone, 2004; Caporale et al., 2006; Cardello and Sawyer, 1992; Siret and Issanchou, 2000). Cardello and Sawyer assessed pre-exposure and post-exposure assessment of liking and bitterness intensity of products based on a written description. The same product formulated to be assessed on the average on a liking and bitterness assessment was tasted by four groups of consumers. Each of the group read the product descriptions and assessed the liking score and the bitterness of the product before tasting: average liking and bitterness (group 1), disliked and very bitter (group 2), liked very much and not bitter (group 3) or no information (group 4). The results highlighted that for group 2, the assessment of bitterness was lower for the tasted product than expected and the liking was higher. In other words, the assimilation effect was induced (Cardello and Sawyer, 1992). This theory, however, is questionable. Indeed, instead of thinking that the subject learns from his mistakes, it increases the probability of them repeating it by making efforts to reduce this disparity by streamlining choice (Anderson, 1973). In fact, assimilation is not always complete (that is, the perceived performance is equal to the performance expected after assimilation). Most of the cases show a partial assimilation, that is, perceived performance tends to match the expected performance but without achieving it completely. Subjects who have completely assimilated the difference between their expectations and the performance of the product will tend not to change their expectations (Langé, 2000).

- The effect of contrast: the consumer exaggerates the gap between expectations and his perception (Anderson, 1973). When the consumers do not find a congruency between the product and the representations related to its category (Wänke et al., 1998b). The consumer therefore anticipates the stimulation (Schifferstein et al., 1999). One way to avoid a situation of contrast is to provide more information about the product through communication (Anderson, 1973). Regarding hedonic measures, if the sign of the ratio $(P - B) / (E - B)$ is negative then the conclusion is a contrast effect. Deliza et al., 1996 showed a contrast effect for a segment of subjects only (Deliza and MacFie, 1996). Similarly,

Cardello and Sawyer (1992) showed in one of their experiments a contrast effect for one of the groups of subjects.

- The effect of assimilation-contrast: a disconfirmation of expectations can bring either a rejection, i.e. a contrast effect, or acceptance, i.e. an assimilation effect (Hovland et al., 1957; Sherif et al., 1958). This effect is fundamentally linked to an acceptance threshold. Thus, if the mismatch between expectations and percept is sufficiently small and below the threshold of acceptance then the subject will tend to reduce this disparity (assimilation). Conversely, if the gap exceeds the threshold of acceptance, this effect predicts a rejection (contrast) (Anderson, 1973).

Effects are symmetrical between the case where expectations are lower than the percept and the case reversed. However, this symmetry is questioned by the "prospect theory" developed by Kahneman and Tversky (Kahneman and Tversky, 1979). Indeed, when the perceived performance of the product is higher than expected, this gap is associated with a gain in performance. Conversely, if the expected performance exceeds the expectations then, in this case, a performance gap is associated with a loss of performance (Kahneman and Tversky, 1979; Schifferstein et al., 1999). The subjective value of a gain is smaller than a loss, there is an asymmetry of effects and thus an effect of disconfirmations different depending on whether it is positive or negative. Schifferstein et al. (1999) thus highlighted lower assimilation in the case of a negative disconfirmation. However, this effect of asymmetry is very questionable since it is not observed consistently in that order. It should be noted that this effect has been demonstrated on the purchase intent in this study (Schifferstein et al., 1999).

A study conducted by Caporale et al. (2004) highlights the opposite effect. By combining a variety of information related to the manufacturing process with negative or positive connotations (organic, GMOs, and traditional) with a well appreciated brand and different products (from a low to high appreciation in blind), they have highlighted that for some combinations this symmetry effect disappeared (Caporale and Monteleone, 2004). In fact, assimilation is most important in a case of negative disconfirmation than a positive one. Specifically, and as pointed out by Deliza et al. (1996), consumers are more likely to assimilate their expectations after a negative disconfirmation of expectations (Deliza and MacFie, 1996).

These effects have been observed related to a discrepancy between expected and actual performances, some other effects can be elicited related to expected and actual perceived characteristics of the product.

In summary, three effects of disconfirmation of expectations of hedonic judgment are defined: assimilation, contrast and assimilation-contrast. Even if the assimilation effect seems to be mostly demonstrated in food studies, the assimilation-contrast should be a better option to understand effects of sensory disconfirmation of expectations. Depending on a threshold of acceptance, disconfirmation of expectations leads either to assimilation, i.e. a reduction of the discrepancy, or a contrast effect, i.e. a rejection.

2.2.2. Limits of hedonic judgment and other affective states

Hedonic measure is widely used in the research focused on disconfirmation of expectations. This is for most studies the baseline to understand how a subject has experienced food consumption. Hedonic judgment as used in food science studies or marketing research is collected through a conscious verbalization from « I like » to « I don't like » (Caporale and Monteleone, 2004; Caporale et al., 2006; Cardello and Sawyer, 1992; Siret and Issanchou, 2000). Assessment of hedonic measure is defined as “the satisfaction” induced by a stimulus, here the tasting of a product. This component is breve and consciously expressed by the subject (Derbaix and Pham, 1991).

A cognitive dissonance induces affective states (Gallen and Brunel, 2014): satisfaction (Anderson, 1973; Bourgeon et al., 2007), frustration and anxiety (Festinger, 1962). Thus, defining sensory disconfirmation of expectations as a case of cognitive dissonance means that hedonic judgment provides only a part of the information regarding affective judgments of consumers. Some research is already done around emotions, for example (Ferrarini et al., 2010; Labbe et al., 2015; Schifferstein et al., 2013).

In food consumption, investigation of possible induced affective items have provided a list including emotions, feelings, attitudes, moods, personality traits and appreciation (Derbaix and Pham, 1991). Defining affective feelings is difficult for two main reasons: The first reason is to differentiate the nature of affective states as feelings and emotions. The second is to differentiate affective states induced by a sensory disconfirmation of expectations from affective states influencing the food consumption.

Differentiating the nature of affective states are difficult as there is no clear consensus on the definition (Meiselman, 2015). However, several aspects are shared as dimensions differentiating affective states (Derbaix and Pham, 1991) :

- The degree of specificity of the stimulus
- The intensity of the affective state perceived by the subject, depending on the arousal of the affective reaction and its dominance on other reactions
- The valency as negative or positive
- The duration of the affective states
- The content or nature of the affective reaction
- The consciousness of the subject, i.e. the fact that the subject can identify consciously the affective reaction and verbalize it.

Different affective states were characterized based on some of these dimensions (*Table 1*).

Table 1: Categorization of affective states

Affective state	Emotions	Feelings	Moods	Personality traits	Attitudes	Appreciations
Degree of specificity of the stimulus	Specific	Specific	Not specific	Not specific	Specific	Specific
Intensity	High	Medium	Weak to Medium	Weak to Medium	Medium	Medium
Duration	Very short	Medium	Medium	Long	Medium	Short

Regarding theories on cognitive dissonance, affective states induced by a sensory disconfirmation of expectations are specific, short and highly intense.

In summary, the appreciation (or hedonic measure) is widely used in food sciences but is not sufficient to characterize a sensory disconfirmation of expectations. Extending the research to other affective states integrates emotions also.

2.2.3. Affective states induced by a Sensory Disconfirmation of Expectations

Emotional assessment has been increasingly used in food science research and marketing research as a component highlighting product experience congruency (Ferrarini et al., 2010; Meiselman, 2015; Schifferstein et al., 2013; Thomson and Crocker, 2015). Thomson stresses the importance of not only relying on a model of explanation based on hedonic measures, but on the emotional measure to segment consumers (MacFie, 2007). Some researchers have showed that emotional profiles induced by expectations need to be aligned with emotional profiles induced by the recipe (Spinelli et al., 2014; Thomson et al., 2010). However, in many studies, benefits or motivations to consume the product, moods or personality traits are assessed as emotions consequently to a food consumption (King and Meiselman, 2010; Meiselman; Thomson et al., 2010). Thus, the definition of emotions is not consensual among researchers. This debate is not relevant to our research. We will speak here about affective states and base the analysis on the same dimensions as for emotions.

Surprise

An unexpected event creates a “surprise episode” (Ludden, 2008). The surprise is an important component of emotional judgment resulting from a confirmation or disconfirmation of expectations (Anderson, 1973). Some authors pointed out that surprise is a first step in affective processes (Teigen and Keren, 2003), felt several times for the same product even if its intensity decreases with time. Surprise draws the attention of the consumer (Ludden et al., 2012a). Surprise is ambivalent, i.e. a subject can be surprised in a negative or positive way. The surprise intensifies other perceived affective states and perceived pleasure (Mellers et al., 2013). However, surprise alone is not sufficient to characterize a sensory disconfirmation of expectations. It is necessary to link it to other components such as fun, confusion or appreciation. Indeed, any incongruity leads necessarily to a surprise reaction. However, if this discontinuity is inappropriate, i.e. that the subject cannot, or hardly, make the connections between this incongruity and other sensory characteristics of the product, then the individual will be confused and will heavily depreciate the product (Ludden et al., 2012b).

Therefore, there is a consensus on the importance of assessing surprise as a relevant item induced by the discrepancy of two cognitions, hereby perceptions and expectations.

Affective states

Affective states as emotions are brief, intense and applied to a specific reference, i.e. induced by the product consumption (King and Meiselman, 2010). It is as well a being state as a feeling (to be unhappy or feel unhappy). It is not defined by a physical state and can be controlled (to feel tired is therefore not an emotion but a physical state (Derbaix and Pham, 1991). These affective states

are organized in two dimensions: positive and negative (Desmet and Schifferstein, 2008; Laros and Steenkamp, 2005).

Affective states are described on intensity, valency, nature and consciousness of subjects, but there is a lack of knowledge regarding the exhaustive list that can be used in studies to understand the effect of disconfirmation of expectations.

A sensory disconfirmation of expectations is induced by an incongruity with the category activated in the mind of subjects before food consumption. Festinger has assumed that a part of this cognitive dissonance can be for some people painful, inducing an emotional dimension (Festinger, 1962). This affective part is namely the « dissonance » relating to emotional and motivational states induced by the discrepancy (Harmon-Jones, 2000).

Some studies have therefore focused their attention on incongruity between senses which is correlated with the sensory disconfirmation by the fact that some of the senses help build strong expectations as visual and tactual senses (Ludden et al., 2007). Based on incongruities between senses, some emotions have been assessed and correlated with different natures and levels of incongruities (Ludden et al., 2012b). However, the list of affective items was not designed for a food application but was determined from a qualitative study applied on objects of design.

In food product experiences, all axes of the product mix must be aligned to ensure a confirmation of expectations (Ares and Deliza, 2010; Cardello, 1995; Thomson et al., 2010). As the emotional profile felt by consumers evolved among the food experience (Schifferstein et al., 2013), and as sensory properties of the product relate to a defined concept depending on the information taken into account by the subject, therefore sensory disconfirmation of expectations can be of different nature. This study will investigate affective feelings induced by different natures of sensory disconfirmation of expectations.

In summary, surprise is directly induced by a sensory disconfirmation of expectations. This is the first step of an affective chain of reactions. Consequent affective states induced after surprise by the sensory disconfirmation of expectations allows for better understanding of the incongruity felt by the subject. However, there is no established list of affective states directly induced by a sensory disconfirmation of expectations.

2.2.4. Reminder: affective judgment is induced by a sensory disconfirmation of expectations without a consensus on its nature

Affective reactions are induced by a cognitive dissonance. Most studies focused their attention on appreciation to understand strategies followed by the subjects to reduce the discrepancy. Several affective states are involved in perception but most of them can't fit to the research because they are not induced directly by the discrepancy (mood, personality traits, and feelings). Some affective states could fit but there is too much discussion around the nature of these items (emotions). Thus, affective judgment induced by a disconfirmation of expectations needs to be studied further and affective states, as we called them, need to be defined directly from consumers' perception and verbalization.

In summary, expectations and perceptions can be different and induce a cognitive dissonance, sensory disconfirmation of expectations, in a food context. This discrepancy is due to a difference in categorization before and after consumption. Several affective states can be aroused starting with a surprise event. Thus, we need further investigation on the relationship between association of concepts and sensory properties and sensory disconfirmation of expectations through the nature of affective states induced.

Chapter 3: Research question

On the one hand, contemporary theories of cognitive psychology state that cognition is grounded and embodied highlighting that memory has an impact on perception depending on the context and the subject. On the other hand, theories in food sciences have not yet focused on the role of past experiences in the expectations of consumers toward his/her experience of the product. Our research addresses links between expectations, categorization, perception and affective judgment in a food consumption context.

Expectations have been studied regarding the effects of the contextual factors and product information on perception through the assessment of product properties. Less information is available regarding the relationship with ad-hoc categories retrieved from consumers' memory based on contextual information available on the product. Grounded and Embodied Cognition postulate that memory is integrated to perception and that concepts relate to sensory perception. In other words, there is much to learn about the relationship between expectations based on concepts stored in memory and sensory perception. Using theories on ad-hoc categories induces also taken into account variability between subjects regarding the motivation to consume a product in a given context. Furthermore, effects of expectations on perception have been studied through liking scores. However, based on theories regarding cognitive dissonance, it seems that affective judgment induced by a disconfirmation of expectations cannot be reduced to a liking score; other criteria could be induced such as affective states.

The objective of the research is to better understand the role of expectations using the framework of Grounded and Embodied Cognition and ad-hoc categories and to study the variability of expectations among subjects. In other word this research aims at providing better understanding on the influence of the context and the motivation to consume the product on the relationship between concepts, expectations, percepts, i.e sensory perception and affective judgments (*Figure 3*). This research aims at using external information to induce various categorization and thus various cognitive associations, sensory perceptions and affective judgments.

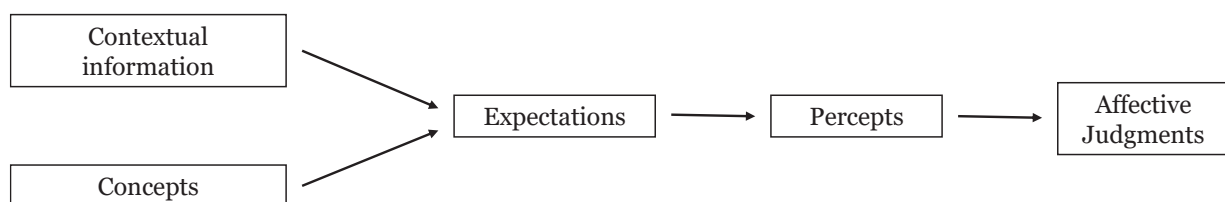


Figure 3: Theoretical background of research

From the literature, the research is based on the following statements:

- Expectations are partly framed from memory and depends on external information available on the object. They are defined from the association of the product to an ad-hoc category inferencing cognitive and sensory associations.
- Cognitive associations are defined as the benefits associated to the product. Sensory associations are defined as sensory perception of the product.
- Concepts are defined as the representation of ad-hoc categories.
- Perception is influenced by expectations, acting as hypothesis on the product. These associations depends on external information available on the product.
- Affective judgment is induced by cognitive dissonance, i.e here sensory disconfirmation of expectations perceived by the subject.

The experimental framework of this research is to manipulate contextual information as packaging information or sensory diversity and motivation to enhance different expectations, different perceptions and then different affective judgments on the product (**Figure 4**). The influence of contextual information is measured on one side on ad-hoc categorization of the product and on the cognitive and sensory associations with the product. On the other side, these effects are measured through sensory disconfirmation of expectations on affective judgments.

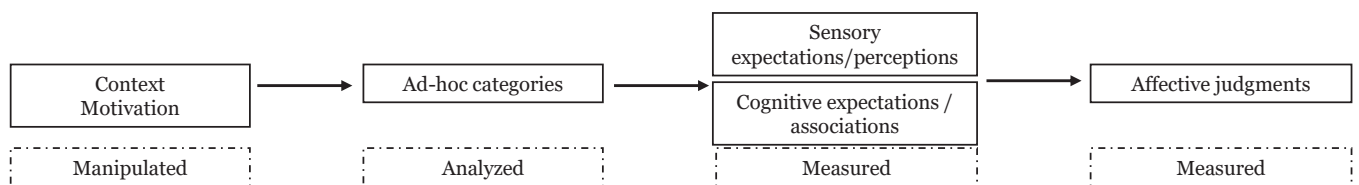


Figure 4 : Experimental background of research

The research is organized in three parts:

1. From cognitive associations induced by external information on packaging to sensory expectations through ad-hoc categories. We aim at better understanding the sensory expectations induced by the information available on packaging of products without tasting through a categorization step. → *Chapter 4*
2. From sensory perceptions to cognitive associations through individual variability. We aim at better understanding the cognitive expectations associated to sensory perceptions of the products. We aim more precisely at better understanding the categorization of blind tasted products and the variability among subjects induced by the design of presentation of products. . → *Chapter 5*
3. Influence of the fit between expectations and perceptions on affective judgments. We aim at better understanding how the relation between cognitive and sensory associations influences the sensory disconfirmation of expectations among subjects and induced affective judgments. → *Chapter 6*

In chapter 4, the research aims at studying the effect of external information, i.e information on the packaging on the relation between expectations and perceptions through categorization process. In other words, we aim at manipulating external information on the packaging to induce different relationship between cognitive associations and sensory perceptions through the measure of ad-hoc categories induced. The results will be then analyzed regarding the theory of Grounded Cognition emphasis that concepts are connected to sensory perception depending on ad-hoc categories.

In chapter 5, the research aims at exploring the effect of external information, i.e information on situation of consumption and perceptive environment, on the association between cognitive expectations and sensory perception through categorization process at an individual level. In other words, we aim at manipulating information delivered on the situation of consumption and the design of presentation of the products to induce different cognitive and sensory associations through the diversity of categorization.

In chapter 6, the research aims at exploring the effect of external information on sensory disconfirmation of expectations and thus on the measure of affective judgments. External information is manipulated through a contextualization step, i.e the priming of a situation of consumption.

The objective of the research is thus to provide a better understanding of the relation between cognitive processes, namely expectation, categorization, perception and affective judgment. This research is made in the context of industrial projects. In other words, by using applications on business projects with real constrains, we aim at providing insights on the understanding of these cognitive processes during product assessments in consumer tests, to better understand results provided by common methodologies of consumer tests using the framework of theories of cognitive psychology.

In addition, studies aim to provide methodological improvements on consumers' tests to integrate expectations in food product design and the inter-individual variability of their relationship with categorization, perception and affective judgment.

**Chapter 4: From cognitive
associations to sensory
expectations through ad-hoc
categories**

-The case of a familiar product range-

Introduction

The first step of the research provides better understanding about the relation between concepts stored in memory through cognitive associations and sensory expectations. In food sciences, expectations are mainly inferred by external information such as brand, packaging or labels and measure through assessment of sensory perception. Knowledge is limited regarding the understanding of this relationship through the measure of the categorization of a product related to past experiences, i.e concepts stored in memory. The Perceptual Symbol System states that concepts are correlated to sensory associations retrieved from a subject's memory. Context inferencing ad-hoc categories, is here manipulated through the information provided on the packaging of the products.

The research objective is to give insights on the relation between cognitive associations induced by packaging information and sensory expectations in a food context through ad-hoc categorization (Figure 5).

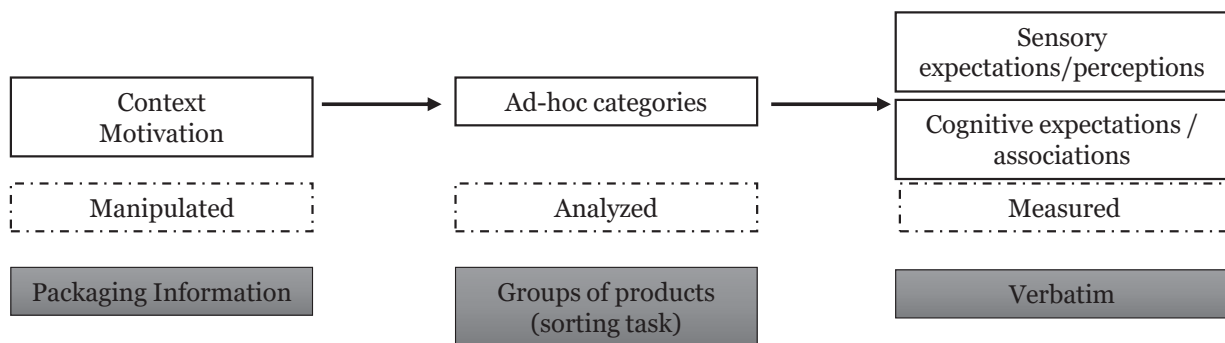


Figure 5 : Research scheme of Chapter 4

We apply the theory to common questions on consumer test designs, hereby the blind versus branded question and the question about the translation of cognitive associations with packaging information on sensory expectations (for example “naturalness” related to a given situation of consumption). This part of the research is using an industrial project aiming at understand perception of the strawberry fresh dairy market by French consumers and the sensory perception defining the categories made by consumers.

Three studies are conducted using a familiar product range, i.e. strawberry fresh dairy products, to understand the relation between cognitive associations induced by packaging

information and ad-hoc categories on the sensory expectations in a food context. We aim also at showing that ad-hoc categorization is variable depending on external information and between subjects.

In food sciences, sensory expectations are assessed before consumption by subjects without clear relation to the concepts representing a category. Based on theories in Grounded Cognition, concepts are related to a sensory pattern of properties relating to categories. **We aim at demonstrating that cognitive associations with packaging information induce sensory expectations.** Categorization based on cognitive associations should impact the nature of sensory expectations toward the product. This question is explored in Study 1A.

Categorization depends on the nature of the information available for the subject and relates to a situation of consumption as defined by ad-hoc categories. In a food context, the situation of consumption is partly determined by information provided on the products, hereby the information carried by the packaging. Furthermore, categorization has been proved to be variable among subjects. **We aim at demonstrating that the relationship between memory and expectations relates to ad-hoc categories, i.e. it is influenced by contextual information and is variable among subjects.** This question is explored in Study 1B.

1. Study 1A: Cognitive associations induce sensory expectations

1.1. Research question

The objective of the research is to understand the translation of packaging information into sensory expectations through the ad-hoc categorization. In other words, how the categorization of a product range without tasting (i.e. based on cognitive associations) induces a different nature of expectations and, more precisely, different sensory characteristics even before food consumption.

1.2. Methodology

“Manipulated” variable

We ensure having packaging information carrying different cognitive associations: light labels, satiating labels with fresh cheese, fresh cheese for children, organic label, healthy labels and daily yoghurts. We ensure also having different usages of consumption (ensuring different ad-hoc categories) associated with the products.

Subjects

47 subjects are recruited. They are all above 18 years old and all consume at least one fresh dairy strawberry product per month. Gender repartition is as follows: 70% of women; 30% male.

Products

Nine flavored products from the French market are selected (*Figure 6*). The choice of products is made to ensure as much diversity as possible and is based on the following sensory criteria: the thickness of the texture; the different strawberry flavors; the presence or absence of pieces of fruit; the level of sweetness; the creaminess; and the intensity of the aroma. The products chosen with various sensory profiles are as follows:

- Yoghurts with pieces of fruit: Activia, Recette crémeuse, Les 2 Vaches
- Yoghurt without pieces of fruit: Velouté
- Low-fat products: Activia 0%, Taillefine
- White cheeses: Jockey, Activia Fromage Blanc
- Fresh cheese “Petit Suisse”: Gervais



Figure 6: Photos of the range of strawberry fresh dairy products selected for the study

Protocol

A pre-test is performed on a dozen people to check that the task is not too difficult and that subjects will be able to make up more than two groups. We also check the number of products is not too high in order to avoid a saturation effect.

The methodology is based on a free sorting task. Products are presented in a comparative design, namely all together but in a random order for each subject. Products are presented in their original packaging and are not tasted by the subjects.

The subjects are given the following instruction: *"In front of you is a range of nine products. Look at them, touch them. Group together products that you perceive as similar and that are at the same time different from the others. You are free to make as many groups as you want. The number of products in group is unlimited"*.

The second step is a description of each group by the subjects: *"Describe the characteristics of each group"*. The nature of description is free and they can provide as many descriptors common to all the products of the group as they want.

Statistical analysis

To validate the hypothesis, the results should show that:

- The sensory characteristics are elicited by subjects to describe the overall range of products without tasting (1);
- For each group of products sensory cognitive associations with it are different from the other groups (2).

Regarding statement (1), analysis is focused on the different nature of the descriptions given by subjects. For the overall set of subjects, we group together synonyms and assumed that all the products for each of the groups are described by commonly used terms. We keep the terms elicited more than 4 times (10% of the whole set of subjects) (Faye et al., 2004). Two groups of verbatim are made. The first group is composed of descriptors relating to cognitive associations, namely the context of consumption or benefits, and visual descriptors; linked to information on the packaging. The second group is composed of descriptors related to sensory perception, namely descriptors of flavor or texture. These criteria are not directly available but are induced from information on the packaging and inferences made by subjects based on what they associate with this information. Elicitation of sensory description validates the hypothesis as subjects do not taste the samples.

Regarding statement (2), analysis is provided per group of product on the overall set of subjects. If results highlight different sensory and cognitive associations, then we can validate statement (2). The following statistical analyses are applied (Faye et al., 2013). For each subject, a similarity matrix is calculated. This matrix is a binary matrix product x product where a zero indicates that the products are not in the same group. The individual matrices are aggregated to give an overall similarity matrix.

The overall matrix of similarities is analyzed by a Multi-dimensional Scaling (MDS) (Kruskal, 1964). Configurations are selected for optimal Kruskal's stress i.e. less than 0.02 (Faye et al., 2004). The coordinates of the best configuration on MDS dimensions are analyzed by a Hierarchical Ascending Classification (HAC) with square Euclidian distance and Ward's method (Giboreau et al., 2001; Lawless, 1989). The histogram of the level index indicates the index corresponding to the number of classes that have to be kept (Lebart, 1997).

Regarding the analysis of verbatim, a matrix of descriptors*products is displayed indicating, in each cell, the frequency of association between one descriptor and one product. A coefficient of correlation between the coordinates of the products on the selected dimensions and the association between each verbatim and each product is calculated. Only descriptors with coefficients of correlation above 0.7 and below -0.7 are kept (Faye et al., 2004). The coordinates obtained for each verbatim are used as a projection on the mapping with the products. This result allows a visual representation correlating the cognitive and sensory associations with each product. A matrix is displayed sensory associations*cognitive associations. Each cell represents the number of subjects describing one product by the corresponding sensory and cognitive association. A statistical criterion is defined through analysis of Fisher's test at 10% on the matrix. We validate the hypothesis if the p-value is significant.

1.3. Results

Descriptors are structured in two groups: cognitive and sensory associations (*Table 2*).

Table 2 : The structure of verbatim in cognitive (concept) and sensory (sensory properties) associations

	Frequency of elicitation	Sum	Mean
CONCEPT	Yoghurt	63	7.0
	O% fat	48	5.33
	White cheese	41	4.55
	Mixed fruits	37	4.11
	Natural	23	2.55
	Chimical	17	1.88
	Appealing	16	1.77
	Good for health	14	1.55
	Not appealing	13	1.44
	Daily	13	1.44
	Activia brand	12	1.33
	Children	11	1.22
	Large pack	10	1.11
	Organic	9	1.0
	Desert	9	1.0
Sweetener	9	1.0	
SENSORY PROPERTIES	Creamy	48	5.33
	With pieces	44	4.88
	Onctuous	26	2.88
	Sweet	23	2.55
	Milky	22	2.44
	Velvet	22	2.44
	Thick	18	2.0
	Liquid	17	1.88
	Low sweet	17	1.88
	Fruity	12	1.33
	Stirred	11	1.22
	Light	11	1.22
	Fat	11	1.22
	Very sweet	10	1.11
	Tasteless	10	1.11

Fifteen sensory descriptors are elicited by more than 10% of the subjects. These descriptors characterize the texture of the product (thick, liquid, stirred), the basic taste (sweetness) and the flavors (milky, fruity, and tasteless for example).

Thus, the first conclusion is that categorization of products without tasting induces the elicitation of sensory expectations.

Results provided by the Fisher's test are significant. In other words, associations between sensory and cognitive expectations are significantly different. Crossing results from MDS and from HAC, the configuration provides three groups of products (*Figure 7*):

- Group 1: Les 2 Vaches, Gervais and Velouté;
- Group 2: Recette Crèmeuse, Jockey, Activia Fromage Blanc, and Activia;
- Group 3: Taillefine and Activia 0%.

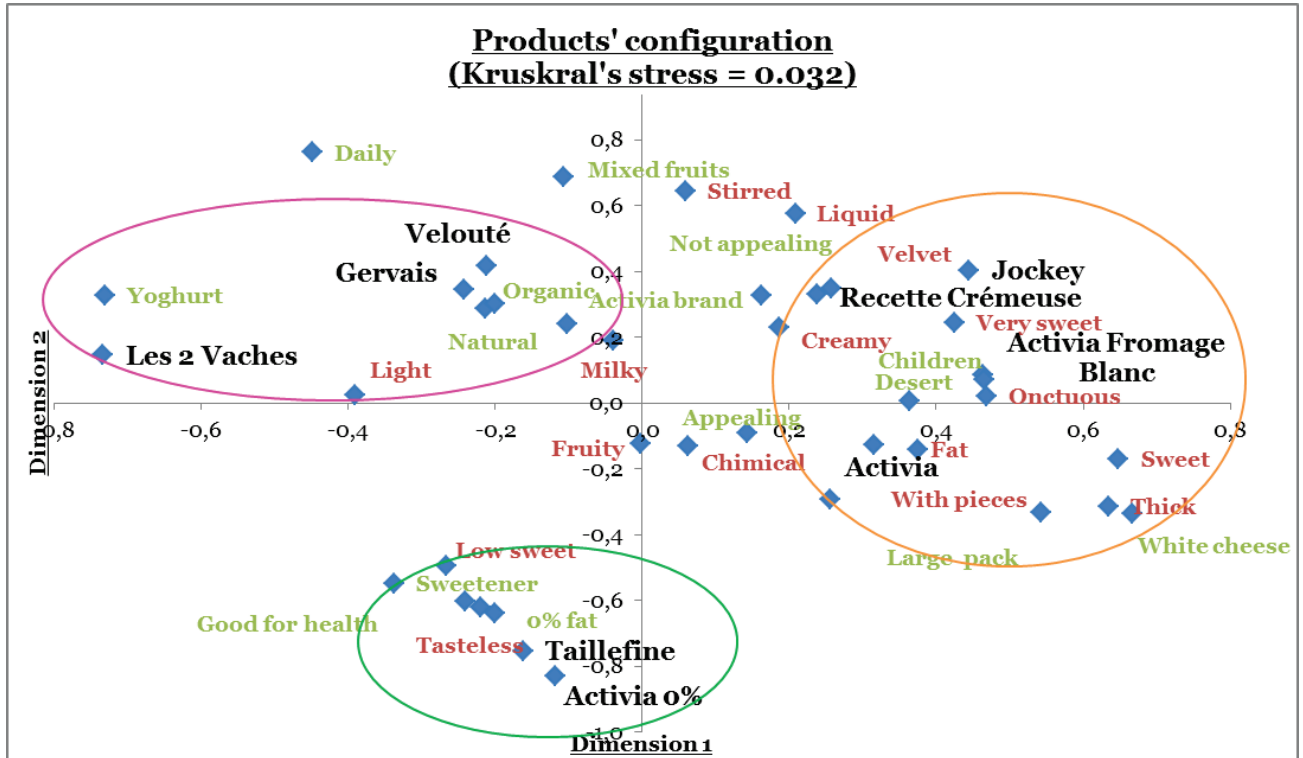


Figure 7 : Configuration of products without tasting obtained with the MDS and grouped with HAC (circles)

The first group gathers Les 2 Vaches, Gervais and Velouté. The products are characterized by the contextual descriptor “daily”, by the benefit descriptors “organic” and “natural”, and the sensory descriptors “light” and “milky”. Regarding group 2, the products are described as “children”, “desert”, “large pack”, and “white cheese” relating to “very sweet”, “creamy”, “sweet”, “thick”, “unctuous”, “fat”, and “velvet”. For group 3, Taillefine and Activia 0% are grouped together based on “good for health”, “sweetener” and “0% fat” related to “tasteless”, and “low sweet”.

Thus, the second conclusion is that the three groups of products are described differently in terms of cognitive and sensory characteristics. In other words, even if subjects had not tasted the products, they were able to associate sensory expectations based on cognitive associations with the packaging of products.

1.4. Main conclusions

Based on the results, the following statements are made:

- **criteria used to categorize the products are sensory expectations and cognitive associations with the product;**
- **packaging information is associated with different sensory expectations.**

Thus these results show that external information, hereby the packaging, has an influence on the relation between cognitive associations and sensory expectations.

These results can be interpreted regarding the perceptual states theory as cognitive associations inducing ad-hoc categorization of the products and thus the association with sensory expectations.

1.5. Methodological limits

The results show that cognitive associations induce sensory expectations. These results were based on the fact that subjects were able to elicit sensory description without tasting the product. Assessment of products was thus based on two types of information. The first type of information is provided by the cues on the packaging such as photos. This is thus a potential limitation of the methodology defined by the fact that these sensory properties were directly induced by multisensorial perception. Indeed, several studies have shown that sensory aspects of the packaging have an influence on the perception of the product, i.e. the recipe itself (Becker et al., 2011; Piqueras-Fiszman and Spence, 2012). Thus, the photos as can be seen on the Velouté, Jockey or Recette Crèmeuse packaging can induce, in some ways, elicitation of sensory description such as unctuousness or thickness. In a way, the results should have concluded that there was a multisensorial effect of the packaging on sensory expectations. However, the discrimination of the samples with differences of association with sensory expectations show that this packaging effect does not give the entire answer. Indeed, the elicitation of sensory characteristics such as tasteless, very sweet, milky or velvety are also strongly correlated to the knowledge consumers had regarding previous consumption of products having the same labels such as lightened products or products for children. The second type of information is related to what the consumers know about the products. Firstly, this knowledge is based on previous tasting and determines his/her sensory expectations (Cardello, 1995). Secondly, this knowledge is based on tasting of other products

having the same labels (such as lightened products) and on social communication (Steenkamp, 1989). Based on these experiences, consumers have already built strong associations between cognitive associations with these external information and sensory expectations (for example a lightened product is considered tasteless). Thus, even if several sensory aspects of the pack can directly induce the sensory expectations of the recipe (photos, format), these results are also based on existing associations between cognitive expectations formed by labels and brand, and sensory expectations.

Another limitation of the methodology is due to the description step. Indeed, asking consumers to describe each group of products is asking for the criteria shared by the members of the group. In other words, this description step gives access to the properties defining the category. However, some criteria that are not used to categorize per se the product can also be inferred from the category to the product (Barsalou, 1983; Rosch, 1978). Cognitive associations elicited by the subjects are either information which is directly readable on the packaging or, for some, induced by existing knowledge as consumers of the product. Descriptors are limited as only describing criteria used to categorize the product range. However, attributes related to categorization and expectations are much more varied. Some cognitive associations, e.g. those relating to the brand, can be transferred to the product itself as a member of the category (Wänke et al., 1998b). Therefore a methodological step to dig more deeply into cognitive associations with the category is needed. Qualitative methodologies are often used to understand the emotional aspects relating to an object or a usage (Anzieu and Chabert, 2004). Some other methodologies based on memory retrieval can help understand the definition of consumers' expectations toward a product.

In this study the set of products was quite large allowing consumers to easily discriminate samples. However, providing a smaller range with only one precise type of products (lightened product for example) would induce a more specific categorization of the products. Thus, subjects without experience of this type of product may have more difficulty associating sensory expectations spontaneously.

Sensory expectations related to cognitive associations depends on previous experiences with the product range. Information on the consumer target should be better controlled, more precisely on the previous experiences they had with the product range. A further step could be to recruit subject on their previous experiences, i.e the context of consumption they use to associate with each of the product.

Another limitation of the methodology is the relation with ad-hoc categories. External information manipulated in the study was packaging information. So we do not ensure in the study that product categories were different regarding food contexts of consumption. Thus, a further study should integrate a step of contextualization. This step ensures that product categories made in the sorting step are related to the context of consumption, and thus representative of ad-hoc categories.

To sum-up, the following methodological limits are stated:

- **Some elements of the packaging can induce directly sensory perceptions of the products.**
- **The description step cannot give access to entire properties inferred by the categorization step, and more precisely cognitive associations.**
- **Further studies needed to be implement on a smaller category of products.**
- **Improvement on the characterization of consumers is needed to ensure that the categories of products are related to different situations of consumption based on their previous experiences.**
- **The context of consumption should be primed at first to ensure getting access to ad-hoc categories.**

1.6. New proposal of study based on insights

Based on the methodological limits of the study and without the constrains of industrial projects we aim at proposing a new design of study to demonstrate that cognitive associations induce sensory expectations through ad-hoc categorization.

First improvement is to ensure measuring ad-hoc categories by manipulating directly the context of consumption. A contextualization of the task as a first step in the design ensures measuring a sorting of the product integrating the context of consumption. Thus, we ensure measuring different ad-hoc categories of the product range.

Second improvement is related to the packaging bias. We need to provide a detailed list of cognitive associations not directly induced by some of the packaging elements. Thus, the free description of each group should be then completed by a list of cognitive associations. This step

ensures that differences between groups of products are made based on the same proposal of cognitive associations and thus avoid partly the bias of some packaging elements.

The objective is to ensure having different categories of products with different cognitive associations. We use the same product range. Thus, the methodology is the following:

- First step: Sorting task of the products based on different contexts of consumption, i.e consumers is asked to make the product sorting depending on the situation of consumption associated.
- Second step: a check-all-that-apply on cognitive associations is proposed. Consumers have to associate with each group of products one cognitive expectation upon a list of proposed words. This list being established from a upon qualitative step (same consumer target as the quantitative step)
- Third step: free description of each group of products to validate if consumers elicit spontaneously sensory expectations.

Results should show that between each group of products cognitive and sensory associations differ. A final questionnaire on their usages with fresh strawberry yoghurt is provided to be able to better characterize the panel of subjects.

2. Study 1B: Expectations are framed by ad-hoc categories depending on contexts and subjects

2.1. Research question and hypothesis

The objective of the research is to show the effect of external information, i.e provided by the packaging on the ad-hoc categorization of a product range. More precisely, the ad-hoc categories are variable among information available for the subject and consumers.

Regarding the context of presentation, the objective is to compare a categorization on a branded without tasting and on a blinded with tasting product space. Regarding the subjects' variability, the objective is to show that for a familiar range of products, categorization is different between subjects⁵.

⁵ This step is available in the appendix 1

2.2. Methodology

“Manipulated” variable

The variability of external information is provided by two different nature of information: a blind and a branded without tasting designs. The study aims at testing these two conditions of information on the categorization of a product space through a sorting task. Two levels of information available on the product for the subjects are proposed. We define the condition as the nature of information available on the products. The first condition is based only on sensory perception through the tasting of samples in blind conditions, called “percept condition”. The second condition is based only on the information provided by the packaging, i.e cognitive associations without tasting, called “concept condition”.

Subjects

47 consumers of strawberry dairy products are recruited. These subjects consume at least one fresh, strawberry dairy product per month and are therefore familiar with these products.

Products

Nine trade products have been selected and pre-tested to ensure the saturation level and the difficulty of the task. These products do not belong to the same brand. They differ in terms of sensory attributes (texture, color, presence/absence of pieces of fruit, and aromas) but also in terms of cognitive associations with the products through labels (lightened products, brand, etc.). These products are the same as for study 1A.

Condition

Two conditions are tested:

- a “percept condition”: in blind, anonymous and standardized, with tasting. The products are served in transparent glasses of 4 ml capacity encoded with a three-digit code;
- a “concept condition”: branded, with all information available on the packaging, without tasting encoded with a three-digit code.

Protocol

The subjects have first to sort products into perceived similarities. Instructions are the same as for study 1A. Products sorted together are perceived as similar and at the same time different from the products in other groups. Once the subjects have formed the groups, they have to describe each group. The tasks for the two conditions are carried out on the same day. To avoid subjects recognizing the products in different sessions, the tasks are carried out in the following order: first

in percept conditions and then sorting in concept conditions, with a pause of several minutes between the two.

Statistical analysis

To validate the hypothesis of the variability of ad-hoc categorization, results should show that the categorization induced by two levels of information should be different. Analysis is run on data exclusively from the sorting task. We follow the same procedure as for study 1A. The two obtained configurations are compared using the Adjusted RV coefficient (El Ghaziri and Qannari, 2015; Escoufier, 1973; Faye et al., 2004) as the number of subjects is low. For an Adjusted RV coefficient above 0.7 we can conclude a similarity of configurations exists. Analysis is run with XLStat 2014. A second criterion is the nature of associations between products. We check that between conditions, associations between products are not the same.

2.3. Results

Comparing the two configurations, the Adjusted RV coefficient does not allow finding a similarity ($ARV = 0.312$). Regarding the configuration of the products in percept condition ($k=0.014$), three groups are formed. Differentiation is made between a highly textured product, Gervais, and low textured products, Velouté and Les 2 Vaches. A larger group is formed grouping together all the products left in the range (Taillefine, Activia, Recette Crèmeuse, Activia 0%, Activia Fromage Blanc, and Jockey). These products all contain fruit pieces (Figure 8).

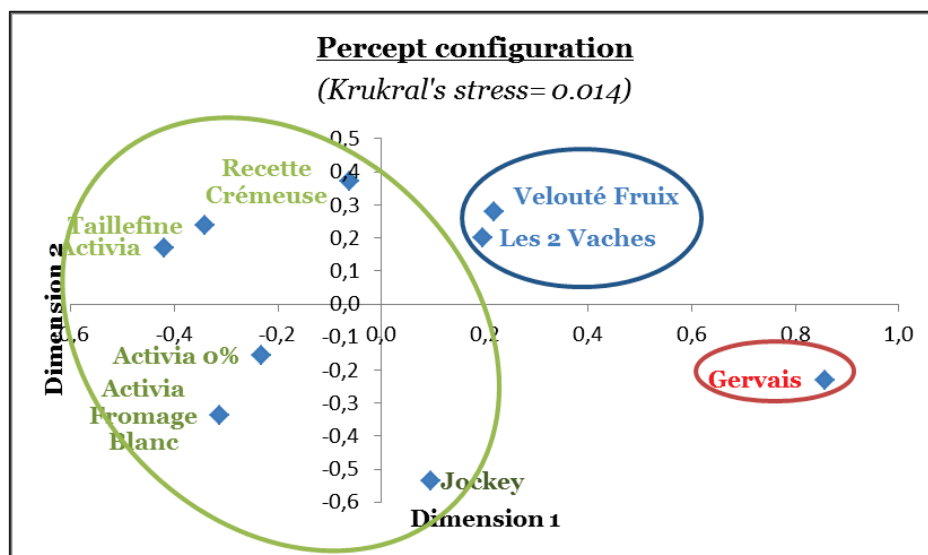


Figure 8: Configuration obtained with MDS in "percept" condition

The configuration obtained under the concept condition shows a different categorization of the product range (Figure 9). Five different groups are provided by HAC. Low-fat products are grouped together (Taillefine and Activia 0%) and differentiated from fresh cheese products such as Jockey and Activia fromage blanc. Gervais is categorized apart from the others as is Les 2 vaches. The last cluster is Activia, Recette Crèmeuse and Velouté.

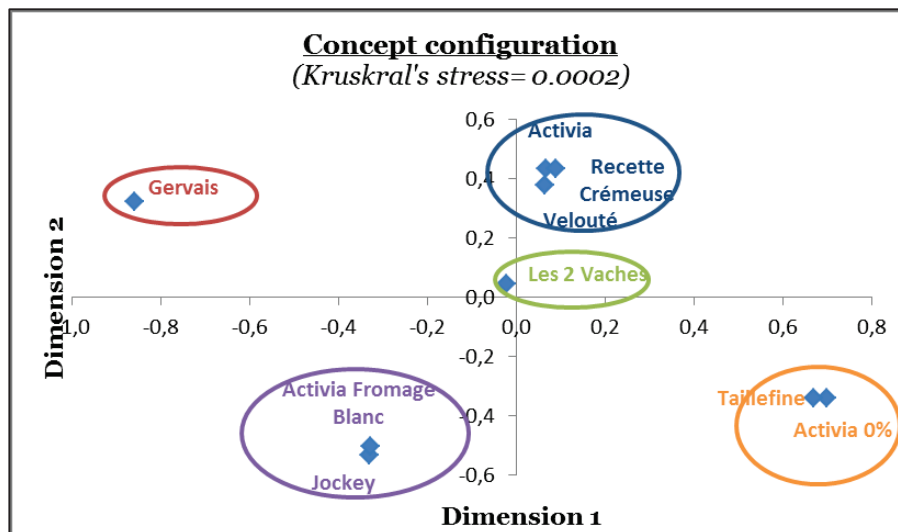


Figure 9 : Configuration obtained with MDS in concept condition

Thus, the common feature between configurations is the discrimination of Gervais in one separated group. Samples grouped together are not the same under percept and concept conditions. For example, Velouté is grouped with Les 2 Vaches in percept conditions and with Activia and Recette Crèmeuse in concept conditions. Discrimination between samples is higher in concept conditions than in percept conditions.

In addition, a comparison of the words used by subjects also show a difference between the categorization criteria. The concept condition gives access to descriptive criteria readable on the packaging ("125g", "0%"), but also to broader criteria relating both to the benefits associated with the product ("to lose weight", "good for health"), to sensory characteristics ("thick", "presence of pieces of strawberry") or consumption contexts ("for women", "to taste"). Under the percept condition the subjects used exclusively various sensory descriptors ("creamy", "thick", "with pieces of fruit", "sweet", "fruity", 'pink').

Thus, the results show a difference in categorization of the range between the two conditions.

2.4. Main results

The study provides several conclusions:

- **The same range of product is categorized differently among condition of information;**
- **the same range of products is categorized differently among subjects (study in the Appendix).**

Regarding theoretical background, ad-hoc categorization is a cognitive process variable among subjects (related to different characteristics as familiarity for example) and depending on the context. Thus, food categorization is depending on subjects but also on the nature of the information available to the subject. Sensory perception depends on the ad-hoc category inferred by the nature of information available on the product.

2.5. Methodological limits

The results showed differences among the level of information given to the consumers. This is close to studies usually conducted to understand the influences of context on expectations by providing different types of information (Caporale et al., 2006; Siret and Issanchou, 2000). If context of consumption widely used is that of manipulating environmental factors, such as time, place, etc. by integrating ad-hoc theories in the research, it can provide another way of thinking. Indeed, with the same level of information, consumers provide different ways of categorizing the same product space. This suggests that the criteria used to sort the products are different. Then, the importance given by the individual subjects to each of the sensory characteristics is not the same. This can then be related to the motivational aspect. If motivation is different among people, then criteria used to categorize product space should be different whenever the nature of the cues provided. This output highlights the fact that much discussion is provided around the effect of context, and semi-ecological factors needed to be presented to reproduce real-life conditions, but little attention has been given to the motivational aspect. So one criticism is the lack of contextualization regarding motivation. We have no clue regarding why subjects have sort the products in this way. Thus, one improvement could be to provide, prior to presenting the products (whatever the condition) a contextualization task regarding not only the context of consumption, but also the motivation.

Another limitation of the study relates also to the definition of ad-hoc category. The study provides understanding on the comparison between two different contexts, hereby branded and blinded designs. However, the context of consumption defining ad-hoc category is not used per se here but retrieved spontaneously through cognitive associations after the sorting task. Thus, we need further research to demonstrate that ad-hoc categories are variable among contexts. In other words, the context of consumption is a condition that should vary in order to induce different ad-hoc categorization of the products.

Main studies of expectations in food sciences compared assessment of product perception in three different conditions: branded without tasting, branded with tasting and blinded. In this study, the second condition was not integrated to the study. Thus, the difference of configurations obtained between the two conditions “concept” and “percept” is not only due to the influence of the packaging but also to the tasting of the samples. The second condition is thus needed if we want to conclude on the effect of packaging information on the categorization of products.

Regarding variability of associations between cognitive and sensory expectations, the study needs an additional step of verbalization to be able to make the link with the variability of categorization. This step of verbalization should help to better understand the variability of cognitive associations and sensory expectations induce by two different contexts depending on the product categorization.

As we would expect, consumers categorize the product range in different ways. This is aligned with previous results provided by Faye et al (Faye et al., 2013). Perception is impacted by many factors and we cannot take them all into account. Thus, clustering on perception allows to get direct access to the structures in the memory retrieved during perception and to understand the association between each category and sensory and non-sensory associated. One factor that could contribute to this variability is the relation with familiarity. The entire product range is familiar to consumers because at some point or other they would have had prior exposure to them (previous tastings, social information, publicity, purchase contexts) (Grunert, 2002). However, familiarity should be related to the goal used to categorize samples. This information has not be provided by the study, but other studies have shown the impact of expertise on categorization task (Medin et al., 1997). Therefore, clustering the subjects’ categorization allows firstly access to a segment of subjects having the same criteria of categorization, and secondly having the same sensory properties answering to the motivation to consume the product. Further investigation is needed to understand differences of perception by looking at different levels of familiarity in food consumption.

To sum-up, the following methodological limits are stated:

- **Contextualization should integrate motivational aspect of food consumption related to the definition of ad-hoc category**
- **Another study is needed to demonstrate the variability of ad-hoc categorization by priming on different contexts of consumption**
- **Condition branded with tasting is missing to the study to be conclusive on the impact of packaging information on the product categorization**
- **A step of verbalization should be integrated to better understand the relationship between variability of categorization and variability of cognitive and sensory associations**
- **Another investigation is needed to understand relation between familiarity of consumers toward the overall product experience and their perception.**

2.5.1. New proposal of study based on insights

Based on the insights provided by the study, two proposals of study can be made.

The first one is focused on the variability of ad-hoc categorization depending on the context. As previously discussed, the study cannot demonstrate the variability of ad-hoc categorization because we did not define the context of consumption as a controlled condition. The objective of the proposal is to show that ad-hoc categorization and thus cognitive and sensory associations with the product are variable among contexts. The context is a situation of consumption defining the ad-hoc category. The following methodology is proposed: compare two conditions of ad-hoc categorization of the same product range.

- **First step: contextualization of one situation of consumption (two contexts of consumption should be chosen: “a desert at home”, “a snack in the mid-afternoon to feel s” for examples).**
- **Second step: sorting task of the products among perceived similarities according to the context**
- **Third step: free description of each group of products.**

Results should show that the grouping of products differ among conditions and that the description associated to each product differ among conditions.

The second proposal is focused on the context defined as the nature of information taken into by the subject in its perceptive process. More precisely, it aims at demonstrating that cognitive associations with packaging information influence the sensory perception through a variability of ad-hoc categorization. As discussed previously the condition branded with tasting is missing to demonstrate the influence of the packaging information on product perception. The following methodology is proposed on the same product range in three conditions; i.e blinded with tasting, branded with and without tasting. The design of the study follows two steps: sorting task on the products then free description.

Results should show that the grouping of products and the description per product differ among conditions. These results should bring also better understanding on the differences of associations regarding expectations and then regarding perception.

In both studies, a final step of characterization of consumers on their familiarity with the situation of consumption and the product range should be made. A final clusterisation based on their familiarity would be made to show an inter-individual variability of categorization.

3. Discussion

Expectations are framed by associations between concepts and sensory expectations. These associations are related to criteria structuring categories, but also inferenced by these categories. In the framework of Grounded Cognition, expectations relate to ad-hoc categories, i.e. the categories of a product induced by a situation of consumption. These results are aligned with previous research made on the impact of context of consumption on the perception of food products (Boutrolle and Delarue, 2009; Piqueras-Fiszman and Jaeger, 2014; Rozin and Tuorila, 1993b). Considering that the expectations and perceptions of a product are influenced by ad-hoc categorization, then the context is a determinant factor to take into account in food products tests. However, ad-hoc categories are not only determined by the context, but also by a specific goal that the subject wants to achieve (Barsalou, 1983). In a food context, motivation to consume the product is thus as important as the context in which the product is consumed. This motivation is related to specific cognitive associations. In the framework of Grounded Cognition, concepts representing ad-hoc categories are retrieved through a particular sensory pattern of information

(Barsalou, 1999). Thus, defining expectations, (i.e. associations between concepts and the sensory perceptions of the product) needs to be contextualized through two variables: the context of consumption (i.e. the environment) and the motivation, (i.e. the reason to consume the product). Few studies have focused their interest on studying expectations by providing a clear motivation with the context of consumption. Most of them are made through the delivery of precise information prior to food consumption, such as the origin (Caporale et al., 2006), the process of manufacturing (Cardello, 2003) or the packaging (Ares and Deliza, 2010) to give a few examples. This information is assessed as a possible motivation to consume the product, thus to categorize it. However, this is also dependent on the implication of the subject to the specific motivation, and can be translated into different possible associations between the concept and sensory perceptions. The situation of consumption is thus important to better understand expectations toward a product. Indeed, the same product can be assessed differently depending on the situation of consumption. Subjects will not focus their attention on the same product properties translating the need they want to fill by consuming the product.

Contextualizing a situation of consumption is also related to the familiarity of the product range. Indeed, a familiar product infers a frequent usage by the subject with strong associations in his memory based on previous experiences. Thus, information provided additionally about the product should have a lower weighting than the common usage of the product. This influence of the context on associations between concepts and sensory perceptions is related to the nature of the products (Puumalainen et al., 2002; Wänke et al., 1998b) and the concept conveyed through the motivation to consume the product (Barsalou, 1982). Further studies should focus more on motivation as a key factor of contextualization to understand food expectations and perceptions.

Main conclusions of this chapter are:

- **Cognitive associations convey by packaging information induce sensory expectations.**
- **Expectations are formed from “ad-hoc” categories, i.e. induced by a situation of consumption, and vary among subjects.**

The next step of the research focuses on the study of the relation between expectations and perception through ad-hoc categories. We aimed at studying the reverse link between sensory perceptions and cognitive expectations through ad-hoc categories.

**Chapter 5: From sensory
perceptions to cognitive
expectations; variability among
subjects**

**-The case of a non-familiar product
range-**

Introduction

This second part of the research is focused on the expectations and their relation with categorization and perception. More precisely, by using theories of Grounded Cognition in Food Sciences, we aim at better defining the relation between sensory perceptions and the concepts underlying expectations and perception in a food context through cognitive expectations

In Chapter 4, we demonstrated that the cognitive associations with a product carried by the packaging information as brand, or labels induce sensory expectations, depending not only on the category to which the product is identified as a member, but also on the subjects diversity. In other words, external information carried by the packaging allows the sensory expectations to be retrieved through ad-hoc categorization shaped by cognitive associations.

This chapter aims at better understanding how the context influences the cognitive expectations through ad-hoc categorization of the product based on sensory perceptions. Moreover, we aim at studying individual variability of this relationship (*Figure 10*).

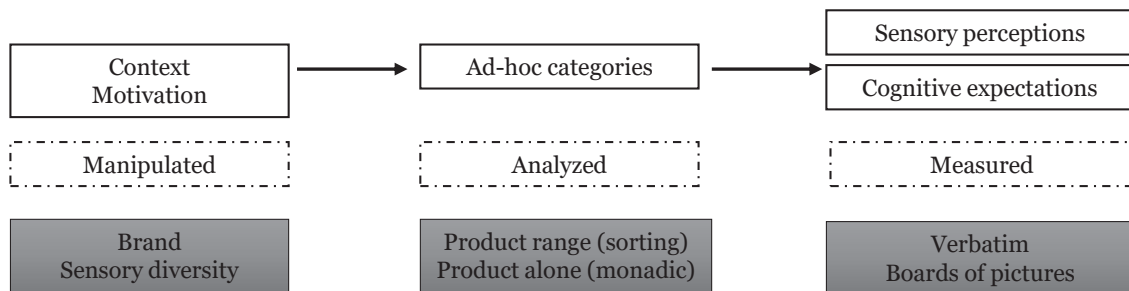


Figure 10: Research Scheme of Chapter 5

We apply theoretical models to consumer test designs commonly used to understand perception of consumers. On the more, the inter-individual effect is also applied to better understand the impact of an overall analysis on the understanding of the consumers' perception.

This part of the research is applied on an industrial project aiming at launching a new cold tea based on water under the brand Zywiec Zdroj in Poland. The objective of the study is providing first insights on the sensory perceptions and cognitive associations with a product fitting with the brand.

Two research questions are defined to understand the variability of associations between sensory perceptions and cognitive expectations among subjects.

In Grounded Cognition concepts are shaped by sensory perceptions. In Food Sciences expectations are mainly studied through sensory expectations. There is no clear evidence showing the impact of sensory perceptions on cognitive expectations related to ad-hoc categories. We aim at studying the impact of the sensory perceptions of the subject on cognitive expectations associated with them. **The question is to understand the relation between the sensory perceptions and the cognitive expectations in two common tasks of consumer test.** This question is explored in Study 2A.

Product properties are criteria shaping ad-hoc categories in a food context. Categorization is variable between subjects. Furthermore the motivation and the context define ad-hoc categories. Thus, the relation between sensory perceptions and cognitive expectations should also vary among subjects. We aim at studying the variability of this relationship between subjects. **The question is to study the influence of the diversity of sensory perception between subjects on the diversity of cognitive expectations.** This question is explored in Study 2B.

1. Study 2A: influence of sensory perceptions on cognitive expectations

1.1. Research question

The research aims at studying the influence of the sensory diversity, i.e variability of elements next to the target product (Yeh and Barsalou, 2006) on cognitive associations with the product. It aims more precisely at comparing two tasks used in consumer tests inducing two different sensory contexts around the product.

1.2. Methodology

"Manipulated" variable

Variability of sensory elements is induced through two methodologies. Indeed, for the same product range, we aim at focusing the attention of the subjects on different sensory characteristics of the product. Two protocols of assessment are used to induce a variety of sensory information: in monadic the product is presented alone, and in comparative condition, the products are presented together. Based on previous studies, results showed that the sorting task focuses the attention of the subject on the shared product properties of the product range, while the monadic condition emphasizes the sensory characteristics specific to the product (Bech-Larsen and Nielsen, 1999; Breivik and Supphellen, 2003; Dubois, 2009). Thus, by modifying the

task and the condition of presentation, the sensory information available for the subject for the same product is different.

Products

Eleven cold tea drink products are tasted by the consumers (based on a pre-study⁶) for both conditions (*Figure 11*).

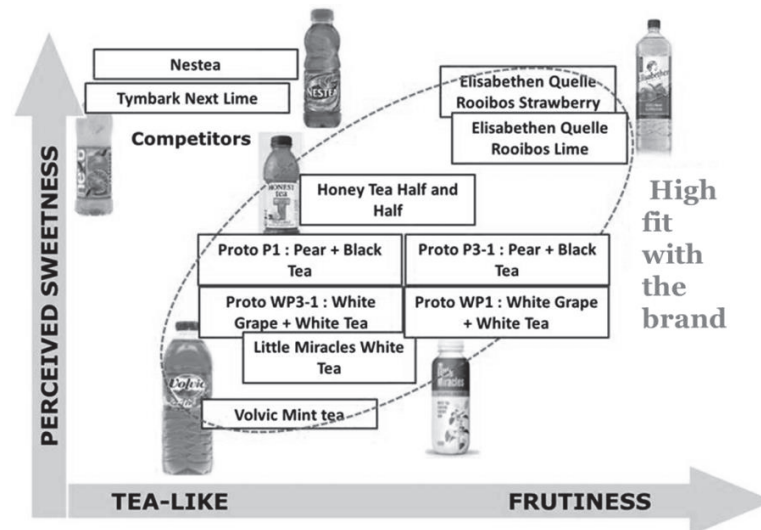


Figure 11: Cold tea drinks product presented for tasting

The product range is differentiated on the main sensory properties: the aroma from tea (green, black, rooibos, and white), the fruit aromatization (pear, lemon, white grape, and strawberry), and the level of perceived sweetness.

All the products are tasted in blind conditions and in transparent glasses of 12ml.

Procedure

Two different methodologies of assessment are tested reflecting the two conditions of contexts.

The “**comparative condition**” is based on a free sorting task. Five steps are followed by the consumers (*Figure 12*).

⁶ The qualitative pre-study is developed in Appendix 2

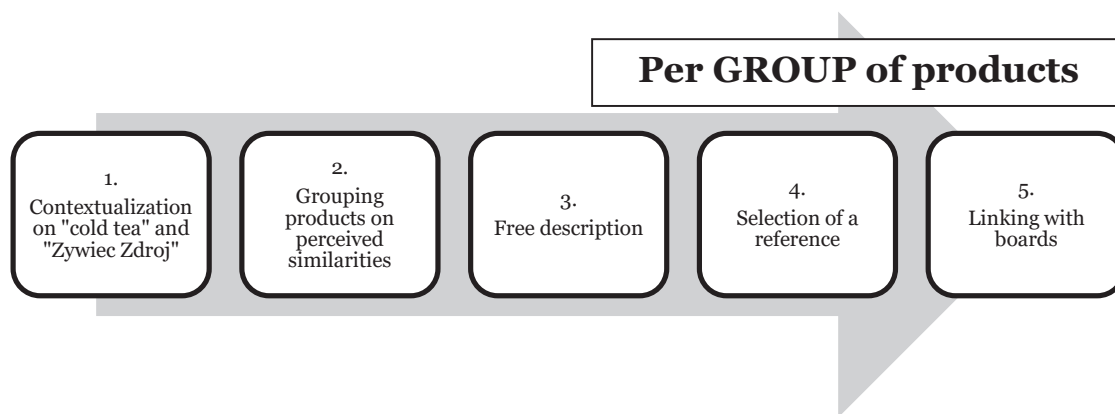


Figure 12: Methodology for the comparative condition

- Contextualization for “cold tea drinks” and the brand “Zywiec Zdroj”. First, consumers are asked to provide a full description of an imagined experience of drinking a cold tea: *“Think about a cold drink. Imagine a drink based on water. You can add tea and the flavor you want. It is a cold tea drink. Clearly imagine you are experiencing this occasion. Now describe it in detail”*. The writing procedure, which ensures the involvement of subjects, provides details relating to the context (moment, location, social context, and atmosphere), sensations, and feelings. The aim of the task is to activate conceptual and sensory knowledge relating to “cold tea drink” products. In the second step, the logo of the brand Zywiec Zdroj is presented to consumers with the following instruction: *“What does it conjure up for you? Please use the 5 first words coming to your mind”*. The aim is to activate the conceptual and sensory knowledge relating to the brand. At the end of this step, subjects are put into the context of experiencing cold tea based on Zywiec Zdroj water.
- Sorting task on the product range. Subjects are asked to group the products: *“group them according to which aspects are the same and at the same time different from the products in other groups. You can make a minimum of 2 groups of products and a maximum of 10”*. Subjects are not asked to explain the way they have made the groups, avoiding rationalizing their choice of sorting.
- Free description. Consumers describe each group of products, i.e. the criteria used to categorize the product range: *“Please state the common aspects of the products in each group”*.
- Selection of a reference. For each group, subjects are asked to select the product which represents the best of the group: *“For each group, choose one sample that is for you the best example of the whole group”*.

- Linking with boards. Six boards of conceptual expectations are presented in a random order at the same time to the consumers. Each board is printed in color on an A4 sheet of paper. For each group of products, subjects choose the board that, in their opinion, best fits the product; or none, if no board matches: *“Now, look at all the boards in front of you. For each group of products select the board that is the best fit. Indicate the number of the board for each group. If none of the boards fit with the groups then indicate zero”*.

The **“monadic condition”** is based on a monadic methodology: “one by one” assessment of samples. Three steps are followed by consumers (Figure 13):

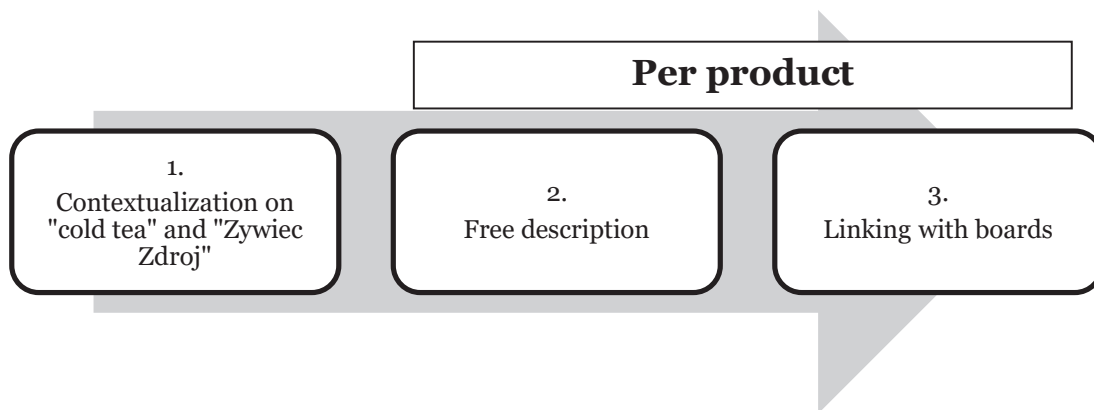


Figure 13: Methodology for the monadic condition

- The contextualization step is similar to the one for the comparative condition.
- Free description: consumers taste and assess the products one by one. Consumers describe each product: *“Look, smell and taste the sample. Then write down all that is important in this sample for you”*.
- Linking with boards: the same instructions are given to consumers as for the comparisons, but related to one product at a time.

In monadic conditions, a five minute-break for the consumption of a cracker to neutralize any lasting aroma in mouth, is imposed between products.

The questionnaires were back translated in polish language.

Boards of cognitivel expectations

Six boards depicting the expectations relating to six situations of consumption are built from collages which were made during the pre-study⁷ by consumers (Figure 14).

⁷ The pre-study is in Appendix 2



Figure 14: Boards of cognitive expectations defined by the consumers through collages

- **“On the go”**: this is an impulsive situation where the subject is walking in the street, and gets thirsty.
- **“Exotic”**: this context is during the summer, or holidays, when the subject wants to relax.
- **“Energy”**: this situation where the subject is going out with friends to a party or a barbecue, for example. The subject drinks the product to get some energy.
- **“Physical activities”**: the motivation is hydration and to replenish in minerals after physical activity.
- **“Family”**: the context of consumption is during a meal with the family and the children present so there is the motivation to drink a healthy and natural product.
- **“My moment”**: this situation is to have a moment alone to relax, for example after work.

Subjects

For each condition, 110 subjects are recruited. The subjects are Polish people from two cities: Warsaw and Poznan. There is a 50/50% division of gender and age (age is grouped into groups: 20-35 years old and 36-56 years old). The same profile of consumers is kept for both conditions:

- For the brand: subjects have to be consumers of the brand Zywiec Zdroj (a brand of Polish water).
- For the “cold tea” category: subjects have to be non rejectors of tea, cold drinks and flavored waters.

Statistical analysis

To confirm that a difference of perceptions induces a difference of associated cognitive expectations, the study aims at validating the following:

- **Between the two conditions of presentation, product properties, i.e sensory perceptions are different (1)**
- **Between the two conditions of presentation, associations with cognitive expectations are different (2)**

Regarding the first statement (1), a two-step validation is needed. Firstly, it aims at comparing the description at the level of the product range based on the similarity of the description between products (1.1). Secondly, it aims at comparing the description per product between conditions (1.2).

- (1.1) The overall assessment of the product range should highlight a difference of associations between products based on the descriptors elicited for each condition. In other words, configurations of products between the two conditions should be different regarding Adjusted RV coefficient.

Data from sorting is organized in an individual matrix of dissimilarities. The matrix for each subject is a product x product matrix; with 0 when the two products are in the same group and 1 when they are not. The aggregated matrix of dissimilarities is analyzed by a Multidimensional Scaling (MDS) (Faye et al., 2004; Kruskal, 1964). Coordinates of the best configuration are then analyzed by a Hierarchical Ascendant Classification (HAC). Selected configurations are selected for optimal Kruskal's stress i.e. less than 0.02 (Faye et al., 2004).

Data from a monadic assessment is analyzed through frequencies of use. For each descriptor, the frequency of use is defined by the number of subjects using the term to describe the products (Ares and Jaeger, 2013). For each subject a matrix product * descriptor is obtained with 1 if the product is associated with the descriptor and 0 if not. The configuration of products is obtained with a Multiple Factor Analysis (MFA) run on the overall set of individual matrices.

A comparison of configurations is made with the calculation of an Adjusted RV coefficient between monadic and sorting conditions (Escoufier, 1973). Good agreement between configurations is considered for a RV coefficient above 0.7 (Faye et al., 2004).

Another step of the validation is to assess the differences regarding the description between conditions based on two criteria: the number and nature of properties elicited by subjects. Distribution of the number of descriptors elicited by the whole panel is calculated for both conditions.

Descriptors are sorted in 5 groups: visual (visual characteristics such as color or transparency), flavors (basic tastes such as sweetness or bitterness, aromas and odor as it is not possible to dissociate flavors from odors by the retronasal process), hedonic (evaluative judgment), perceived benefits (benefit or context), and finally, drink identified (identification of a food taxonomic category). A chi-square analysis is run for each group of descriptors elicited on the whole range of products by all the consumers between the two conditions (Ares and Deliza, 2010).

- (1.2) The assessment per product should highlight the differences of product properties elicited between conditions. For each product, descriptors elicited by more than 10% of the set of subjects are kept (Ares and Deliza, 2010). Then data from the monadic condition is standardized in order to compare the two sets of data (comparative and monadic) on percentages. A Chi-square analyses is run for each product and each attribute between the two conditions (Ares et al., 2010). The frequency of elicitation of the sensory descriptors should be significantly different at 5% between conditions for each product. The analysis is then focused on the products owning the themes “visual” and “flavors” referring to sensory perception. To validate the hypothesis (1) these product properties should be different between the two conditions. Significant differences are classified in four cases.
 - Case 1: descriptors with a significantly higher frequency of elicitation in comparative conditions than in monadic conditions (used more to describe the product in comparative conditions, but used also in monadic conditions).
 - Case 2: descriptors with a significantly higher elicitation in monadic conditions than in comparative conditions (used more to describe the product in monadic conditions, but used also in comparative conditions).
 - Case 3: descriptors only elicited in comparative conditions.
 - Case 4: descriptors only elicited in monadic conditions.

Regarding the second statement (2), the following criteria are needed to validate the hypothesis: (between conditions; each product; and the board(s)): if a board is chosen more in one condition, it should differ from the other condition. An analysis is conducted for each product. A matrix of conditions*board is displayed with each cell providing the number of subjects associating with each condition on the board with the product. A chi-square analysis is run on the matrix at 5% to

compare distribution of boards between conditions for each product. Then for each product the significance level P_s (1) is used to determine the boards that are more elicited for each product and each condition. The significance level is the minimum value that the frequency should equal in order to be significantly more elicited than if it was chosen by chance at a 5% risk (Pineau et al., 2009).

$$P_s = P_0 + 1.645 \sqrt{\frac{P_0(1-P_0)}{n}} \quad (1)$$

P_0 is the chance level equal to $1/p$ with p being the number of variables.

n is the number of subjects

This confidence level is recommended for $np(1-p) > 5$ with p the probability of success (Rosner, 2011). Here the probability of success is $P_0 = 1/7 = 0.14$ (six boards or no association). Thus the minimum number of observations should be $n = 5 / (0.14 \times (1-0.14)) = 41$. Then considering that we have 114 subjects we can use the P_s as a criterion of decision.

$$P_s = 0.14 + 1.645 \sqrt{\frac{0.14(1-0.14)}{114}} = 0.2. \text{ Thus the significance level is considered at 20\%.}$$

Graphical representation of the distribution of boards for each product and each condition is displayed with standardized frequencies (obtained on 100% basis).

Hypothesis is validated if boards which frequencies of use are above the significance level differ between conditions for the same product.

1.3. Results

Differences of sensory perceptions between conditions

First of all, looking at the two mappings obtained on the basis of product range perception (Figure 15), configurations are different. The Adjusted RV coefficient calculated between the dimensions of configuration of each condition is equal to 0.428 concluding a dissimilarity between the mappings. The difference observed between the mappings is the first evidence to point to a difference of categorization between the two conditions.

By looking deeper into the results obtained with the HAC for the two conditions, and by looking at the mappings, some products that are quite close in regards to the sensory characteristics remaining together whatever the conditions: WP31 and WP1, P31 and P21, Nestea

and Little Miracles. However, products that are quite heterogeneous to the whole range, such as Volvic Mint Tea or Honest Tea, are much more differentiated from the full range in monadic conditions.

Furthermore, by looking at the positioning of each product in the two conditions, following results are provided:

- Seven products are associated with the same products whatever the condition: Nestea, Little Miracles, Tymbark, P31, P21, WP31 and WP1.
- Three products are grouped together in comparative conditions, but stand alone in monadic conditions: Honest Tea, Volvic Mint Tea and Elisabethen Quelle Lime.
- One product is associated with different products in comparative and monadic conditions: Elisabethen Quelle Rooibos.

Thus, configurations of products are not similar and four products have different positioning between configurations.

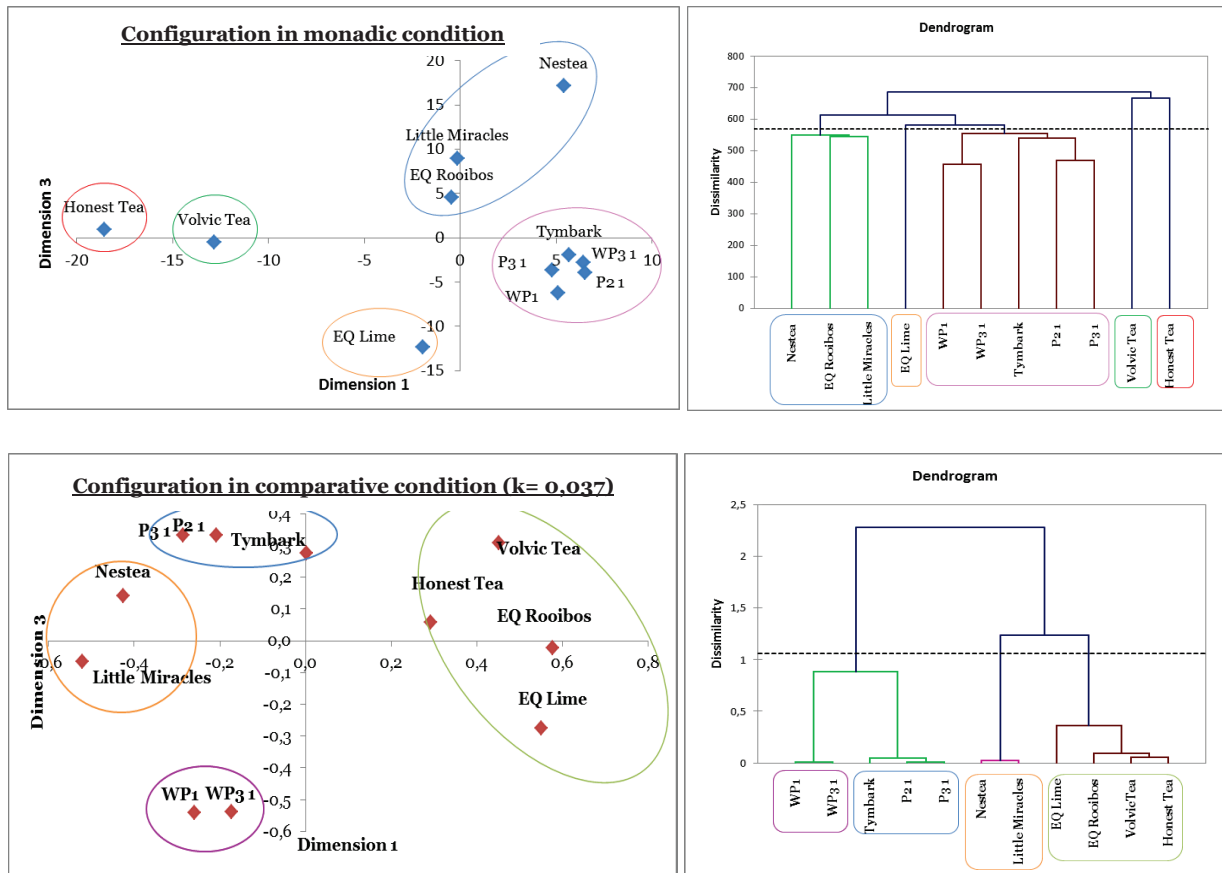


Figure 15: Mappings representing products configuration and dendrograms based on HAC

Monadic condition: mapping based on an AFC on individual matrices of products*descriptors

Comparative condition: mapping based on an MDS on individual sorting matrices product*product

The number of descriptors elicited in the comparative condition is lower than in the monadic condition (Figure 16). These results show that comparative presentation induces a restriction of the properties taken into account to describe the product range. In the monadic presentation, description is more spontaneous and numerous.

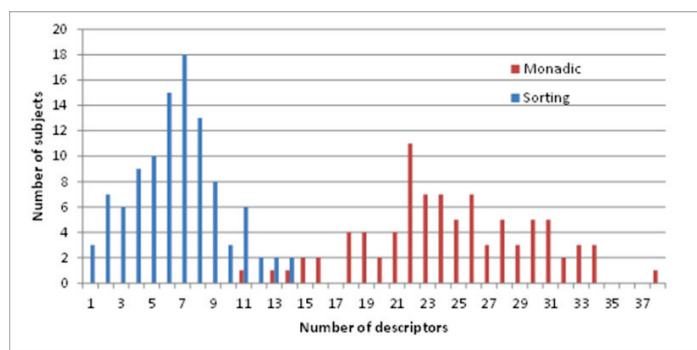


Figure 16: Repartition of the number of descriptors between the two conditions

Regarding the nature of descriptors elicited in both conditions (Figure 17), more descriptors relate to hedonism or benefits are used in the monadic condition to describe the products. Properties used to categorize the samples in the comparative condition are mostly sensory-driven, i.e. visual or related to taste or flavor, whereas in monadic, properties relate to the five different type of properties.

For standardized data, the frequency of words describing flavor is significantly higher than for monadic conditions (Figure 18). On the other hand, the frequency of elicitation of descriptors relating to hedonic themes is significantly higher for monadic conditions than for comparative conditions.

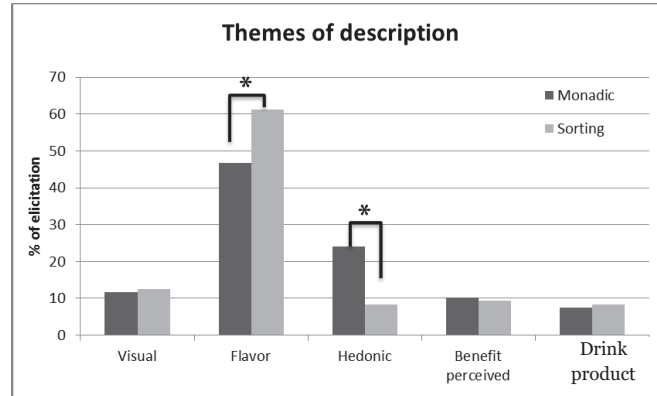


Figure 18: Percentages of elicitation for each thematic descriptor for standardized data
 * = significant differences calculated with a chi-square analysis for a p-value < 0.005

Thus, the number and nature of descriptors elicited by subjects for the whole product set are different between conditions.

The first conclusions for the overall assessment of description show that:

- **Configurations of products and associations between products based on description differ according to the conditions.**
- **The nature and number of descriptors elicited for the whole set of products differs according to the conditions**

The second step of the analysis is focused on each product. Analyses of Nestea, Little Miracles, Honest Tea and Volvic Mint Tea are presented as examples. For a detailed analysis provided on other products of the set, refer to the Appendices

Nestea and Little Miracles are grouped together in the comparative condition and differentiate from the other products in the set. They are described as: “very sweet”, “fruity”, and “strong”. The same descriptors are used to describe the two products. In monadic conditions, commonly used elicited descriptors are “fruity” and “good flavor”. Different descriptors are highly elicited among the two products. Nestea is mainly described as: “based on tea”, “tea”, “golden color” and “refreshing taste” Little Miracles is mainly described as: “cloudy” (Table 3).

Table 3: Frequencies of elicitation of descriptors for the two conditions for Nestea and Little Miracle products (superior to 10% of the set)

Nestea	Comparative condition	Monadic condition	Little Miracles	Comparative condition	Monadic condition
Very sweet	37	23	Cloudy	4	62
Fruity	20	56	Colored	13	0
Strong	18	16	Other colour	4	13
Tea	15	43	Fruity	27	80
Colored	13	0	Strong	18	12
Other flavour	11	0	Mild	1	13
Based on tea	11	46	Slightly sweet	3	22
Good flavour	0	54	Very sweet	39	24
Golden color	0	39	Tea	5	12
Refreshing taste	0	34	Too sweet	3	16
Nice colour	0	31	Good flavour	7	60
Nice smell	0	20	Nice smell	1	30
Too sweet	0	14	Nice colour	1	28
Slightly sweet	0	13	Refreshing taste	7	25
Dark	0	12	Flavoured drinks	3	15
Transparency	0	12	Other product	0	12

For Nestea, regarding the four cases of analysis of verbatim, the results show six significant differences among the two conditions (Figure 19):

- Case 1: “strong”, “other flavor”, “very sweet”
- Case 2: “transparency”
- Case 3: “colored”
- Case 4: “golden color”

For Little Miracles, five significant differences can be seen among the two conditions:

- Case 1: “strong”, “very sweet”
- Case 2: “cloudy”, “mild”
- Case 3: “colored”

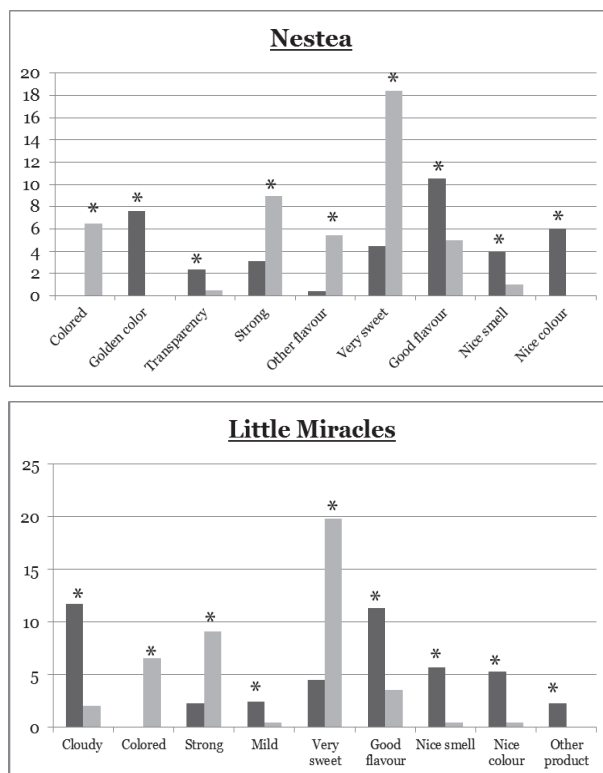


Figure 19: Frequency of elicitation on standardized data for the two conditions for Little Miracles and Nestea

- = significant differences with a chi-square analysis at 5%

Thus, for the comparative condition, the sensory description for both products are the “strong” intensity of aroma and the intensity of sweetness, whereas for the monadic condition, it relates to visual aspects such as the color: “golden color” and “transparency” for Nestea and “cloudy” for Little Miracles.

Furthermore, for monadic conditions, descriptors relating to evaluative judgment such as “nice” and “good” are more frequently elicited. For the comparative condition, descriptors are used with adverbial forms, or with adjectives positioning the product in a scale for a given attribute: “very sweet”, “dark”, “and strong”.

For the comparative condition for Honest Tea and Volvic Mint Tea, there is no high consensual elicitation of a particular descriptor (maximum frequency is 18 for Honest Tea and 14 for Volvic) (Table 4). For the monadic condition, frequencies are higher for “cloudy” for Honest Tea (120) and for “minty” for Volvic (72). This result can be explained by the fact that these products are clearly differentiated from the product range because of specific aromatization (honey aroma and mint aroma).

Table 4: Frequencies of elicitation of descriptors for the two conditions for Honest Tea and Volvic Mint Tea products (superior to 10% of the set)

Honest Tea	Comparative condition	Monadic condition	Volvic Mint Tea	Comparative condition	Monadic condition
Cloudy	6	120	Colored	11	0
Colored	15	0	Golden color	0	22
Golden color	0	16	Fruity	9	12
Unpleasant smell	3	14	Minty	13	72
Bitter	7	16	Not very intense	5	20
Fruity	11	33	Other aftertaste	5	13
No smell or aroma	0	21	Other flavour	14	2
Not sweet	9	12	Slightly sweet	6	21
Not very intense	8	22	Very sweet	11	3
Slightly sweet	12	14	Bad product	0	11
Tart	11	7	Good flavour	5	37
Tea	12	19	Nice smell	1	23
Unpleasant color	0	35	Nice colour	2	27
Bad product	0	13	Bad taste	14	26
Good flavour	3	24	Chemical	5	16
Bad taste	18	41	Refreshing taste	12	30
Based on tea	12	17	Flavoured drinks	4	14
Flavoured drinks	3	15			

Regarding the analysis for each product between conditions, significant differences are highlighted (Figure 20).

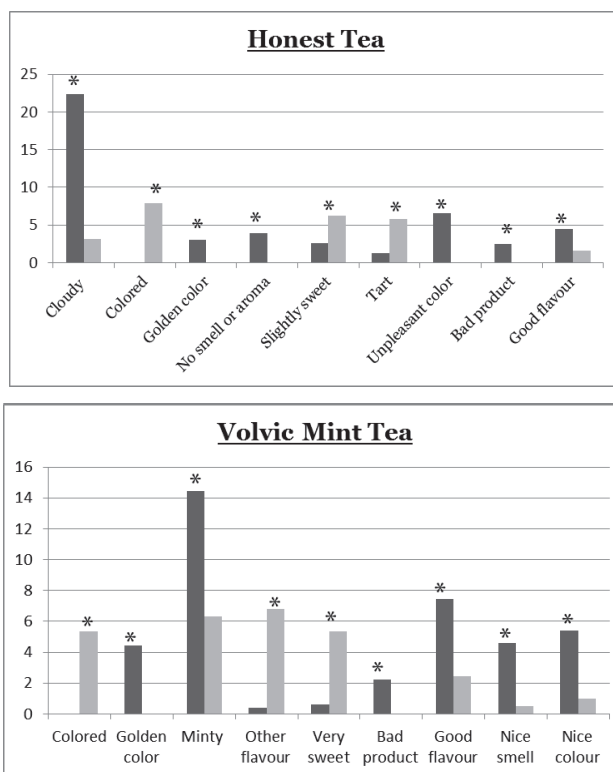


Figure 20: The frequency of elicitation on standardized data for the two conditions for Honest Tea and Volvic Mint Tea

- = significant differences with a chi-square analysis at 5%

Regarding Honest Tea, six significant differences can be elicited for sensory properties:

- Case 1: “slightly sweet”, “tart”,
- Case 2: “cloudy”
- Case 3: “colored”
- Case 4: “golden color”, “no smell or aroma”

Regarding Volvic Mint Tea, five significant differences can be elicited:

- Case 1: “other flavor”, “very sweet”
- Case 2: “Minty”
- Case 3: “colored”
- Case 4: “golden color”

For comparative conditions, “strong”, “very”, “slightly” show that products are positioned on a scale for each attribute. For monadic condition, subjects elicited more hedonic descriptors (“good”, “nice”). The specificities of the product are also more frequently elicited: “minty”, “cloudy” than for the comparative condition. For the comparative condition, descriptors that are more frequently elicited are shared by the whole set of products.

For the overall range of products, descriptors are summed-up in Table 5⁸. For all the samples, the descriptors used in Cases 1 and 3 are different from the descriptors used in Cases 2 and 4. Thus, the description used by consumers for the same product for both conditions is different.

Table 5: A summary of the descriptors most elicited and discriminating samples among the conditions (chi-square analysis at 5%)

Products	Comparative condition		Monadic condition	
	Case 1	Case 3	Case 2	Case 4
WP1	“very sweet”, “other flavor”	“colored”	“no smell or aroma”, “not very intense”, “light smell”	
WP31	“very sweet”	“colored”, “flavoured”	“too sweet”	
Tymbark	“very sweet”	“colored”	“Bitter”	“No smell or aroma”
P21	“very sweet”	“Colored”		“No smell or aroma”
P31	“very sweet”	“strange scent”		“Flavoured”
Elisabethen Quelle Lime	“colored”			“No smell or aroma”
Volvic Mint Tea	“very sweet”, “other flavour”	“Colored”	“minty”	“Golden color”
Honest Tea	“Slightly sweet”, “tart”	“Colored”	“cloudy”	“No smell or aroma”, “golden color”
Elisabethen Quelle Rooibos	“Not sweet”, “very sweet”	“Colored”	“Fruity”	
Nestea	“strong”, “other flavour”, “very sweet”	“colored”	“transparency”	“Golden color”
Little Miracles	“very sweet”, “strong”	“colored”	“cloudy”	

⁸ Detailed analysis for the whole product range is in the appendix 3

The second conclusion that can be drawn on the assessment per product is that the descriptions of the sensory perceptions between the two conditions are significantly different.

The results show that product properties elicited by the subjects are different depending on the context through the following assessments:

- the configuration of the whole product range, nature and number of sensory descriptors are significantly different between the two contexts of presentation
- for each product description related to sensory perceptions, there are significant differences in nature between the two contexts of presentation.

Differences of cognitive expectations between conditions

The results show that distribution of frequencies of elicitation of boards is different among conditions for six products out of eleven (Table 6). Thus, for these six products, associations with boards are different between comparative and monadic conditions: Elisabethen Quelle Rooibos, Elisabethen Quelle Lime, Tymbark, Little Miracles, WP1 and P31.

Table 6: Comparison of distribution of boards' frequencies between comparative and monadic conditions

Product	χ^2	p-value
Elisabethen Quelle Rooibos	13.612	0.034
Elisabethen Quelle Lime	16.384	0.012
Tymbark	13.635	0.034
Nestea	4.078	0.666
Volvic Mint Tea	7.230	0.300
Little Miracles	13.670	0.034
WP1	13.405	0.037
WP31	9.148	0.165
P31	17.957	0.006
P21	3.563	0.736
Honest Tea	6.951	0.325

The first conclusion for the results is therefore that for a majority of the samples distributions of boards between conditions are not the same.

For each product, the frequencies of association with the boards are compared for both conditions. Results are summed up in Table 6⁹.

⁹ For detailed results of each product refer to the Appendix 4

Table 7: Significant associations with situation of consumption for each product in the two conditions

Product	Comparative condition	Monadic condition	Conclusion
Little Miracle	Exotic	Exotic / Family	Slight difference
Nestea	Exotic / Family	Exotic/ Family	No differences
Elisabethen Quelle	Physical	Exotic	Differences
Rooibos			
Elisabethen Quelle	Physical	No association	Differences
Lime			
Honest Tea	Family/Nothing	Family / Nothing	No differences
Volvic Mint Tea	On the go	Energy	Differences
Tymbark	Physical/ Exotic	On the go/ Exotic	Slight differences
P21	Exotic	Exotic / Family	Slight differences
P31	Exotic	No association	Differences
WP1	Physical / Exotic	No association	Differences
WP31	Physical / Exotic	Exotic	Slight differences

Conclusions for each product are provided in the right-hand column of the table. Three cases can be observed. Firstly, five products show a complete difference of associations with the boards between conditions. This is the case for example of Volvic Mint Tea when it is associated with On the go situation in a comparative condition and to the Energy situation in a monadic condition. Regarding WP1, none of the boards are clearly associated with the product in a monadic condition. In a comparative condition WP1 is associated with the Physical and Exotic situations.

Secondly, four products show slight differences, i.e. only one board is common to both conditions. This is the case for Little Miracles and P21 when associated with the Exotic situation in both conditions, but also to the Family situation in a monadic condition. Tymbark is associated with the Exotic situation in both conditions. In the comparative condition it is also associated with the Physical situation and On the go situation in a monadic condition.

Thirdly, two products show no differences of associations between the conditions. Honest Tea is associated with the Family situation in both conditions. Nestea is associated with Family and Exotic situations in both conditions.

Thus, for nine products out of eleven, the boards associated with them are different between conditions.

The results show that cognitive expectations associated with the product are different between conditions, i.e. contexts of presentations.

1.4. Main results

Study 2A allows us to conclude that:

- **The description of the products is different among conditions**
- **Different cognitive expectations are associated with the products depending on the context**

The context described here as sensory diversity has thus an influence on the sensory description and cognitive associations with the products. These results give also insights on the influence of the categorization on the association with concepts and product properties. Indeed, depending on the ad-hoc category to which the product is associated, the product is perceived differently by the subject as stated by literature in cognitive psychology. Addressing then different ad-hoc categories by manipulating the sensory environment of the product should then induce a difference of sensory perception and then a difference in cognitive associations.

1.5. Methodological limits

Some methodological limitations due to the product range and the subjects can be elicited. First, the high number of products (eleven) can induce a saturation effect especially in a monadic case as the subject tastes the products one after the other. This effect can partly explain the lack of consensus in the monadic condition. However, looking at the configurations, consumers were able to find differences in the categorization task between products. In monadic conditions, consumers were also able to associate different descriptors between products. Another limitation relates to the order effect in the monadic condition. We tested products in monadic sequential, thus there is a possible effect of bias from one product to another. As the products were non familiar, the first product tasted can be seen as a warm-up and thus influencing the perception of the following samples. Bias can be also be due to the order of samples, as some samples that have more a intense fruit or tea flavor, can saturate in-

mouth perception. However, this effect can also be induced in a comparative task as the samples are also tasted one after the other by subjects (Lelièvre et al., 2008). Thus, this limitation can't explain the differences among conditions. Another limitation is that the subjects from both conditions are different. This choice is made in the context of non-familiarity of samples to avoid inducing possible bias from one session to another.

The difference among the two conditions is not only the diversity of sensory information, but also the task given to the subjects. In comparative conditions, a categorization task is asked of the participants inducing a description based on the whole set of products. In the monadic condition, the product is assessed through a comparison with an internal referent in the subjects' minds, which is in line with conclusions provided by other studies focusing on the comparison of the products' assessment methodologies (Bech-Larsen and Nielsen, 1999; Breivik and Supphellen, 2003). Based on the Perceptual Symbol System, attention is a crucial process in perception for selectively extracting information that is stored in the subjects' memory (Barsalou, 1999). Categorization in the sorting task is relative to the whole product range and based on main shared criteria ranked in intensity, while in the monadic condition only specific sensory features of the product are elicited. This can be explained by the fact that the sorting task induces the focus of subjects' attention on the shared criteria of the product range, erasing in this way the main features that are product-specific. Therefore, the task has an influence on the way subjects perceive the product by orienting their attention on specific sensory modalities. However, the sorting task is not per se a bias, because if we had compared both conditions using the same protocol, the same processes would have been followed by consumers positioning the products to each other. Therefore, the addition a sorting task allows a closer proximity to the reality of perception, namely the categorization task that determinates the identification of the products and therefore the perception.

Additionally, the contextualization we chose to prime in the study relates to the brand and the product range. The results show that subjects were able to associate with each product or products group a situation of consumption. However, we have not induce directly a variability of ad-hoc categorization because we do not contextualize on different contexts of consumptions and compare the categorization in each case. Further study should integrate the context of consumption as a variable to be compared, primed at the beginning of the study and not as a final association to products.

The boards of cognitive associations are also a potential limitation of the study. We chose to present the benefits related to each situation of consumption through collages made by consumers. The objective is to avoid potential bias related to words and their interpretation without contextual cues. However we have no guarantee that the boards were interpreted in

the same way than in the pre-qualitative study. This is not per se an important bias as we wanted to focus on the discrimination of the boards between products and not on their nature, i.e the benefits associated to each of them. A pre-step in the study should have been added to ensure that each board was differentiated from the other by the subjects.

The results have been analyzed taking into account the entire set of subjects. However, differences can be noticed among products and conditions which are only slight. Moreover the lack of consensus for two products on conceptual associations can be discussed as a high individual variability of perception. Barsalou explains that concepts are based on sensory modalities referring to previous experiences (Barsalou, 1999). Therefore, depending on the previous experiences of the subjects, associations between percept and concept will be different. Therefore, the differences of perception can induce differences in expectations between subjects toward the same product. This observation will be the focus of the next study.

To sum-up, the following methodological limits are stated:

- **Some biases are related to the product range and the subjects panel: saturation of in-mouth perception, order effect, two different samples of consumers between conditions.**
- **Attention of subjects is not focused on the same properties of the product range due to the task in each condition.**
- **Contextualization should integrate the context of consumption and vary among conditions.**
- **Boards of cognitive associations can be interpreted differently between subjects**
- **A lack of consensus between subjects due to an interindividual effect on their perception.**

3.1. New proposal of study based on insights

Objective of the study is to show that a difference of sensory perception due to a difference of ad-hoc categorization has an influence on cognitive associations with the product.

As previously discussed we first want to avoid a potential bias due to the difference of tasks. However the study needs to ensure having two conditions inducing two different perceptions. Thus, selecting a sorting task allows having access to categories based on different product properties.

Secondly, only the brand and the product range were part of the contextualization in the previous study. To ensure giving access to a diversity of ad-hoc categorization, the context of consumption should be primed and the condition we want to compare.

The following methodology is proposed on the same product range with two different sets of subjects. Two conditions of presentations of the products are tested to induce two different sensory perceptions. These two conditions are a contextualization on two different situations of consumption for each panel of subjects on the same product range.

- First step : contextualization of the tasting
- Second step: sorting task
- Third step : free description of each group
- Fourth step : association with boards of cognitive associations

By contextualizing on two different situations of consumption, we should induce two different categorization of the product range, i.e two different sensory perceptions. The results should then show a difference of categorization of the product range between the two sets of subjects, a difference of sensory characteristics used to describe the product range and to cluster the products, and then a difference of association with boards of cognitive associations.

For this study the recruitment step should integrate a questionnaire on familiarity to have the same target of consumers. In other words, we need to ensure that the subjects have no previous experiences with the product range.

2. Study 2B: diversity of cognitive expectations induced by sensory perception between subjects

2.1. Research question

The relation between cognitive expectations and sensory perception is shaped by ad-hoc categories. Categorization is an individual process. The aim of the research is to understand if the concepts representing ad-hoc categories induced by sensory perceptions are variable among subjects based on a variability of categorization (*Figure 21*).

Figure 21: Research aims of studies 2A and 2B

Familiarity is a factor influencing perception through categorization. We aim also at understanding if some aspects of the familiarity toward the product experience is related to a variability of associations between sensory perceptions and cognitive expectations.

2.2. Methodology

Subjects

214 consumers are recruited using the following criteria¹⁰ : 50% of the consumers are women with a partition of 50% between 20-35 y.o and 36-56 y.o. All the subjects are consumers of the Zywiec Zdroj brand and non rejectors of tea, cold drinks and flavored waters.

Products

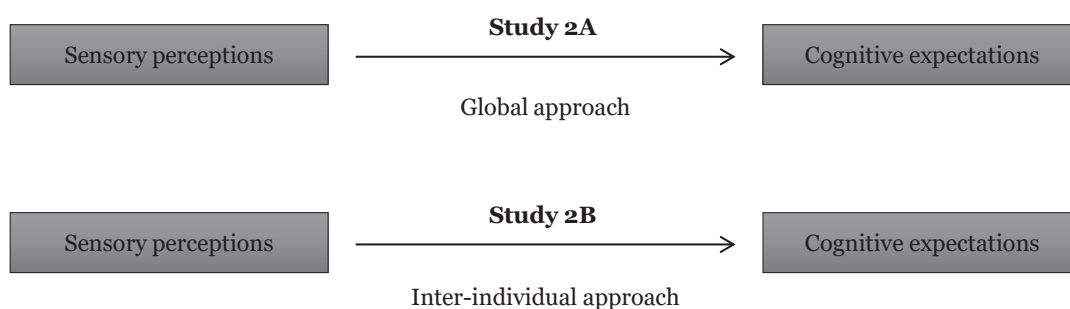
The products are the same as for Study 2A.

Modality of presentation

All the samples are served in plastic and transparent glasses of 12mL, under the Zywiec Zdroj brand. All the products are presented in a comparative way, i.e. at the same time, in a random order on the table.

Protocol

The protocol is described in Study 2A for the comparative condition.



At the end of the study a step of characterization is added. The questionnaire¹¹ provided covers different themes related to familiarity:

¹⁰ Criteria used for recruitment are similar to the one used in the pre-study

¹¹ Questionnaire is detailed in the appendix 5

- Frequency of the consumption of flavored drinks, tea and soda.
- Distance to tea, a sociological index regrouping three axes: knowledge (subjective and objective), implication and usages (Boussoco, 2015; Dany and Abric, 2007) . This index takes into account the relation between one social object (hereby the tea) and the subject.
- Familiarity with the brand focused on two aspects: loyalty and implication (Cho, 2011).
- Food Neophobia scale (Pliner and Hobden, 1992).

The questionnaire was back translated in Polish language.

Statistical analysis

A diversity of categorization on product properties should induce a variability of associations with cognitive expectations between subjects. In other words, clusters of subjects obtained on sensory perceptions should make different associations between groups of products and cognitive expectations.

Thus, to validate the hypothesis a two-fold assessment is made:

- Checking that subjects have a significantly different way of categorizing the same product range. Data from sorting is organized in an individual matrix of dissimilarities. The matrix for each subject is a product x product matrix; with zero when the two products are in the same group and 1 when not. The Adjusted Rand Index (ARI) is calculated between two subjects and assess the proximity between the two partitions, i.e the way each of the two subjects categorized the product range (Faye et al., 2004; Hubert and Arabie, 1985). The index lies between -1 and 1. For negative values, partitions are completely dissimilar. The index equals to 1 when the two partitions are exactly the same. Next step is to build an overall matrix subject*subject for which each cell corresponds to the ARI between the two considered subjects. Then, a Hierarchical Ascendant Classification (HAC) is done on the matrix in order to cluster consumers based on their categorization of the product range. For each cluster, the same analysis is performed. All the individual matrices for one cluster of subjects are added together to give an aggregated matrix. A Multi-Dimensional Scaling (MDS) is performed with XLStat 2014 on the aggregated matrix. Dimensions for the best configuration of products are selected for a Kruskal's stress inferior to 0.05 (Faye et al., 2004). A comparison between the configurations of the clusters of

subjects is made with adjusted RV coefficient (Escoufier, 1973; Faye et al., 2004) and assessed as similar to a RV above 0.7. This criterion allows checking that the categorization between the clusters of subjects in order to validate the hypothesis, descriptors associated with the same product between clusters of subjects should be different. To analyze data provided by the description, a matrix of products*descriptors is displayed. For each subject, a correlation coefficient is calculated between the coordinates of each sample on the mapping and the descriptors associated with it. We assume that synonyms close on the mapping describing the same group of products have the same signification. We only select descriptors elicited by more than 10% of the subjects for each cluster (Faye et al., 2004). A projection on the mapping of the verbatim allows us to associate samples to specific descriptors and boards.

- Demonstrating that for each cluster, associations between the product and the board of cognitive expectations are different. The same analysis is made as the one for the descriptors. The hypothesis is validated if the same product is associated with different boards among clusters of subjects. In addition for each product a matrix clusters*boards was displayed. Each cell corresponded to the number of subjects of each cluster associating the product with the corresponding board. A F Fisher's test was run on each matrix. The hypothesis is validated if the p-value is significant for a majority of samples.
- Additional analysis is made to explore the relation between familiarity characterization of consumers and variability of perception. An ANOVA on familiarity items to test significant differences between clusters of consumers is applied.

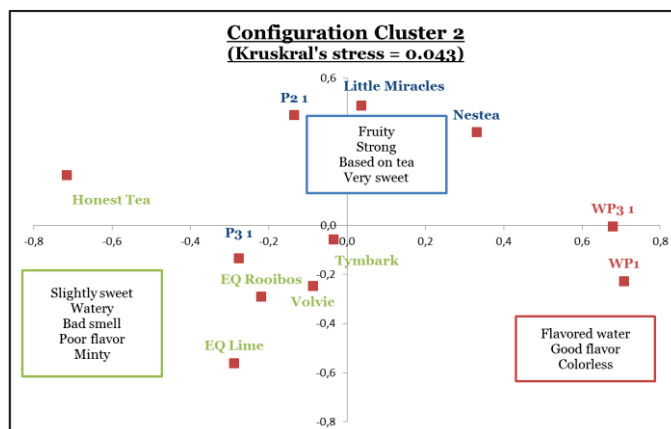
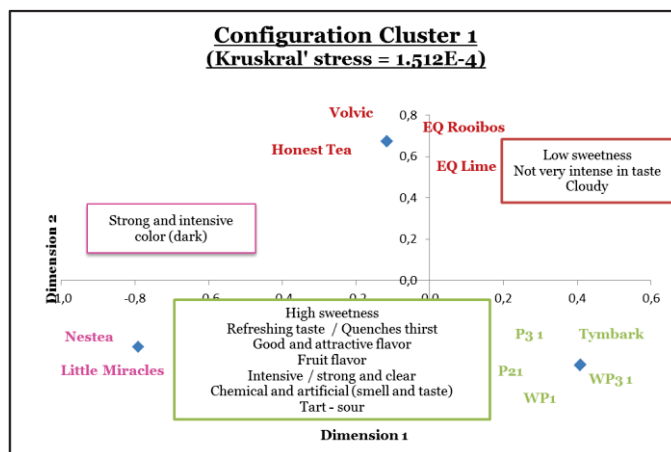
2.3. Results

Variability of categorization on sensory perceptions between subjects

Four different categorizations are provided by the clusterisation of consumers on the ARI matrix (*Figure 22*). Analyses provided by ARV coefficients cannot conclude that there is a similarity between the configurations of clusters expect for the comparison between the whole set and clusters 1, 3 and 4 (Table 8).

Table 8: Table of ARV coefficients

ARV coefficients	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Global
Cluster 1	1.00				
Cluster 2	0.37	1.00			
Cluster 3	0.58	0.44	1.00		
Cluster 4	0.48	0.37	0.59	1.00	
Global	0.76	0.61	0.74	0.79	1.00



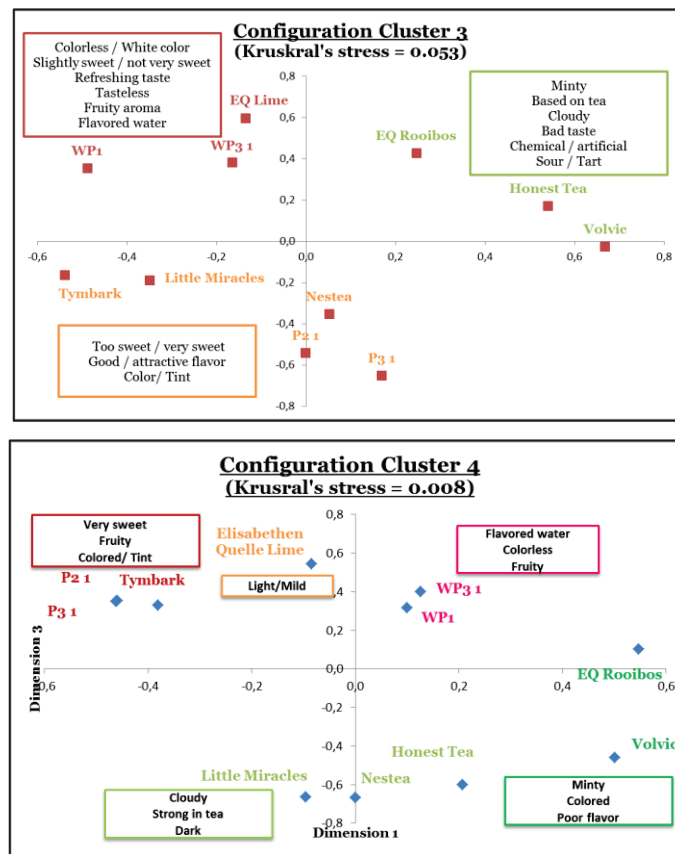


Figure 22: Mapping obtained with MDS and projection of sensory descriptors for the four clusters

The numbers of groups are not the same among clusters of consumers. For clusters 1, 2 and 3, three groups of products are obtained and for the cluster 4, five groups. Thus, the discrimination of the sample range among the clusters of subjects is not the same.

The nature of association between samples is also different depending on the cluster of consumers. Most of the products are not grouped with the same samples by the four clusters of consumers except for P2-1 with P3-1, and WP3-1 with WP2-1.

Regarding the sensory characteristics elicited by subjects to describe groups of products, the numbers of sensory descriptors are higher after clustering the set of subjects. This result highlights a higher consensus among subjects. Indeed, we only kept the descriptors that are close to each other on the mapping and elicited by more than 10% of the subjects. The sensory descriptors most frequently stated by the clusters are: sweetness intensity, fruity intensity, tea intensity and color. Nevertheless, associations between the sensory descriptors and the products differ depending on the clusters of subjects.

Sensory descriptor cannot be elicited by the subjects to describe the product. For example, clusters 1 and 2 describe Elisabethen Quelle Rooibos as “Low sweetness” or “Slightly sweet”, and clusters 3 and 4 do not use sweetness to describe the product. The same results are

observed for Elisabethen Quelle Lime described as low sweet by cluster 1 or slightly sweet by clusters 2 and 3, while cluster 4 does not use sweetness to differentiate the product. This is also the case regarding specific aroma as minty is associated with Volvic by clusters 3 and 4, but not by clusters 1 and 2; and tea aroma is used by clusters 2, 3 and 4, but not by cluster 1. The second case relates to the use of the same descriptor to differentiate the products, but not with the same intensity. For example, WP3-1 and WP1 are described as highly sweet by cluster 1 and as not very sweet by cluster 3.

Thus, results allow us to conclude that a variability of categorization on sensory perceptions exists between subjects highlighted through:

- **the non-similarity of configurations between clusters of consumers**
- **the number and nature of groups of products different between clusters**
- **the variability of associations between sensory descriptors and products.**

Variability between subjects of cognitive expectations

The results provided by the Fischer F test show that for X products the p-value is significant. Thus, distribution of boards among clusters is different for X products. Comparison between the results obtained with the whole set of subjects and after clustering show a highest consensus in association between groups of products and boards (*Figure 23*).

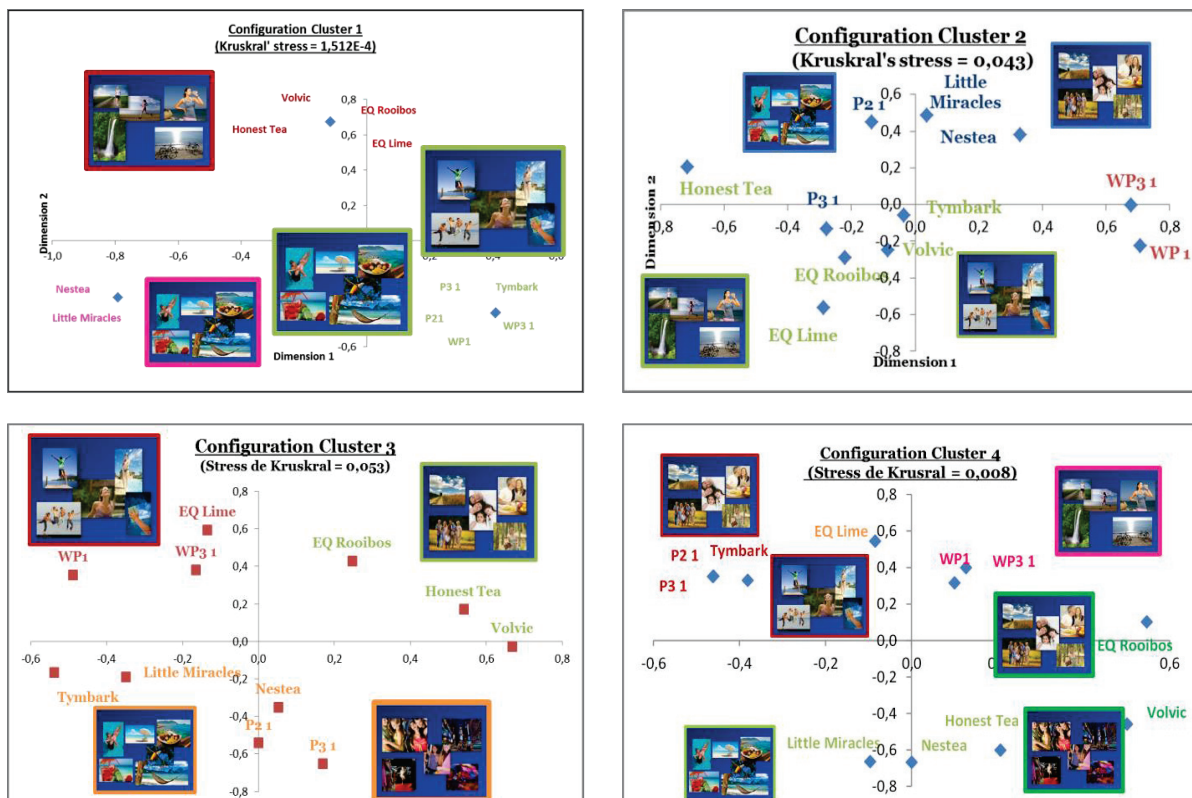


Figure 23: Mapping obtained with MDS and projection of associated boards for clusters of subjects

For the whole set of subjects, only two different boards of expectations are associated with the product range. Clusters 1, 2 and 3 associate four different boards with the groups of products. Looking at cluster 4, all the boards are associated with the product range. Thus, the clusterisation of the subjects based on the categorization on sensory perceptions, induces a higher consensus among the subjects in the association between cognitive expectations and the products and a better discrimination of the products among the boards.

A variability of association between products and boards of expectations is observed. For example :

- Volvic and Elisabethen Quelle Rooibos are associated with the energy situation and the family context for cluster 4, while for cluster 1 they are associated with physical activities, and with the family context for cluster 3.
- Tymbark is associated with the exotic situation by cluster 4, with the energy and exotic situations by cluster 3, with the exotic and on the go situations by cluster 1, and with the physical activities and on the go situations by cluster 2.
- Little Miracles is associated with the exotic situation by all the clusters, to energy situation by clusters 3 and 4 and family situation by cluster 2.

Except for Nestea, which has the same association with the exotic situation whatever the cluster, all the samples have different associations with the boards among clusters.

Therefore, we can conclude that a variability of associations exists between groups of products, i.e. the categorization and cognitive expectations between subjects.

Characterization of clusters of subjects on familiarity

The results on familiarity allow differentiating clusters of consumers regarding their familiarity to the products (Table 9).

Table 9: items significantly differentiating clusters of consumers (10%)

	Clusters	Mean	p-value
Implication for tea	C1	8.371	0.088
	C3	7.629	
Objective Knowledge about tea	C2	5.868	0.083
	C3	6.418	
	C4	5.787	
Perceived Knowledge about tea	C1	6.790	0.069
	C2	5.967	
	C3	5.916	
	C4	5.846	

Reading books on tea	C3	0.259	}	0.069
	C4	0.583		
Shopping	C2	2.219	}	0.014
	C4	2.583		

Cluster 1 has the highest significant scores for the Implication for tea and the Perceived Knowledge about tea. Regarding Objective Knowledge about tea, cluster 3 has a significantly higher score than clusters 2 and 4. On usage, cluster 4 read more on tea and did more shopping than clusters 3 and 2.

These results lead to conclude that there is a relation between ad-hoc categorization and familiarity of subjects. In other words, relation between cognitive expectations and sensory perceptions is correlated with the different aspects of familiarity such as knowledge, implication or usage.

2.4. Main conclusions

The results highlights that there is a variability between subjects of the relation between sensory perceptions and cognitive expectations:

- **subjects categorize the same product range differently, using different natures of sensory descriptors**
- **cognitive expectations associated with the groups of products are different between clusters of subjects.**

Furthermore, familiarity of consumers regarding the product range is correlated to the relation between sensory perceptions and cognitive expectations.

2.5. Methodological limits

This study is designed to demonstrate that sensory perceptions induce the activation of concepts through the categorization process in a food context. Ad-hoc categories as defined by Barsalou relate to a goal, in this case the situation of consumption (Barsalou, 1983). Contextualization in the study is the brand and the definition of the product “cold tea”. The

situation of consumption is then not explicitly given to the subjects, but associated with it after the categorization task; this then allows a conclusion to be drawn on the induction of cognitive expectations from sensory perceptions. These results then give access to various ad-hoc categories relating to a group of products with a specific pattern of sensory information within the situation of consumption.

The sorting task is a methodology frequently used in cognitive psychology to understand the categories in the mind of subjects. A limitation of this protocol is that the categorization task is dependent on the range of products. The association between sensory perceptions and cognitive expectations could have been different if one or more product owning a specific sensory criterion had been added. This is why a preliminary qualitative study is needed to define the product range and understand which main sensory modalities should be explored and are activated in the mind of the subjects.

Regarding the statistical analysis, some limitations can be explicated. The results are provided through analysis in line with previous research on inter-individual studies in sorting tasks (Faye et al., 2013; Lelièvre, 2010). However, we provide results partly on a qualitative analysis of associations between groups of products and associations with boards. Further quantitative analysis could be made by better defining the statistical criteria highlighting the significant differences of associations between one product and several boards among clusters of subjects.

Familiarity is correlated to the difference of perception and then to the difference of expectations. It could be interesting to cluster people among familiarity and then highlight a difference of perception and then expectations. Indeed, Faye has proven that the level of expertise, meaning the level of knowledge on the product, can influence the way the product range is categorized. The nature and graded structure of category can be different among different levels of knowledge. In the same way, the implication of the brand and the cognitive associations to it, are different among subjects and therefore can influence expectations toward a product. Therefore, a complementary study, following the same procedures, could show the effect of familiarity on expectations by recruiting subjects with a different level of familiarity (for the brand, the product, or the category).

To sum-up, the following methodological statements are made:

- **Contextualization made in consumers tests should integrate the definition of the product category**
- **A limit relates to the product range defining the sensory perceptions taken into account by the subjects.**

- **Improvement on statistical analysis could be made to build a stronger statistical criteria highlighting differences between clusters of consumers.**
- **A complementary study is needed to show the effect of familiarity on expectations of consumers.**

3. Discussion

The studies presented in this chapter are focused on the perception of a non-familiar product range. In this case, that the relation between sensory perceptions and concepts is not deduced from previous experiences with the product. The results showed that subjects are able to make associations with concepts even with products they had never tasted. Identifying a new product is thus associating it to an existent category in the mind and inferencing associations with the properties of this category. Ad-hoc categories are built on shared properties answering to a specific goal, thus not necessarily structural properties (Barsalou, 1983). In the case of new products, understanding how subjects make these associations is not demonstrated through our studies. However, some research directions can be discussed. Results provided by Study 2A showed that for some products there is no discrepancy of association among conditions. They keep the same cognitive expectations independently of the conditions and therefore of the pattern of sensory modalities. These results could be discussed in relation to the prototypical theory of categorization (Reed, 1972; Smith et al., 1988). The sensory features of the referent prototype could be associated with all the members of the category. Products that are more representative of the category tend to have the same conceptual expectations whatever the conditions, because the pattern of sensory modalities taken into account by the subject remains the same. This strongly correlates to results demonstrating that helping the subject identifying a new stimulus based on sensory properties induces a better acceptance : indicating “tastes like food X” (Pelchat and Pliner, 1995), providing information on the sensory characteristics and resemblance with familiar food (Tuorila et al., 1998) or information on a familiar process of fabrication (Deegan et al., 2015). Thus, giving sensory information on a new product should help subjects categorizing it and inferencing cognitive associations. Providing shared properties between the new product and the most typical example of the category, induces a higher adhesion of the new product to the category (Ladwein, 1995).

Considering that food products are perceived as members of ad-hoc categories structured among the situation of consumption, thus sensory characteristics are not the only information

helping the subject categorizing the product. Indeed, product properties are less discriminative than cognitive associations (Masson et al., 2009). Thus, information on the proper use of context enhances hedonic responses to novel food (Cardello et al., 1985) and could help the subject inferencing ad-hoc categories. Furthermore visual criteria, such as the color or the transparency of the products, are also strongly connected to other sensory modalities. Indeed, perception is cross-modal, thus these visual aspects can induce specific expectations for the subjects (Driver and Spence, 2000; Karjalainen, 2007; Schifferstein et al., 2013), and thus induce a way of categorization.

Results of Study 2B showed that associations between cognitive expectations and sensory perceptions are different among subjects. Thus, factors helping the categorizing of a novel food are dependent of the subjects. A further research direction could be then more focused on the influence of the familiarity of the subjects on the categorization of the novel food. Indeed, factors taken into account in the familiarity scores relate not only to specific ingredients of the product (such as the tea), but also to context (drinking it cold), or to the brand. Depending on subjects, some factors weigh more strongly than others, and are then translated into key product properties that the novel food should have in order to be included as a member of a particular category. Indeed, a subject that is more familiar with tea drinks can be assumed to make associations of this novel drink based on tea, with previous experiences of tea drinks. This variability is also verified with the familiarity with the brand. Depending on the importance of the brand for the subject and the cognitive expectations associated with it, the attention of the subjects will be focused on different product properties. Giving the name of the brand (as we did in the study) induced an ad-hoc categorization taking into account properties related to the brand (Wänke et al., 1998b). Product affordance should then integrate a brand-sign properties, i.e. specific sensory characteristics associated with the brand (Kreuzbauer and Malter, 2007)

Finally, it is worth noting that in the framework of Grounded Cognition, experiences with novel foods induce a change in associations between sensory perceptions and cognitive expectations. This is already used in brand extension. Adding a novel object as a member of the category related to the brand could thus change some of the sensory characteristics shared by the members (Kreuzbauer and Malter, 2005). This is the case with Zywiec Zdroj brand launching a new product based on tea. This new product has to keep the “signature” of the brand and will also change the category of brands related to the brand.

A main conclusion of the chapter is that contextual information, hereby sensory diversity and brand, induce different relationship between sensory perceptions and cognitive expectations among subjects.

The next steps of the studies are focused on the influence of a cognitive dissonance based on a difference of categorization to define expectations and perception of the product. Depending on the properties of the category retrieved during expectations that do not fit with the tasted product, the affective judgment of the subjects could be different.

**Chapter 6: Influence of sensory
disconfirmation of
expectations on affective
judgment**

**-The case of a familiar product
range-**

Introduction

The aim of this chapter is to study the influence of a disconfirmation of expectations on affective judgment. As concepts are directly related to sensory patterns of information, the research will be focused on sensory disconfirmation of expectations. We aim at better understand the interactions between expectations, perception and affective judgment. In other words how the nature of the discrepancy between categories activated during the perceptive process can influence affective judgment at an individual level.

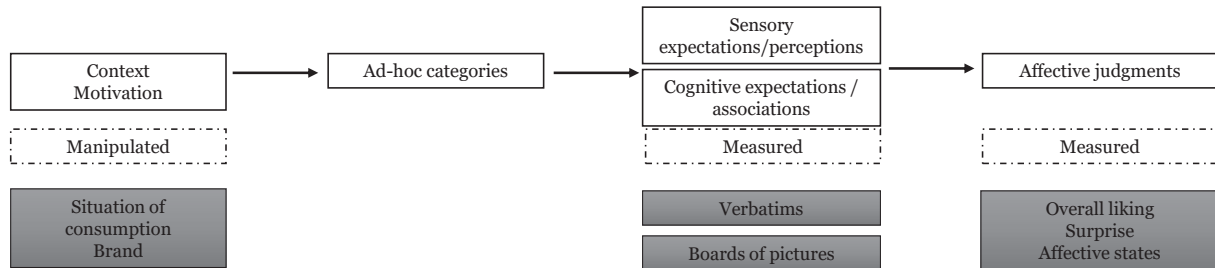


Figure 24 : Research scheme of chapter 6

This part of the research is using an industrial project aiming at selecting the product sample fitting the best with the positioning of Actimel brand. In other words, the situation of consumption associated with Actimel brand has changed. The objective of the project is to propose the prototype with product properties that are fitting the best with the new benefits carried by the brand. The consumer test is made in Germany and limited in number of subjects due to business constrains.

Three research questions are defined in order to understand which affective items are induced by a sensory disconfirmation of expectations, and the variability of these items depending on the nature and the level of sensory disconfirmation of expectations taking into account the familiarity of subjects.

Expectations are related to ad-hoc categories as previously seen in Chapter 4. However, in food science, sensory disconfirmations of expectations are mainly studied through the influence of external information on the sensory perceptions of the product. We aim therefore at highlighting the relation between ad-hoc categories retrieved during perception and sensory disconfirmation of expectations. Thus, the question is to understand the link between a discrepancy of ad-hoc categories retrieved during food perception and a sensory disconfirmation of expectations. This question is explored in Study 3A.

Ad-hoc categories relate to strong associations between sensory perceptions and cognitive expectations inherent to subjects as previously concluded in Chapter 5. As sensory

disconfirmation of expectations should relate to a discrepancy of ad-hoc categories retrieved during perception, thus depending on the nature of the properties, affective judgment induced should differ. Therefore, how do the nature and the degree of sensory disconfirmation of expectations influence affective states? This question is explored in Study 3B.

1. Study 3A: understanding the link between ad-hoc categories and sensory disconfirmation of expectations

1.1. Research question

The purpose of the study is to dig more into the link between categories activated before consumption, or namely expectations and sensory disconfirmation of expectations. We aim to show that activating a concept can therefore create a sensory disconfirmation of expectations without explicitly priming on sensory specific characteristics.

The research hypothesis is: as long as **a concept is translated into sensory perception related to the category, activating a concept can induce a sensory disconfirmation of expectations.**

1.2. Methodology

Procedure

The procedure is a two-steps methodology (Figure 25).

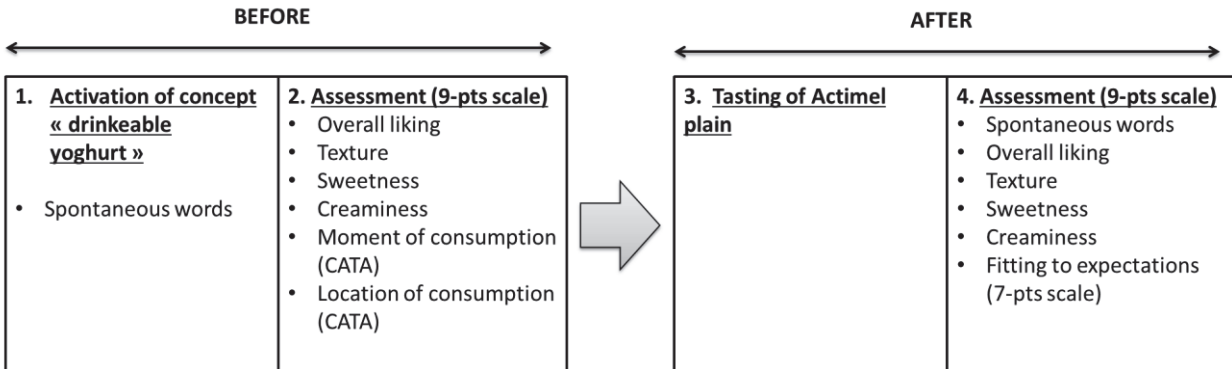


Figure 25: Procedure in two steps. Before consumption / After consumption

The first step is dedicated to activating the ad-hoc category around the concept “drinkable yoghurt” with a first assessment based only on conceptual expectations. Subjects are asked to think about drinkable yoghurt that they take from the refrigerator and answer to the following questions while thinking about this product. Then subjects are asked to state the first words that come to mind while they are thinking about the product. Then they assess the overall liking

and three global sensory modalities: texture, sweetness, and creaminess on a 9 points scale (Cardello and Sawyer, 1992; Tuorila et al., 1998). The last questions required the subject to tick answers on the context of consumption (moment and location) of the “drinkable yoghurt”.

The second step begins by a blind tasting of a plain Actimel i.e. without telling the participants the brand, i.e. in a plastic glass. Following this tasting, subjects give the first words that spring to mind, and then assess the product using the same questions as the first step on a 9 points scale. After assessing the overall liking, subjects state the positive and negative characteristics of the product. The last question is an assessment of how the product fits expectations on a 7-pts scale.

This procedure is conducted in hall

Subjects

We used a convenience sample of adults (more than 18 years old). A questionnaire was provided at the end of the test to get information on the consumers. 40 subjects took the test: 15 men and 25 women. It was found that 50% of them used to drink drinkable yoghurt less than once a month. 20% of them had never drunk it and 12% of them consumed drinking yoghurt it more than once a week. Out of all of those who consumed drinking yoghurt, half of them consumed the brand YOP and only 15 % of them consumed Actimel.

Product

We decided to choose Actimel as a non-fitting product within the category “drinkable yoghurt”. Previous market research by DANONE has shown Actimel is less thick than drinking yoghurts. Therefore, by selecting Actimel, we should induce a sensory disconfirmation of expectations.

Statistical analysis

To validate the hypothesis we need to ensure having:

- a disconfirmation of expectations through: calculation of the mean score of fitting to expectations below 4 (average score) and a delta of overall liking that is significantly different from zero between concept and percept conditions.
- a disconfirmation of sensory properties indicated by a delta of at least one of the sensory characteristics being significantly different from zero between concept and percept conditions.

To compare the two conditions, before and after consumption, a t-test at 5% is run for the liking, the texture, the sweetness and the creaminess.

To confirm the results of sensory disconfirmation of expectations, analyses are provided on the reasons of dislike, and spontaneous elicitations of words through a qualitative observation.

CATA questions are defined as manipulation checks, only provided to ensure the activation of the concept for the respondents.

1.3. Results

Disconfirmation of expectations?

First results are provided by the analysis of the overall liking score and the fitting to expectations (Table 10).

Table 10: Description of the assessment of the three items OL before (concept) and after consumption (tasting) and fitting to expectations

Variable	Mean	Standard deviation
Overall liking concept	6.7	1.5
Overall liking tasting	5.0	2.0
Fitting to expectations	3.7	1.8

]
*
p<0.001

The analysis of fitting to expectations shows a disconfirmation of expectations with a low score for this item. Furthermore, looking at the assessment of the overall liking, the difference between the two scores is about 1.7 less. A t-test run on the data highlights a significant difference between the quotations (p-value < 0.001). The overall liking assessed after tasting is lower than the overall liking assessed before. Therefore the valence of the discrepancy is negative because the expected product is better assessed than the actual one.

Thus, the results show that the tasting of Actimel induces a negative disconfirmation of expectations when activating expectations relating to a drinkable yoghurt.

Sensory disconfirmation of expectations?

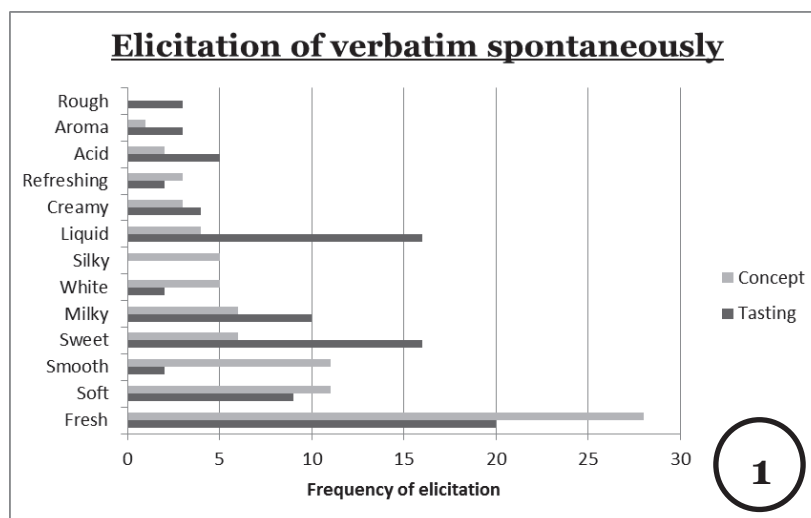
The analyses of the three items related to sensory characteristics provide the nature of the disconfirmation (Table 11).

Table 11: Description of the assessment of the three sensory items before (concept) and after consumption (tasting)

Variable	Mean	Standard deviation
----------	------	--------------------

Texture concept	4.8	1.9
Texture tasting	2.9	1.8
* p<0.001		
Sweetness concept	5.2	2.2
Sweetness tasting	6.0	1.8
Creaminess concept	4.6	2.1
Creaminess tasting	4.4	2.2

Of the three sensory items assessed by the subjects only one highlights a significant difference between expected (concept) and actual (tasting) assessments (p -value<0.001). The texture is assessed as significantly more liquid after consumption. This result shows then, that the expected texture is thicker than the texture perceived during the tasting. Therefore, this is a sensory disconfirmation of expectations. These results are enhanced by the analyses of the verbatim provided spontaneously before and after tasting and by the reasons given for dislikes (Figure 26).



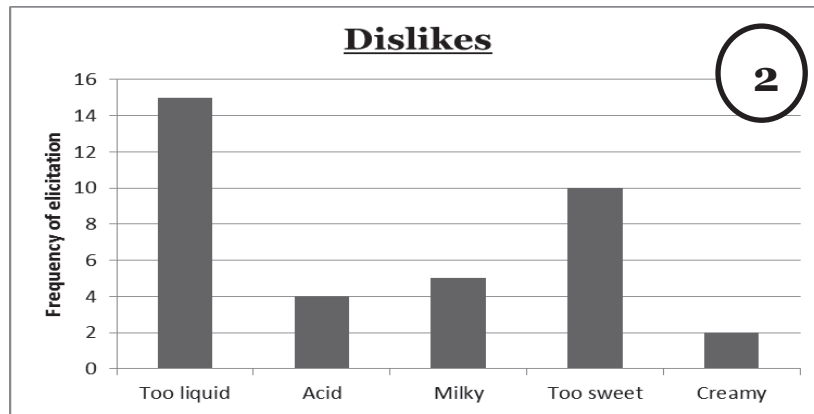


Figure 26: 1/ Frequency of elicitation of verbatim before (concept) and after (tasting) consumption (elicited by more than 5% of the subjects)

2/ Frequency of elicitation of dislikes (elicited by more than 5% of the subjects)

The analysis of the Figure 24:1 focused on the verbatim provided spontaneously by consumers showing that the expected product was mainly described as fresh, soft and smooth. Regarding the tasted product, spontaneous verbatim provided was fresh, liquid, sweet and milky. Therefore the spontaneous verbatim for the tasting part is focused on the product properties that are not congruent with properties expected relating to “drinkable yoghurt”. This is aligned with the analysis of the dislikes. The highest frequency of elicitation is “too liquid” followed by “too sweet”.

Therefore, we induce a sensory disconfirmation of expectations mainly due to a lack of texture.

1.4. Main conclusions

To sum-up, activating a category in the mind of subjects through a specific concept (here “drinkable yoghurts”) induces sensory expectations. Incongruency between the ad-hoc categories activated before and after consumption induces a sensory disconfirmation of expectations.

2. Study 3B: Influence of a sensory disconfirmation of expectations on affective judgments

2.1. Research question

Sensory disconfirmation of expectations relates to the activation of discrepant properties relating to ad-hoc categories during the perceptive process. **The aim of the study is to understand the influence of the nature and the degree of the sensory**

disconfirmation of expectations on the affective judgments of consumers. In other words we aim at studying the role of the relation between cognitive and sensory expectations on the affective judgments of consumers.

Several hypotheses underlay this objective:

H1: Affective states induced by a sensory disconfirmation of expectations are different among subjects because of an inter-individual variability of categorization.

H2: Affective states are dependent on the degree of sensory disconfirmation of expectations. In other words, affective judgment is different depending on the level of discrepancy between ad-hoc categories activated at the beginning and during perception.

H3: Affective states are dependent of the nature of the sensory disconfirmation of expectations, and more precisely the relation between cognitive associations and sensory perceptions of ad-hoc categories activated during perception.

H4: Affective states induced by a sensory disconfirmation of expectations are related to the familiarity of consumers.

2.2. Methodology

Protocole

The following procedure is followed by participants (Figure 27):

- Contextualization step: the purpose is to help the subjects to define expectations, i.e. ad-hoc category, relating to a given situation of consumption: *“Now, think about an occasion, when you are eating your breakfast, in the morning and you want a drink that makes you feel stronger, that is better for your immune system and makes you feel better prepared to get through your day. Think clearly about what you were experiencing during this occasion. Now describe this experience in detail. Please take your time and provide a description that is as complete as possible”*. The task is carried out on a sheet of paper in order to improve contextualization through the writing. Details are provided by consumers about the circumstances, the reason why and how they consume the product, and the sensations, i.e. the properties the ad-hoc category activated. Once they finish the task, subjects are informed that they will taste several versions of a strawberry Actimel.
- Once they have tasted the product, they are given a questionnaire about the product on a computer. The questionnaire has two steps:

- Affective states are first assessed following the decision-making process of the subjects as closely as possible: from the most spontaneous to the least. Consumers start by filling in the questionnaire which is the list from the qualitative study. The list of affective states was double-checked based on results provided by the literature (Ludden et al., 2007, 2012b). Each item was assessed on a 7-points scale in a random order; this is followed by the assessment of the fit to their expectations on a 7-points scale and their overall liking on a 10-points scale.
- The properties of the disconfirmation are then assessed (diagnosis part). This part is dedicated to highlighting the nature of the sensory disconfirmation of expectations, i.e. properties that are inconsistent:
 - Open question on sensations perceived: *“Imagine that you are experiencing the experience you have described earlier, write why you like or dislike drinking this product”*. Open questions avoid steering the attention of consumers towards specific sensations from one product to another; open questions also improve the spontaneity of the answers by only eliciting sensations related to the disconfirmation. Relating the questions to the overall liking makes it easier for a consumer to understand them.
 - Assessment of the cognitive expectations (benefits and the context of consumption). Six boards of pictures, based on a previous qualitative study focused on the context, are presented to the participants. The match with each of the six boards is assessed on a 5-points scale. An assessment of the matching different moments of consumption for customers is carried out by a Check-All-That-Apply methodology.
- Finally a questionnaire on the familiarity of the subjects with the product range and the brand is given¹². Several items were assessed:
 - Frequency of consumption of strawberry Actimel
 - Implication related to food healthiness (Gomez, 2009).
 - Distance to probiotics, a sociological index regrouping three axes: knowledge (subjective and objective), implication and usages (Boussoco, 2015; Dany and Abric, 2007).
 - Knowledge and implication of Actimel product.
 - Familiarity with the brand focused on two aspects: loyalty and implication (Cho, 2011).

¹² Detailed questionnaire is provided on Appendix 7

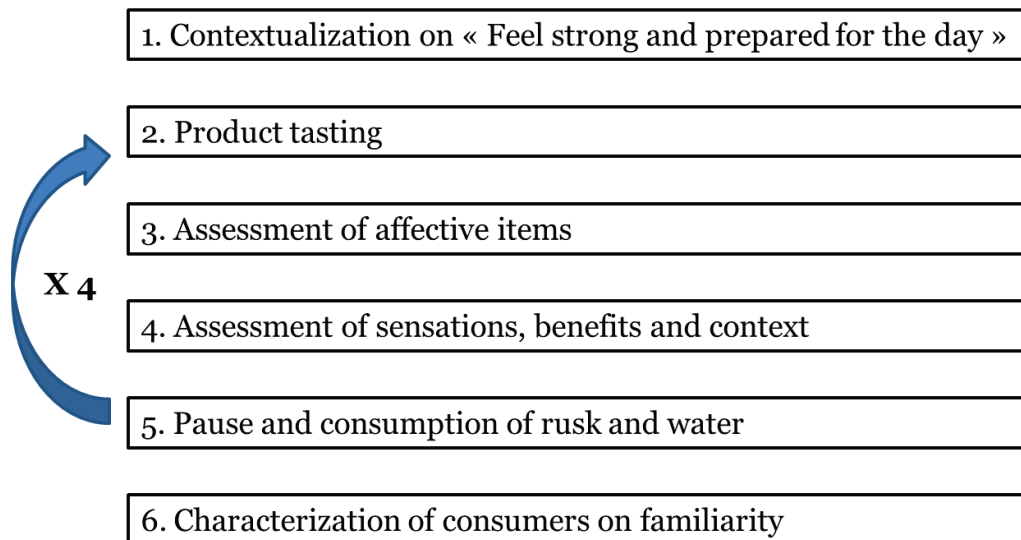


Figure 27: Procedure of assessment (repeated for the 4 samples)

Subjects

114 subjects were recruited in Germany based on criteria defined by the marketing team. Targeted consumers are characterized as 80% of women from 25 – 60 years old, heavy users of strawberry Actimel (at least once every two weeks) for breakfast. All the consumers were recruited because they believe consuming Actimel helps to strengthen immunity or increase vitality.

Products

Four products are presented (Table 12) and designed to obtain different degrees of sensory disconfirmation, by modifying sensory properties of the product. Based on a previous qualitative study with heavy users of Actimel, sensory guidelines have been elicited by consumers ensuring the fit of the product with the following benefit “Feel strong and prepared for the day”.

Table 12: Description of products

Hypothesized fit with expectations	Sensory properties ensuring disconfirmation	Product
High degree of disconfirmation (Contrast)	Thicker	YOP
Light degree of disconfirmation (Assimilation)	More watery Warm notes	1/3 Yakult 2/3 Strawberry Actimel
Light degree of disconfirmation (Assimilation)	More watery Too sweet	Strawberry Actimel
Confirmation		1/2 Strawberry Actimel 1/2 Plain Actimel

Assessment of cognitive expectations

Cognitive expectations are proposed through six boards of pictures (Figure 28). These boards are based on collages made by consumers during a previous qualitative study. Starting from “Feel strong and prepared for the day”, subjects expressed four different benefits and made collages to illustrate each of them.

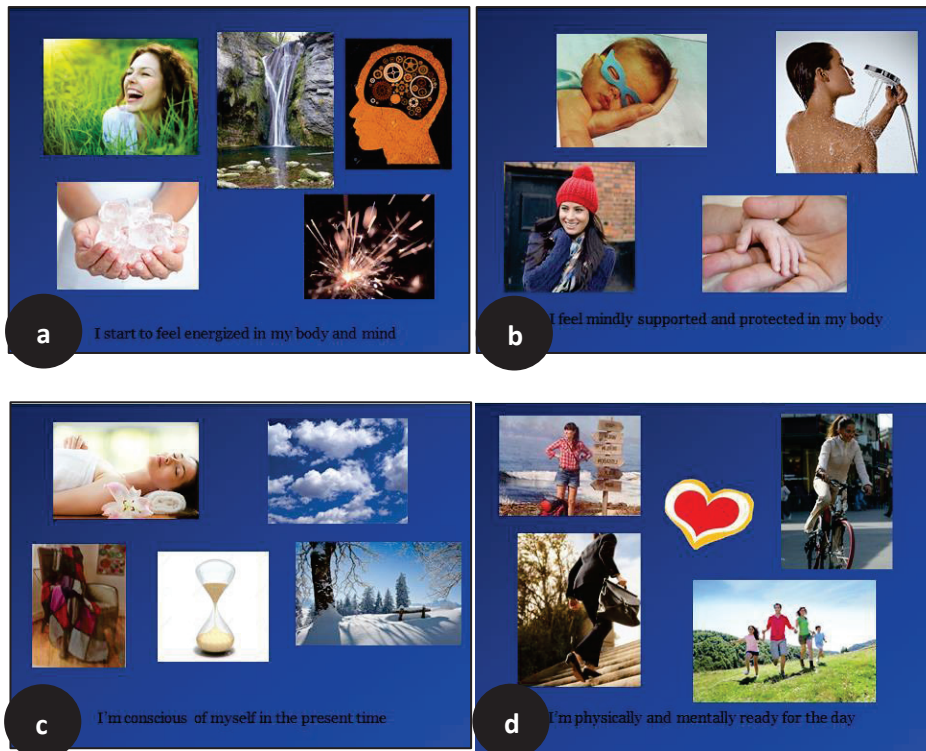


Figure 28: Boards of pictures illustrating each of the four benefits fitting with the motivation « Feel strong and prepared for the day » and the context of the morning breakfast.

The four different benefits are the following:

- “I start to feel energized in my body and mind” (a) :
- “I feel mentally supported and protected in my body” (b) :
- “I’m conscious of myself in the present time” (c):
- “I’m physically and mentally ready for the day” (d) :

Each of the boards is completed with a sentence elicited from subjects taken from the qualitative study in order to complete the interpretation of pictures. Indeed the benefits primed for each of the boards are quite close and therefore complete pictures with a sentence ensure a better understanding by the consumers.

Two other boards are added as false negative (Figure 29).

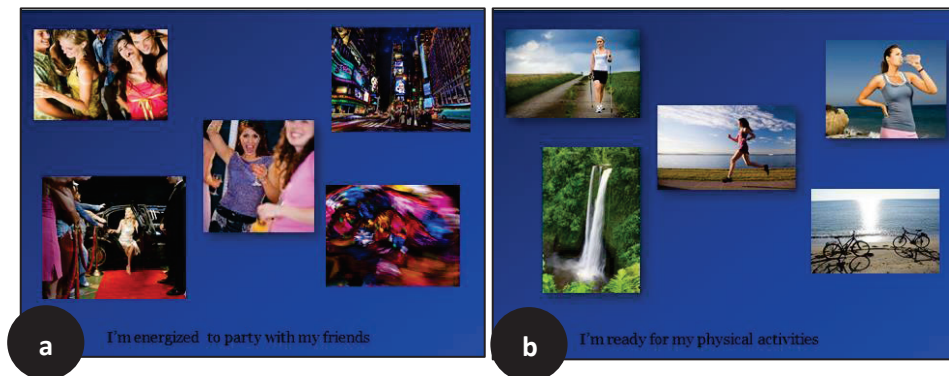


Figure 29: Boards of pictures illustrating two false negative benefits

The two false boards are the following:

- “I feel energized and ready to party with friends” (a): this benefit is not congruent with the brand Actimel, so must not be matched with any of the products.
- “I’m ready for physical activity” (b): this benefit fits with Actimel, but not with the motivation and the context primed at the beginning of the test. Therefore, this board does not fit with any of the products confirming expectations.

Boards are presented to consumers in a balanced order.

Statistical analysis

H1: To validate the first hypothesis of research, we need to ensure we have different clusters of consumers among fitting to expectations. More precisely, we need having:

- a difference of ranking of products among the three items: fit with expectations, surprise, and overall liking between clusters

- a significant difference of scoring between clusters on the three items assessing a disconfirmation of expectations : fit with expectations, surprise, and overall liking. In other words, the effect of cluster*product in the ANOVA should be significant for these three items at 10%.

The following statistical analyses are run: CAH on fitting with expectations, and an ANOVA including product*cluster effect. For each cluster, an ANOVA with a Bonferroni test at 10% is run on every affective item to test significant differences among products.

H2: To validate the second hypothesis of the research, we need to ensure that for each cluster of consumers, depending on the level of fit, the affective states induced are different. Action standards are as follows:

- Between clusters, ranking of products among affective states are different
- For each cluster perceiving a disconfirmation of expectations, at least one of the affective items shows a significant difference between products at 10%.

The following statistical analyses are run: for each cluster, an ANOVA with a Bonferroni test at 10% is run on every affective state to test significant differences among products.

H3: To validate the third hypothesis of research, we need to ensure that relations between cognitive and sensory expectations inducing affective judgment are different among clusters of consumers. Action standards are as follows:

- Between clusters, sensory descriptors elicited are different
- For each cluster perceiving a disconfirmation of expectations, at least one sensory property is more mentioned for the disconfirmant product.
- Between clusters, either on benefit or on context, the significant differences are similar to the ranking among the fit to expectations.

The following statistical analyses are run for each cluster of consumers:

- an analysis on frequencies of elicitation per product of sensory items
- an ANOVA with a Bonferroni test at 10% on each board of benefits to test significant differences among products
- a Cochran Q analysis to check significant differences of association with context of consumption among products.

H4: To validate the fourth hypothesis on the familiarity, we need to ensure having significant differences on at least one score of a familiarity item between clusters of consumers at 10%.

The following statistical analyses are run: an ANOVA on familiarity items to test significant differences between clusters of consumers.

2.3. Results

Is there a consensus on perceived disconfirmation of expectations (H1)?

Based on fitting with expectations, CAH shows three clusters of subjects (Table 13).

Table 13: Number of subjects per cluster obtained with HAC

Cluster 1	N = 43 subjects
Cluster 2	N= 39 subjects
Cluster 3	N= 30 subjects

The first analysis is provided per clusters of subjects and focused on the fitting with expectations, the level of surprise and the overall liking. These three items allow identifying a disconfirmation of expectations, assessing the degree of disconfirmation and understanding the valence of the disconfirmation.

The three clusters of subjects show differences in the assessment of products of fitting with expectations (Figure 30).

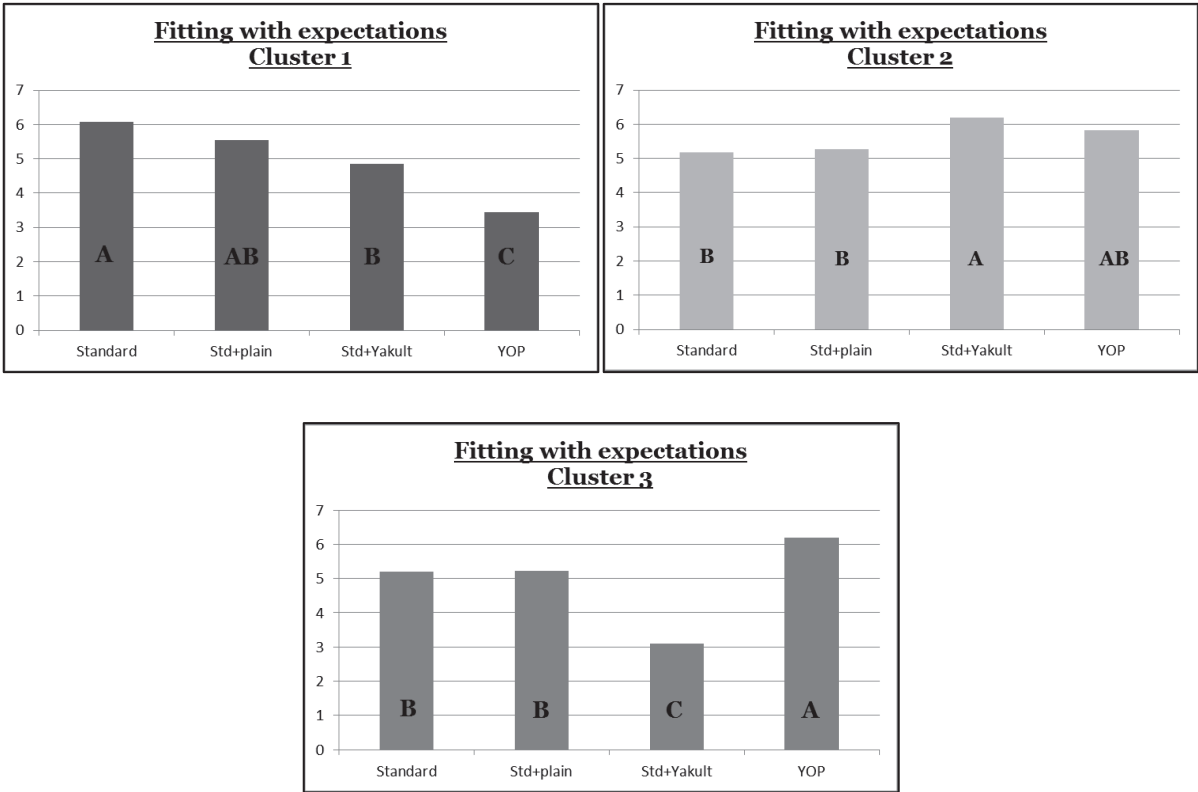


Figure 30: Means of assessment of fitting with expectations for each product for each cluster. Letters in bold show significant differences among products at $\alpha = 10\%$

For cluster 1, there is a significant difference of scoring between the standard and the YOP. The standard fits the best with the combination of standard and plain. The product that fits the least is YOP. Cluster 1 almost follows the hypothesis proposed for the products.

For cluster 2, the mix with Yakult scores significantly higher than the standard and the mix with plain. The combination of Yakult and YOP fits the best with their expectations. The standard and the mix with the plain fit the least well with the expectations.

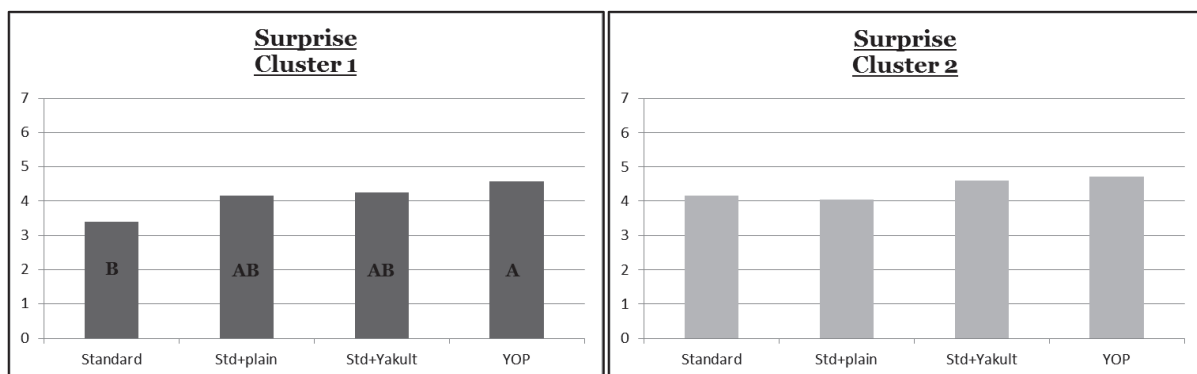
For cluster 3, there are significant differences of scores between YOP, the group standard and the mix with standard, and the mix with Yakult. YOP is the product fitting the best with expectations and the mix with Yakult fits the least well.

Thus, ranking of products on “fitting with expectations” is different among the three clusters showing a difference of disconfirmation perceived between subjects.

Regarding the results provides by the ANOVA, the effect of a cluster*product is significant with a $p\text{-value} < 2e-16$. Thus, the assessment scale is not the same among clusters. For clusters 1 and 3, the product fitting the least well is assessed at around 3 on a 7-points scale, and the product fitting the best is assessed at around 6. There is a clear difference of 3 points between the first and the last products. For cluster 2, the discrimination between samples is lower. Indeed, the last product has been assessed at around 5 and the first at around 6.2 meaning a difference of 1.2 points.

Thus, the three clusters are not equally discriminant, as the scoring of the products on the fit to expectations is significantly different among clusters.

The second analysis focuses on the “surprise” item that reveals a disconfirmation of the expectations (Figure 31).



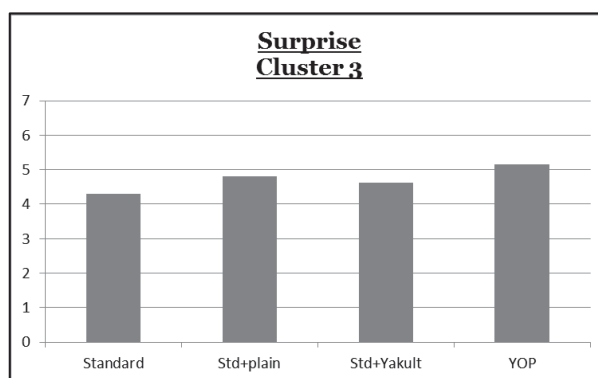


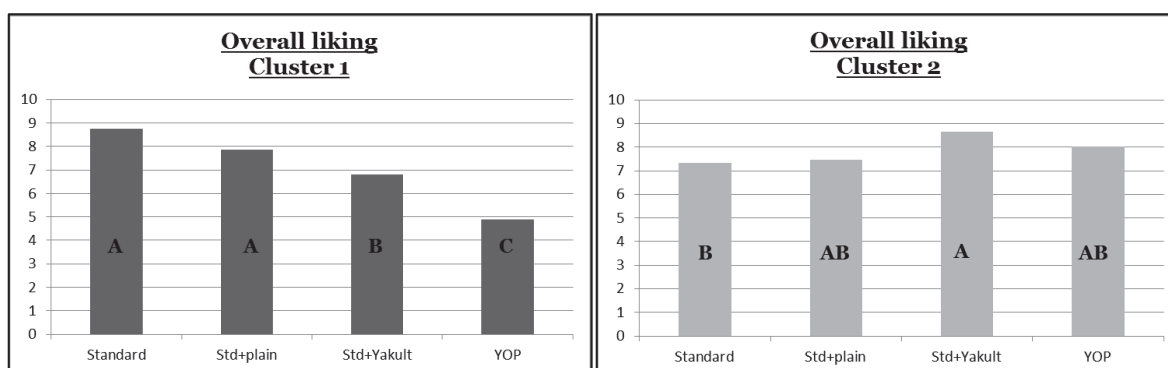
Figure 31: Means of assessment of surprise for each product for each cluster. Letters in bold show significant differences among products at $\alpha = 10\%$

Only cluster 1 discriminates between the products on the surprise: YOP has a significantly higher score than the standard. YOP has the highest number of quotations on surprise and fits the least well with expectations. The standard fits the best with expectations and has the lowest number of quotations on surprise. For cluster 1, the assessment of surprise has a ranking that is opposite to the fitting with expectations.

For the other clusters, this correlation is not the same. The product that fits the best with expectations is not always the one with the lower quotation on surprise. Furthermore, the assessment of the item is quite similar among clusters regarding the effect product*cluster of the ANOVA (p-value=0.743).

Thus, ranking of products on surprise are almost the same between clusters. Differences are only significant for cluster 1. There are no significant differences of scoring between clusters.

The third step of the analysis is focused on the overall liking to understand the valence of the disconfirmation (Figure 32).



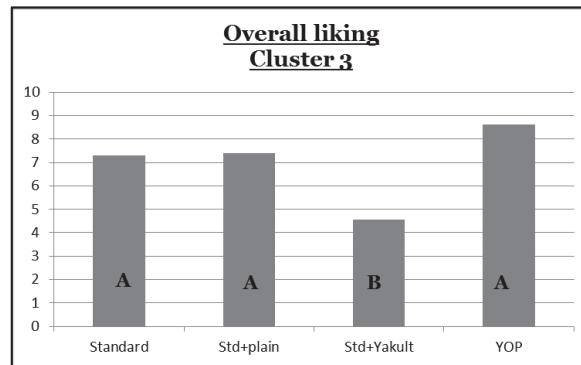


Figure 32: Means of assessment of overall liking for each product for each cluster. Letters in bold show significant differences among products at $\alpha = 10\%$

Looking at the results, the ranking of products for overall liking is the same as fitting to expectations. Therefore for each cluster of consumers, the product fitting the best with the expectations has the highest overall liking. The product having the lowest quotation on fitting to expectations has the lowest liking. Effect of the product*cluster factor is significant for the ANOVA (p-value < 2e-16).

Thus we can validate both action standards as well for overall liking.

We can validate H1 and conclude an individual perception of adequacy to expectations. From a set of subjects recruited with specific characteristics related to gender, age and use of standard Actimel, different clusters can be obtained based on the fitting to expectations. The first study highlighted individual differences of perception and therefore adequacy between expectations and perception of products. Three profiles of consumers can be described:

- **Cluster 1: consumers discriminating all the product range**
- **Cluster 2: consumers that are low discriminators**
- **Cluster 3: consumers discriminating one product through a strategy of contrast, namely rejecting this product as completely disconfirming expectations**

Is the affective judgment influenced by the degree of disconfirmation (H2)?

An analysis of the affective items will be made for each cluster, as the ranking of products is different depending on the cluster of subjects.

Looking at the results provided by cluster 1, all the items show significant differences of assessment among products (Figure 33).

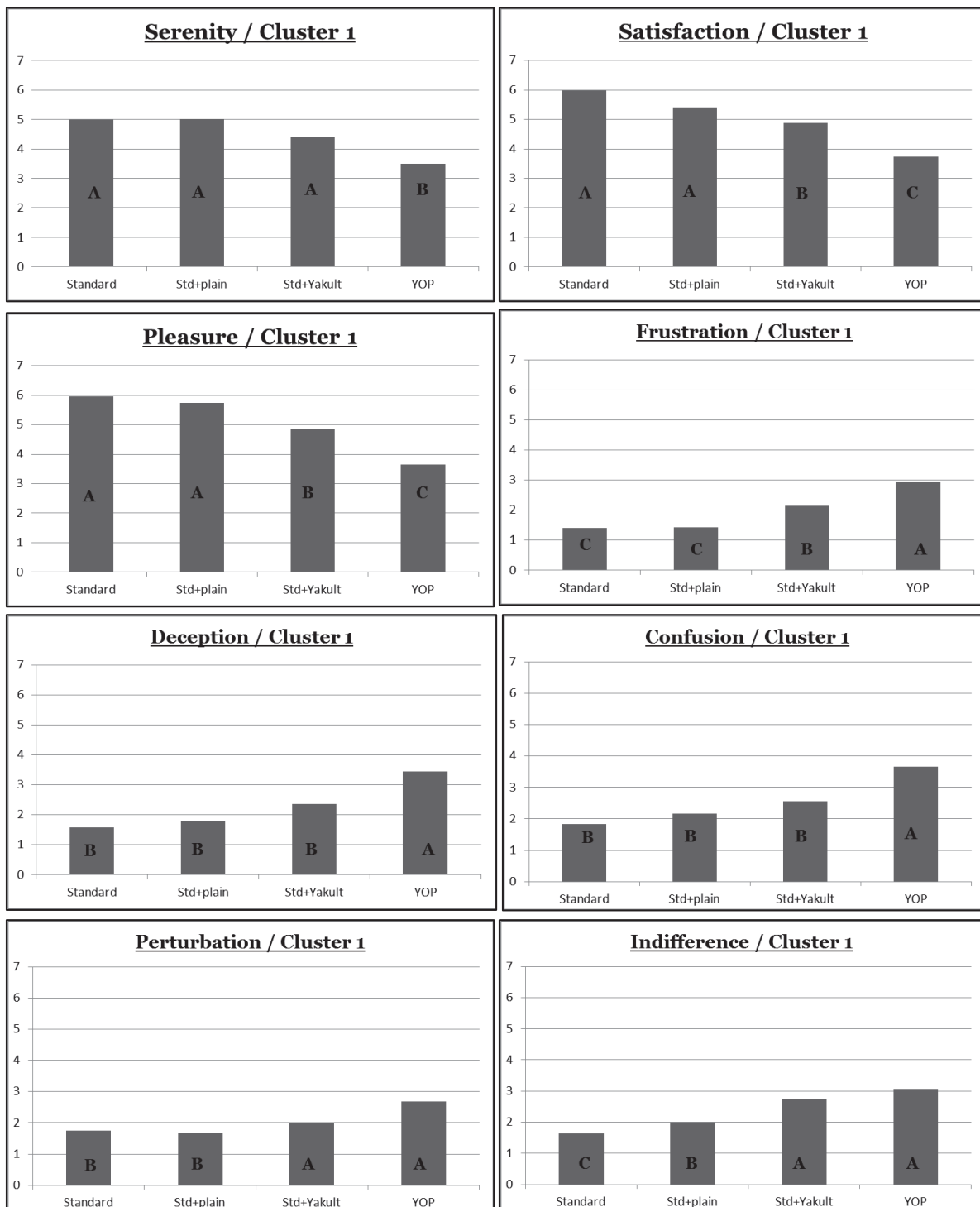


Figure 33: Means of assessment of affective items for each product for cluster 1. Letters in bold show significant differences among products at $\alpha = 10\%$

For positive items (serenity, satisfaction, pleasure), the ranking of products is the same as fitting to expectations. For negative items, the ranking of products is reversed. Regarding serenity assessment, two significant different groups of products are formed separating YOP from the rest of the group. Regarding satisfaction and pleasure, three significant, distinct groups are made separating YOP from the mix with Yakult, from the standard and the mix with

plain. Thus, among the three positive items, satisfaction and pleasure are more discriminative than serenity when it comes to the number of significant different groups.

Looking at the results obtained on the four negative items, they present three different cases. Regarding frustration, three significant, distinct groups are made separating YOP (the higher score) from the mix with Yakult, from the standard and the mix with plain (lower score). Regarding deception and confusion, there are only significant differences between YOP with the highest score (YOP) and the rest of the group having the lowest score. Regarding perturbation, YOP and the mix with Yakult have a significantly higher quotation than the rest of the product range.

Looking at the last item, it differentiates significantly three groups of product: YOP and the mix with Yakult having the highest score and being not differentiated.

Thus, for cluster 1, all affective states allow discriminating samples, but not at the same level. Some of the items discriminate only a high disconfirmation as serenity, deception and confusion. Some others allow discriminating closer products with a lighter discrimination as satisfaction, pleasure, frustration, perturbation and indifference.

Detailed analysis for clusters 2 and 3 are provided in appendix 8.

Therefore, we can validate H2 as results highlight a difference of affective judgment among the three clusters. Indeed, depending on the degree of disconfirmation of expectations affective states discriminating the products are not the same.

A cross-analysis between clusters 1 and 3 shows some consensual results on affective items:

- **Serenity only allows discrimination for the more disconfirmant product for a high degree of disconfirmation**
- **Satisfaction and pleasure allow discrimination of the close disconfirmant products, for a high and low degree of disconfirmation**
- **Deception allows to discriminate only the most disconfirmant products for a high and low degree of disconfirmation**
- **Perturbation allows discriminating disconfirmant products.**

The influence of the nature of the disconfirmation on the affective judgment (H3)

Results will be organized per cluster by analyzing sensations, benefits and context of consumption that can explain the disconfirmation.

Analysis of sensory characteristics

The first analysis for cluster 1 can be shown in Figure 34 explaining sensory perception inducing the disconfirmation.

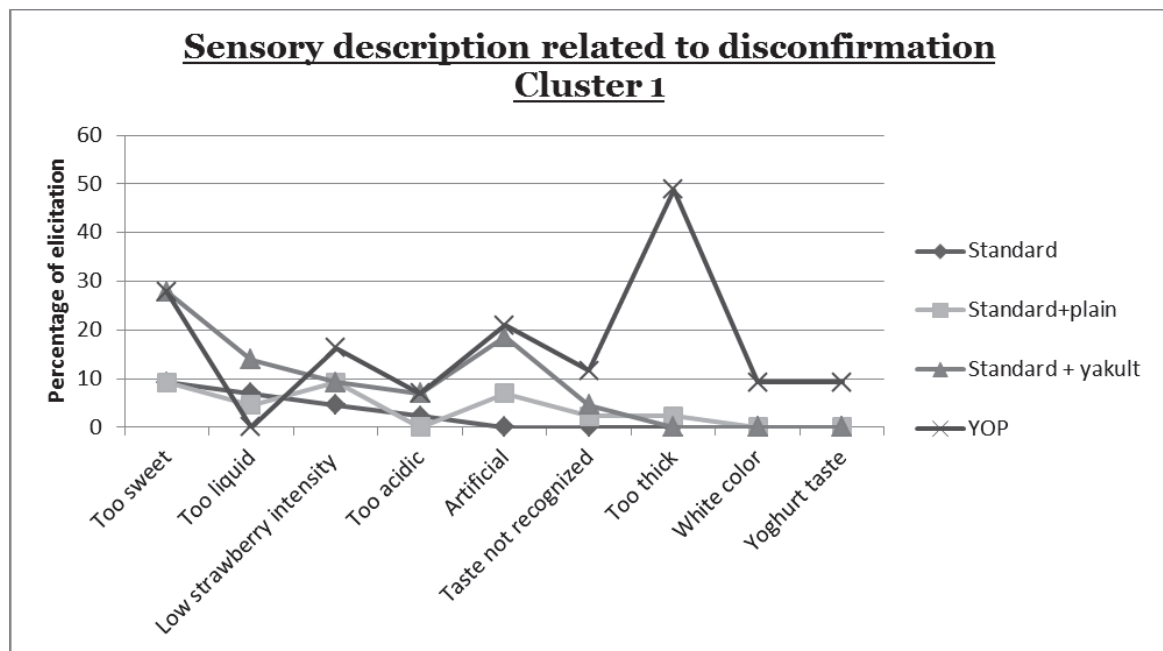


Figure 34: Percentage of elicitations of the reasons why the product does not fit with expectations. The percentage of descriptors elicited by more than 5% of the subjects is retained.

The description elicited by consumers relates to the visual characteristic (white color), to the flavor (sweetness, acidity, strawberry intensity and yoghurt intensity), to the texture (thickness). The highest percentage of elicitation relates to “too thick” for YOP product for 48% of the subjects. “Too sweet” is evocated by 30% of the subjects for YOP and the mix with Yakult. Therefore, sensory disconfirmation relates to the thickness for YOP, as hypothesized, and with too much sweetness. For the mix with Yakult, sensory disconfirmation relates partly to too much sweetness.

Detailed analysis for clusters 2 and 3 are provided in appendix 8.

To sum-up, for each cluster, sensory perceptions inducing a sensory disconfirmation of expectations are not the same:

- **For cluster 1, YOP does not fit with their expectations due to its thickness.**
- **For cluster 2, there is no specific highest elicitation as there is no case of disconfirmation.**

- For cluster 3, the mix with Yakult does not fit with their expectations because it is too sweet, liquid and artificial.

Analysis of benefits

The first analysis of data provided by the subjects of cluster 1 show differences among products for all the benefits illustrated by the boards (Figure 35).

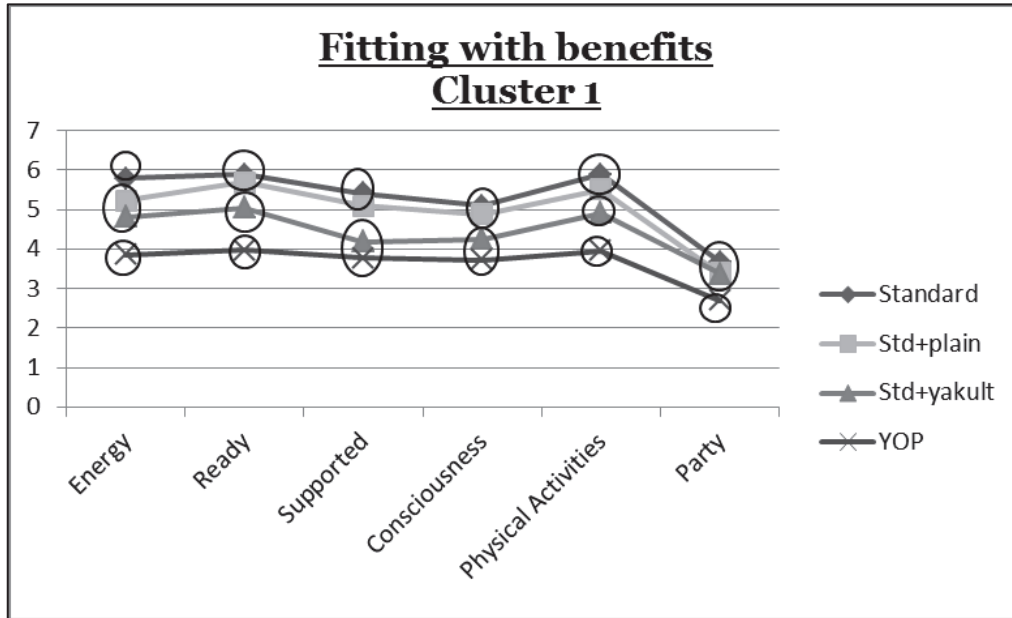


Figure 35: Means of assessment of fitting with benefits for each product for cluster 1. Significant differences at 10% are illustrated by circles

For cluster 1, YOP has the lowest quotations for all the boards; it is significantly different from the mix with plain and the standard. The standard has the highest assessments for best fit with all the boards; it is significantly different from the mix with Yakult and the YOP. Therefore this results show that the standard fits the best with all the benefits associated to Actimel in the primed situation of consumption, namely “Energized”, “Ready for my day”, “Supported and protected” and “Conscious of myself”. YOP is the product that fits the least well with all these benefits. This aligns with the results provided by the fitting with expectations, the more the product disconfirms the expectations, the less it fits with the benefits.

Moreover, looking at the board “Party” which does not fit at all with the product Actimel, results show that this boards has the lowest number of quotations among all the boards for every product. This shows that checking the priming has been well done on Actimel. However, for “Physical activities”, the assessment of this board is almost the same as the four other boards fitting with the situation of consumption. This board was designed to fit with Actimel but not with the situation of consumption, therefore our hypothesis is not conclusive.

Detailed analysis for clusters 2 and 3 are provided in appendix 8.

To sum-up, except for cluster 2, the results highlight significant differences among products on all the boards fitting with the primed situation. However, cluster 1 differentiates more the products than cluster 3.

Contexts of consumption

For cluster 1, analysis shows significantly higher frequencies of elicitation of the two contexts for all the products (Table 14).

Table 14: Frequencies of check for each product and each context for cluster 1.

Coloration: significant higher frequencies per product between contexts.

Bold letter: significant differences per context between products.

Cluster 1	Usage just after getting up	Usage for breakfast	Usage on the go before work	Usage during the morning	Usage at lunch	Usage after sports	Usage in the afternoon	Usage during dinner	Usage after dinner	Usage other
Standard	23	42	24	29	3	17	10	3	4	4
Standard + plain	23	39	25	26	4	19	12	1	2	3
Standard + Yakult	18	35	21	20	7	12	8	1	5	2
Yop	13	24	16	15	8	6	12	1	5	1

“Usage for breakfast” has the highest frequency for every product; therefore, the context breakfast is significantly more associated with all the products. These results provide evidence that the contextualization made at the beginning of the test has been a success. However, there is no incongruent context associated to products that are not fitting with expectations; therefore there is no clear evidence of a relation between the sensory disconfirmation of expectations and a non-fitting with the context

Regarding the comparison among products, two contexts show significant differences of frequencies of association: “Usage for breakfast” and “during the morning”. The standard is significantly more associated to the « Usage for breakfast » and « during the morning » than YOP. In other words, these results are aligned with the ranking among « fitting to expectations». The product fitting the least with expectations has a significantly lower association with the context enhanced at the beginning of the test.

Detailed analysis for clusters 2 and 3 are provided in appendix 8.

To sum-up, there are no clear differences of results on contexts between clusters.

Summary of the relation between the nature and degree of sensory disconfirmation of expectations and affective judgments

In order to better define the relation between affective judgments and sensory disconfirmation of expectations, a synthesis is provided (Table 15).

Table 15: Summary of the results for each cluster

Cluster	Degree	Nature	Affective judgments
1	Discrimination of the whole set	Sensations (thickness : YOP & sweetness : YOP &Yak)	Surprise (YOP)
			Serenity (YOP)
	High degree (YOP)	Benefits (YOP & Yak)	Satisfaction & Pleasure (YOP&Yak)
	Low degree (Std+Y)		Frustration (YOP&Yak)
			Perturbation (YOP+Yak)
			Deception & Confusion (YOP)
			Indifference (set)
2	No disconfirmation		Confusion (YOP+Yak)
3	Discrimination of one sample	Sensations (sweetness / Liquid/ Artificial) : Yak)	Serenity & Satisfaction &Pleasure (Yak)
	High degree (Std+Y)	Benefits (Yak)	Frustration & Confusion (Yak vs YOP)
			Deception (Yak)

Regarding results H3 is validated. Indeed product properties related to sensory disconfirmations of expectations are different among clusters and the differences among products on the fit to benefits are different among clusters.

The third conclusion on the relation between the nature of sensory disconfirmation of expectations and affective feelings is:

- **Differences of perceived sensory disconfirmation of expectations can be explained by the nature of the criteria that do not fit with expectations**
- **All clusters show elicitation on sensory characteristics concluding that a sensory disconfirmation of expectations is perceived by all the consumers**
- **Clusters 1 and 3 have perceived a lower fit with benefits for the most disconfirmant product allowing us to conclude a link between concept and sensations**
- **No clear evidence has been provided on the relations between specific affective judgments and the nature of criteria providing the sensory**

disconfirmation of expectations. All items allow differentiating the product that fits least well with expectations

Characterization of consumers on familiarity

An analysis of the characterization of consumers has been made among the three clusters through each theme of familiarity proposed in the questionnaire and related to different part of the product. A chart summarizes results provided on familiarity between clusters (Figure 36).

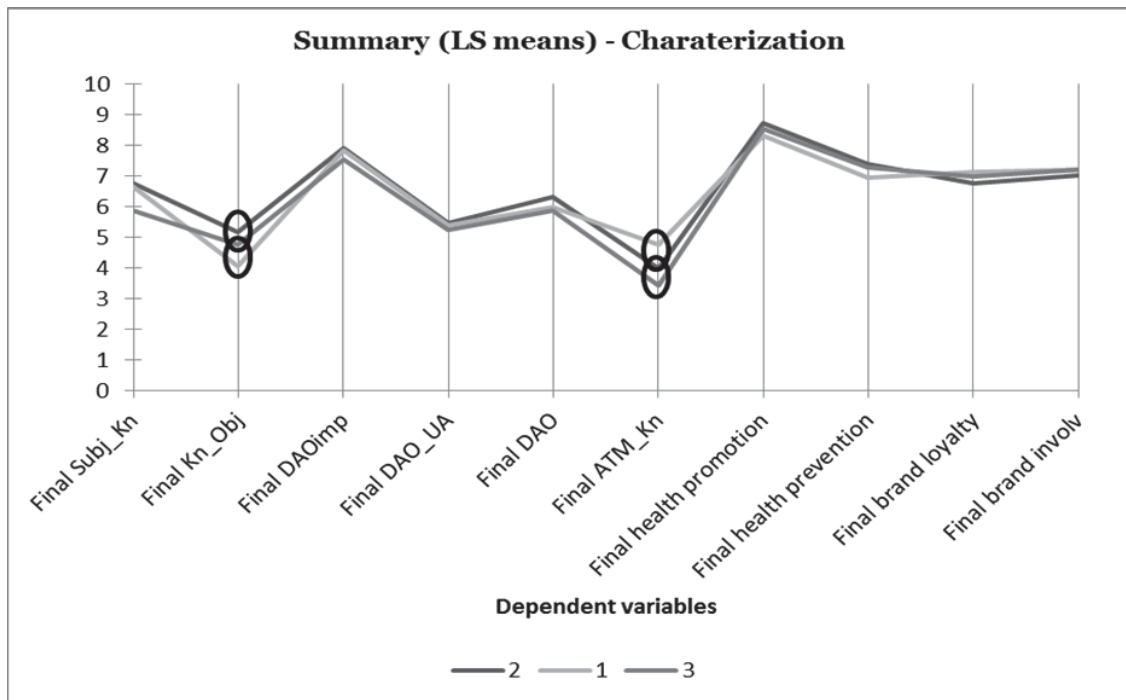


Figure 36: Means of assessment of themes of characterization between clusters. Significant differences at 10% are illustrated by circles

A first glance at the chart it seems there are no significant differences among the clusters. Among the ten variables of familiarity, only two are discriminating the clusters of consumers. “Objective knowledge about probiotics” and “Knowledge about Actimel” are the two variables showing significant differences among the clusters. “Objective knowledge” grouped together questions relating to expertise on probiotics. This is an objective assessment of the level of expertise of the subjects on probiotics category.

Looking at the differences among the clusters for these two variables, cluster 2 has a significantly higher number of quotations on objective knowledge on probiotics than cluster 1. Cluster 1 shows a significantly higher assessment on “Knowledge about Actimel” than cluster 3. This result is correlated to the ranking of product made on the fit with expectations as the standard for this cluster fits the best with expectations and YOP the less.

To sum up, H4 is validated as two items allow discriminating clusters of consumers.

2.4. Main conclusions

The main results provided by the study are as follows:

- **A difference of perception of sensory disconfirmation induces a difference in affective judgments (H1).**
- **The degree of perceived sensory disconfirmation induces differences of affective judgments (H2).**
- **The nature of sensory disconfirmation of expectations influences affective judgments (H3). However no clear evidence has been revealed of the relation between the nature of sensory disconfirmation of expectations and affective judgments.**
- **The perception of the discrepancy between expectations and the actual product is different among the subjects, even amongst those recruited specifically because of the situation of consumption and their heavy usage of the actual product. One factor correlates to this variability is familiarity (H4).**

2.5. Methodological limits

One purpose of the study is to validate the hypothesis made through the qualitative study on affective judgments. Instead of a two-step methodology asking the consumers to assess the properties and affective states related to the product twice both before and after consumption (Cardello and Sawyer, 1992; Thomson and Crocker, 2015), the objective is to propose a list of affective judgments after consumption, ensuring an understanding of the degree and origin of sensory disconfirmation of expectations. Indeed, affective states are more spontaneous than a “fitting to expectations” assessment. The results provided by the study allow a conclusion to be drawn on the relation between the degree of the discrepancy and affective judgments induced, but not on the nature of the discrepancy. These results are aligned with those provided by Ludden et al (Ludden et al., 2012b) correlating the degree of discrepancy with emotions in an object design process. Therefore, the results are similar in food design. The role of the relation between sensory perceptions and cognitive associations inducing a sensory disconfirmation of expectations and thus an affective judgment is not proved in this study. One methodological issue may induce these results: the next set of proposals should be better designed in order to have a higher fit with expectations. Results

should be more discriminant in every aspect of the sensory disconfirmation of expectations: sensory characteristics, benefits and contexts of consumption.

Surprise is only felt by the consumers in cluster 1 and the results from this group are aligned with the hypothesis built on the products. Regarding results provided by cluster 2, differences among the products are close and all the quotations are high, meaning that even if this group of consumers differentiates the product on the level of fit, all the products are good proposals for them responding to their expectations. This is aligned with the fact that there are no differences perceived in sensory characteristics, benefits and contexts of consumption for this cluster. Therefore, surprise should be a more discriminative item than the level of fit to expectations. Indeed, as emphasized by Mellers et al (Mellers et al., 2013), surprise should be induced each time the subject felt a cognitive dissonance, namely a discrepancy between what s/he expected and what s/he actually perceived. The correlation between surprise and sensory incongruency was also proved whatever the degree of disconfirmation (Ludden et al., 2012b) Therefore, for the two last clusters, the discrepancy between expectations and perception was not so successful. Recommendations in consumers test design to screen samples among their fit to expectations should add the level of surprise as a first item. A further recommendation should be clustering subjects on surprise to check the correlation with the fit to expectations and the overall liking.

The sentences at the bottom of the boards may have induced a bias in the assessment because they are close to the words used for the priming; therefore a product that was fitting well with expectations was naturally associated with all the boards presenting the same words. An improvement of the methodology would be to remove the sentences and only keep the images. Regarding the lack of differences in the context, these results could be due to the priming effect, as the contextualization was made for “breakfast”, all the participants have spontaneously ticked the congruent context. One proposal to avoid the bias could be to have an open question related to context as was done for sensory characteristics. Indeed the results show that providing an open question for sensory characteristics was successful as the participants focused their attention on the sensory properties that were not congruent. The results are aligned with the hypothesis made about the product. If we had provided questions on a scale for a defined list of sensory properties, the risk would have been to bias the focus of the subjects from one product to the next, and bias, therefore, the spontaneity of the answer. Therefore in the same way by providing an open question on context rather than an exhaustive list, may induce participants to choose the most appropriate context for each product and therefore highlights the differences among products.

The hypothesis built by the qualitative pre-study on the benefits relating to the new positioning of the brand Actimel, “Feel strong and prepared for the day” and the link with sensory characteristics, needs to be more strongly validated through a quantitative step. Another study with closer proposals to the sensory guidelines could induce different results. This point can also be discussed as a question on the role of qualitative methodologies in the development of product. Hypotheses made through these methodologies on lower number of people, even with a precise target specific on several criteria related to a define situation of consumption, need to be validated by a quantitative step. Indeed, based on the qualitative pre-study, the sensory guidelines and benefits provided by the consumers were consensual. However, with the same target of people, the results of the quantitative study show that there is a lack of consensus between consumers.

The results show that even for a target group (recruited based on criteria of high frequency of consumption) the specific motivation to consume the product in a given context, perception of sensory disconfirmation of expectations are not consensual. Only cluster 1 show results aligned with the hypothesis made on samples. Therefore, the number of recruits should have been greater and with less selection criteria. Clusterisation provided through the analysis thus allows us to characterize the target that best show the opportunity for the business, or find consensus between clusters in order to address more consumers through a sensory expert characterization of the best proposals for each cluster.

Familiarity has been proved to be a factor influencing the categorization process (Faye et al., 2004; Medin et al., 1997). Results have shown that knowledge differentiate two clusters. However the differences are not so great inducing two points of discussion. Firstly, some factors may have been forgotten; secondly, clusterisation is made on perception and not on familiarity. The next step should be then to cluster consumers on familiarity in order to assess if the differences of perceived sensory disconfirmation of expectations are induced. This could also be related to the product range, and may be confirmed through a further study with closer products. Results are anyway aligned with the correlation between the level of expertise and the perception.

Due to practical constrain, the panel of subjects was limited. Further investigation is needed with at least 200 subjects (as made for study 2B) ensuring having a sufficient number of subject in each final cluster. Indeed, 40 subjects at least are needed in each cluster to ensure a good statistical criterion.

To sum-up, the following statements are made:

- **Next study should be made on proposals more different on the fit to expectations, with a proposal designed to be closer to consumers expectations.**
- **Surprise should be integrated in consumers tests as a criterion to check if the product is dissonant with consumers expectations.**
- **Sentences on the board of pictures should be removed.**
- **Targets of consumers should be designed based on perception and familiarity.**
- **Clustering subjects on familiarity should be a next step of investigation to understand the relation with the properties inducing a sensory disconfirmation of expectations.**
- **A higher number of subjects is needed to cluster the panel of subjects on their perception.**

4. Discussion

The sensory disconfirmation of expectations is not only a matter of the sensations perceived in the recipe, but also of the translation between the benefits and context, as the concepts into sensory characteristics of the recipe relate to an ad-hoc category.

The design of the test for study 3B is organized in order to activate firstly the knowledge relating to the situation of consumption, and then knowledge relating to Actimel. Looking at the results of the three clusters, it shows that the way of categorization was different. Indeed, cluster 1 has clearly differentiated the standard from the YOP on the fit to expectations and the surprise, meaning that the categorization primed should have related to Actimel in this specific situation of consumption. For cluster 2, the low discrimination of the samples and the lack of discrimination on the level of surprise, could be a matter of categorization. Indeed, these consumers have a defined category in mind relating to food for the breakfast (to feel strong and prepared for the day) but both the proposals, either Actimel or YOP, could fit to this. Therefore, they have no clear category, i.e. Actimel, in mind. These results can be discussed as evidence of the influence of the level of categorization on perceived sensory disconfirmation of expectations. This study does not result in a conclusion on the categorization explaining these results. Adding an assessment of the fit to the brand Actimel after the fit to expectations would have helped. Indeed, if the consumers of cluster 2 had given a lower quotation on YOP than on

the standard, then it would have meant that they could differentiate between an Actimel and a YOP, and therefore had the clear category of Actimel in mind. On the contrary, as there was no difference among this quotation, this cluster didn't have a specific category (i.e. Actimel) in mind. Therefore, a questionnaire which aims at screening the products among the fit to expectations should also contain a question on the fit to the brand.

The relation between concept and sensory pattern in a subject's memory depends on the individual as previously shown on study 2B. The results are aligned with these conclusions through the clusterisation on perception of sensory disconfirmation of expectations. Each subject has a different focus on sensory characteristics and therefore associates with different concept in mind. It is why, by priming a situation of consumption, it induces different perceptions and thus different sensory disconfirmation of expectations. As explained by Barsalou, perception relies on the sensory pattern of information taken in by the subject through selective attention (Barsalou, 1999). This process of attention is different among subjects and depends also on the strategy used by the subjects to reduce cognitive dissonance. Studies focusing on the impact of the disconfirmation of expectations of hedonic judgment have mainly concluded an assimilation-contrast strategy (Lange et al., 1998; Schifferstein et al., 1999; Siret and Issanchou, 2000). The results provided do not allow for a conclusion on the strategy as we don't have the discrepancy between liking before and after consumption. However, regarding cluster 3 of the study 3C, results show that the mix with Yakult is rejected by subjects as not fitting with their expectations. We may hypothesize that subjects have used a strategy of contrast for this product assessment. In other words, by relating this hypothesis to categorization, this product has been rejected as a member of "ad-hoc category" primed with the contextualization. Therefore, depending on the attentional process and the size of the category, the strategy (Faye et al., 2004; Medin et al., 1997) used by the subjects should change with perception and have an impact on affective judgment. Another study would be needed to relate categorization with strategy to reduce cognitive dissonance.

If the criteria used to define the level of categorization change among subjects, then a key step is to understand, before the screening test, how consumers organize their knowledge of products for a given situation of consumption. Sorting tasks allows revealing structures of categories in mind related to a specific context. Therefore, one recommendation could be to ask consumers to sort products according to the situation of consumption which could induce a direct access to categories and their association with sensory characteristics. This is a way to get access to sub-categories for a specific situation of consumption.

The results have shown that sensory disconfirmation of expectations can address sensory characteristics of the product but also the benefits and context of consumption. These results

are aligned with previous conclusions drawn from studies 3A and 3B on the relation between concept and sensory characteristics depending on the category which the product is recognized as a member. If results show sensory characteristics elicited as inducing the sensory disconfirmation of expectations are different among products, the benefits assessment is quite linear. Indeed, a product that does not fit expectations is going to be ranked lower on the assessment of all the benefits. The nature of sensory disconfirmation of expectations addresses, therefore, almost all the axis of the product-experience in this study: the recipe through sensory assessment, the benefits and contexts fitting with the brand. The packaging part is missing. As many studies have already shown, packaging also induces sensory and cognitive expectations (Ares and Deliza, 2010; Piqueras-Fiszman and Spence, 2012; Schifferstein et al., 2013). Indeed, each of the parts of the product-experience needs to be congruent in order to avoid consumers feeling a discrepancy. Therefore, adding a packaging part with a two-step methodology: firstly screening packaging; and secondly recipes in the best packaging, could be the best way to define the most adequate product experience.

Mains conclusions on the chapter are:

- **A sensory disconfirmation of expectations is a discrepancy of ad-hoc categorization during the perceptive process induced by a criteria related to either sensory or cognitive associations**
- **A sensory disconfirmation of expectations induces a different nature of affective judgments depending on the degree of disconfirmation and the nature of criteria inducing the discrepancy**
- **Perception of sensory disconfirmation of expectations is variable among individuals and induces various affective judgments because of different cognitive and sensory associations.**

Chapter 7: Conclusions

This PhD research aims at better understanding relationships between expectations, memory, perception processes and affective judgments. More precisely, we aimed at

demonstrating that these relationships are formed by a two-way association between cognitive associations on one side and sensory perceptions on the other side. Three different pieces of fieldwork were conducted based on categorization tasks and affective judgments of familiar and non-familiar product ranges.

The first part (chapter 4) was dedicated to studying **the relationship between memory and expectations**. Two studies were conducted (1A and 1B) on a familiar product range: strawberry fresh dairy products with French consumers. The objective of the research was to demonstrate that expectations are defined by labile ad-hoc categories and that **cognitive associations with these categories induce sensory expectations**.

- Study 1A concludes that cognitive associations with packaging information induce sensory expectations. The study was a free sorting task followed by participants giving a description of nine packagings of strawberry yoghurts without tasting them. The results showed that the categories are described by contexts of consumption, functional benefits, AND sensory characteristics.
- Study 1B concludes that the categorization of a product is dependent of the context, and is variable among subjects. It compared on the one hand a free sorting task carried out under two different conditions with the same range of products: a free sorting task on packaging without tasting and a free sorting task with a blind tasting. On the other hand, the individual variability of free sorting on the blind tasting was investigated. The results showed first two different configurations of products between conditions. They also showed different configurations between the clusters of subjects.

This first part allows us to conclude that contextual information, hereby packaging information with different cognitive associations induce sensory expectations through the retrieval of “ad-hoc” categories which depend on the contexts and the subjects.

The second part (chapter 5) was dedicated to the investigation of the **relationship between the expectations based on “ad-hoc” categories and perceptions**. Two studies were conducted (2A and 2B) with Polish consumers and applied to a non-familiar range of products: cold teas. The objective of the research was to understand if **contextual information, hereby sensory diversity and brand, influence the sensory perceptions elicited by subjects and association with different cognitive expectations depending on individuals**.

- Study 2A concludes that a sensory diversity of presentation induces a variability of sensory perceptions and a diversity of cognitive expectations. The study compared two

contexts of presentation inducing two different sensory perceptions of the same product range: monadic (product presented alone) and comparative (the whole set of products presented together). In both conditions participants were asked to undertake a descriptive exercise, followed by a task of association with one situation of consumption. Results showed that for most of the products, the nature of cognitive expectations is different depending on the sensory perceptions elicited by the subjects.

- Study 2B concludes that associations between sensory perceptions and cognitive expectations are different among subjects and are correlated to familiarity of consumers of their product experience. The methodology was based on a free sorting task with a description exercise and an association to a situation of consumption. Results showed four clusters of subjects as having different associations between sensory perceptions and the situation of consumption for the set of products. These clusters were also diverse in terms of familiarity.

This second part allows us to conclude that contextual information, hereby sensory diversity and brand induces different relationships between sensory perceptions and cognitive expectations depending on the subjects. This is correlated to the familiarity.

The third part (Chapter 6) studied the interaction between **expectations and perception adequacy and affective judgments through ad-hoc categories retrieved before and after consumption.** Three studies were conducted with German and French consumers (3A, 3B) and applied to familiar fresh dairy products and drinks. **The objective of the research was to study the influence of sensory disconfirmation of expectations on affective judgments.**

- Study 3A concludes that priming a concept associated to a different category than the one associated with the tasted product, induces a sensory disconfirmation of expectations. It aimed at studying the influence of a discrepancy between categories activated before and after consumption on the assessment of the sensory characteristics and hedonic judgment of a product. The methodology was applied to a particular fermented yoghurt drink: Actimel. Results showed that texture and hedonic assessments were different before and after consumption.
- Study 3B concludes that a difference of perceived sensory disconfirmation of expectations induces a different nature of affective judgments. It studied the effect of sensory disconfirmation of expectations on affective judgment applied to a set of fermented drinkable yoghurts. The methodology is based on a two-fold assessment of

the products (affective items first, then sensory and conceptual properties) in sequential monadic. Results showed three different clusters of consumers assessing differently the product range among the fit to expectations and the fit to cognitive and sensory associations leading to different affective judgments.

This third part shows that a sensory disconfirmation of expectations: relates to a discrepancy of cognitive associations and sensory perceptions related to different categories activated before and after consumption; is diverse among subjects depending on the cognitive and sensory associations; and induces different affective reactions depending on its nature and degree

The main conclusions of the research aim at providing a theoretical model of perception that relates categorization to expectations to affective judgment (Figure 37).

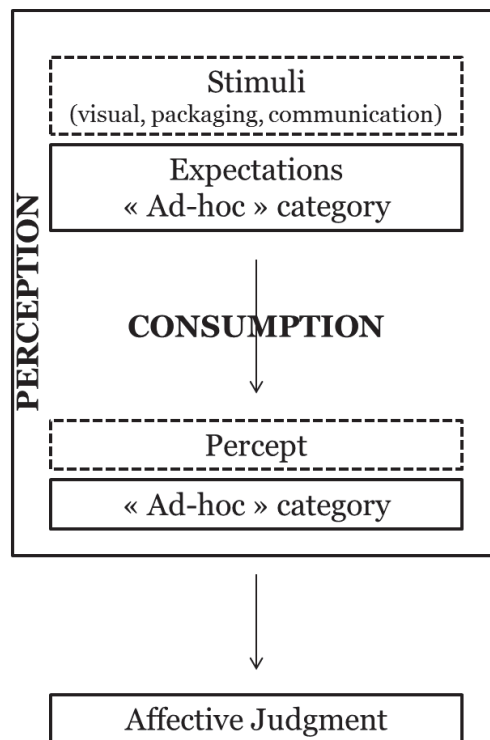


Figure 37 : Final theoretical model of the research

- Expectations are based on “ad-hoc” categories primed at the first step of perception. Expectations can be defined therefore as a categorization step at the beginning of perception. From external cues taken into account by the subjects, strong relations are made with expected benefits and with expected sensations.
- Expectations are diverse between individuals because of a diversity of cognitive and sensory associations. This diversity is framed by a diversity of categorization between subjects related to their familiarity and the nature of the sensory information taken into

account by the subjects. Sensory disconfirmation of expectations is induced by a discrepancy between categories retrieved before and after consumption. All the properties defining the category (contexts of consumption, benefits, and sensory characteristics) can then induce a sensory disconfirmation of expectations. Depending on the number and the nature of the criteria inducing the discrepancy between categories, i.e. the degree of disconfirmation, the induced affective judgments are different and could be correlated to the familiarity of consumers with the product.

Chapter 8: General discussion

The general discussion is organized in two sections, the first one is dedicated to the methodological questions and the second to theoretical ones.

Beyond providing insights as to the relationship between expectations and perceptions, this PhD aims at integrating consumers expectations as a key driver in food product design. Thus, by better understanding the cognitive processes supporting the consumers' perceptions and their final judgments, we aim at improving current methodologies behind consumer tests. The following methodologies were implemented in other DANONE business projects with our support:

- Elicit expectations of consumers through a qualitative study (applied on pre-study Chapter 5). Starting from a broad concept, this study reached different types of knowledge: benefits, contexts of consumption and sensory characteristic based on subjects' memory. It includes a last tasting part to readjust sensations with tangible stimuli.
- Translate consumers' expectations into sensory characteristics (applied on study 2B). This is a quantitative methodology based on a free sorting task with description and an association to cognitive expectations. This methodology allows us to gather the association made by subjects between sensory perceptions and cognitive expectations. In parallel, sensory expert panels described the products. Cross-analysis allows us to give recommendations on sensory guidelines to the R&D team and communication guidelines to the Marketing team.
- Characterize consumers on familiarity (applied on studies 2B and 3B). The questionnaire allows us to describe consumers based on different aspects of familiarity: knowledge, usage and attitudes, implication with different components of the product experience (recipe, brand, and category) and not only on social criteria. These criteria help marketing teams better recruit the target of consumers fitting with the concept.
- Clustering subjects on perception (applied on study 2B). This allows for the definition of consumers' targets having the same association between sensory perceptions and cognitive expectations. Results obtained through this analysis help the marketing teams by giving a characterization for each target and the cognitive associations. Additionally, the development team gains precise sensory guidelines for each target.
- Clustering subjects according to perceived disconfirmation of expectations for screening test (applied on study 3B). Based on the individual variability of relation between sensory and cognitive expectations, the analysis must be made at an individual level. Therefore, clustering subjects according to the perceived disconfirmation of expectations allows to access for each cluster to the best prototype and associations provided.

- Affective questionnaire (applied on study 3B). It allows for an understanding, through spontaneous reactions, of the degree of sensory disconfirmation of expectations. Beyond liking, these affective judgments provide more information as to the perception of consumers.

Main limit of this work is related to the relationship between contextual information provided on the product and the familiarity of consumers, i.e their previous experiences with the products. Familiarity of consumers was only measured and contextual information were only manipulated through a contextualization step. Thus improvement of the design research should be through tests in context and by recruiting subjects on their familiarity to the product range. One way is by using new products range, i.e prototypes unknown for the subjects designed for the purpose of the research and making a step-by step familiarization in different real situations of consumption. One set of subjects recruited at the beginning of the research work is exposed during the studies to one precise situation of consumption associated to the range of products. For each study a standard panel “non familiar” is recruited as a neutral sample. The design of the research follows the one we used for our research (*Figure 38*)

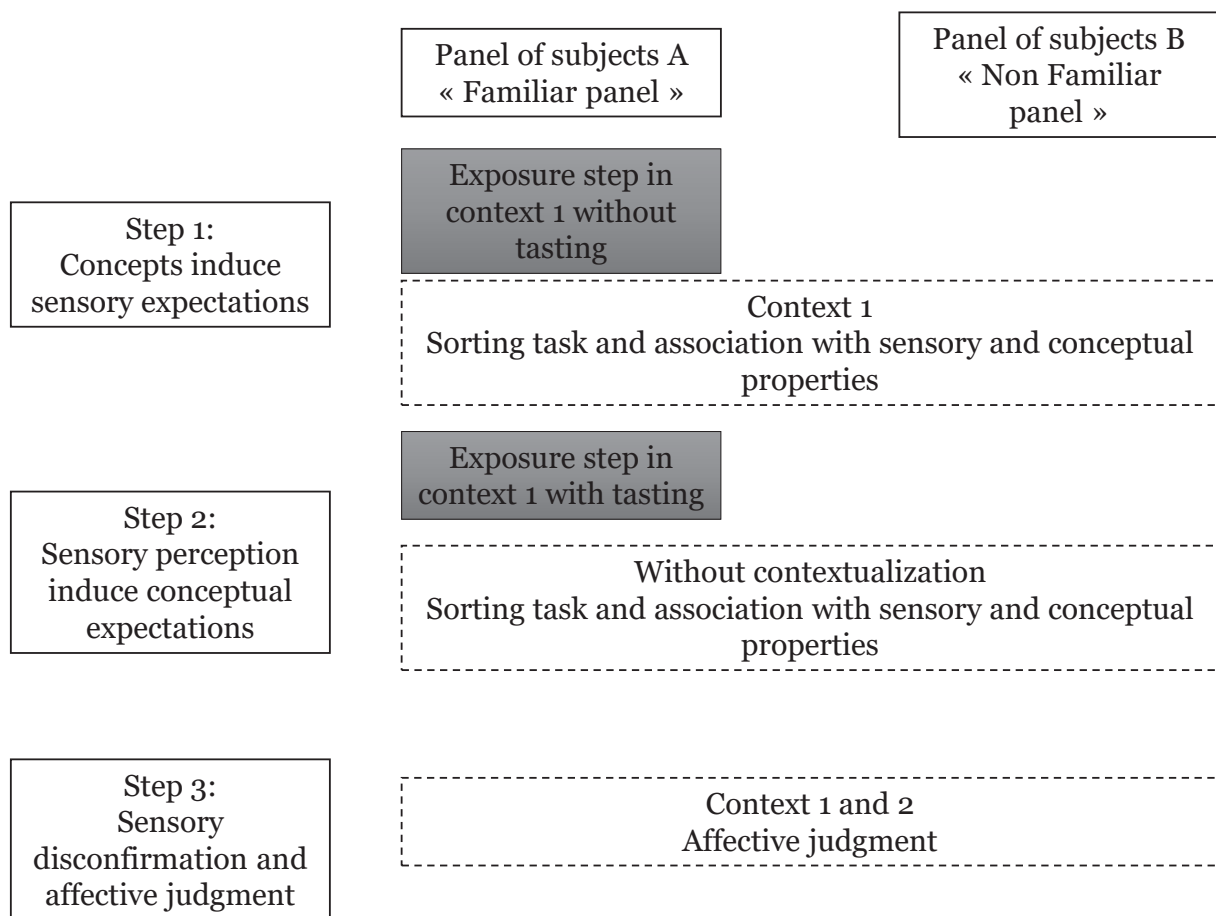


Figure 38: Overview of the research

First part of the research aims at demonstrating that cognitive associations with a situation of consumption influence the sensory expectations. The familiar panel is exposed during a pre-step to one concept during several days in one real situation of consumption. Then the same product range is assessed by the two panels of subjects. Design of the methodology is based on a free sorting task with a description step and an association with boards of cognitive expectations. A comparison of the results obtained by the two panels should demonstrate a variability of ad-hoc categorization and thus a variability of sensory expectations depending on the familiarity of subjects to the association between the context and the concept associated.

Second part of the research aims at demonstrating that a variability of sensory perceptions through ad-hoc categorization should induce a variability of cognitive expectations. An exposure step should be plan during several days. Subjects of panel A have to taste the products in context 1. Then, as for the first part, the product range is assessed by two panels of consumers.

Third part of research aims at demonstrating the influence of sensory disconfirmation of expectations on affective judgment. This influence depends on the cognitive and sensory associations of the ad-hoc category to which the product is identified as a member. The variability of ad-hoc categorization is induced by proposing two different contexts: context 1 adequate to the product range as learned by panel A of subjects and the context 2 which is not fitting with the product range. The comparison is also made between panels to assess the influence of the familiarity on the perception of sensory disconfirmation of expectations and the affective judgments of subjects.

Some methodological points are still being decided upon. These methodological points have not yet been validated through our fieldwork. Thus, more studies must be implemented to apply the methodologies and accumulate data to ensure clear conclusions on the following hypotheses:

- Regarding familiarity, items were selected based on the literature. However, according to the results provided by chapters 5 and 6, we still need to implement the questionnaire on different product ranges and different consumer targets to make strong associations between the variability of categorization between subjects and familiarity.
- Regarding affective judgments, the study 3B does not allow validating the hypothesis made during the qualitative group interviews on the relationship between the origin of sensory disconfirmation of expectations and the nature of affective judgments elicited by the subjects. Further studies are needed to validate these hypotheses on different product ranges and different consumer targets with a higher number of consumers

- Regarding surprise items, we also need further investigations on a product range with closer sensory perceptions to ensure that this item is always correlated to a sensory disconfirmation of expectations.

Based on the results, several perspectives are proposed regarding the improvement of classical consumer tests using liking in laboratory assessment as a standard. We focus our main recommendations around two axes: using the sorting task in the design of a product to understand consumers' expectations and perceptions; and taking into account individual differences in the key performance indicators (KPI).

Going further with sorting task in a food product design

The sorting task has proved to be an efficient methodology to reveal consumers' expectations and perceptions by defining ad-hoc categories and cognitive and sensory associations. Thus, by modifying some of the information given to the consumers during the test, more recommendations should be given as to the food product design and we should increase applications of the free sorting task. Results provided by a free sorting task can help designing food products at different stages of the process and give different information about the categorization process and the criteria taken into account by the subject depending on the various stimuli proposed. Several objectives are hereby proposed in line with the use of the free sorting task. These objectives have been derived from results derived from this research.

Gaining access to full product experience expectations

Our results on “cold tea based on water” products show that this new methodology based on the free-sorting task allows us access to information regarding the three pillars of the full product experience. By clustering subjects according to their categorization and characterizing them on familiarity we gain information regarding the target based on their perception and their usage. Through a cross-analysis between groups of products selected by consumers and the sensory descriptions made by experts we learned information about the recipe, i.e the product itself. Then, by adding a step of association with boards, we provided information relating cognitive associations with the product and the brand, namely the situation of consumption. Based on this free sorting task, through the access to categories retrieved, we were able to understand the criteria of sensory categorization but also the cognitive associations inferred from the category. In a full product experience design, results provide clear information for the development team to formulate the recipe but also to marketing teams for the target and the positioning of the product in terms of its communication. One further step should have been to add the packaging part to design the product entirely from the recipe to the holistic experience. Indeed, sensory cues on packaging design influence the perception of the recipe itself. Thus, by proposing a further step with the same methodology

applied to packaging, we should be able to propose guidelines to design the full product experience.

Gaining access to consumers' perception of the market and competitors

Food consumption is oriented by a motivation to consume the product and a context of consumption associated. A product, composed by a recipe, a pack and a brand, is always positioned in the market to ensure it delivers to the consumer a specific benefit. It also must through advertisement, for example, give information on how, when and where to consume the product. However, sometimes it is clearly difficult for the consumers to understand this positioning and for the marketing teams to understand which products or brands the product is in competition with. It is even more true for products identified as members of a specific category. This positioning made by the subject is depending in the market, on the place of the product on the shelves, or on the experience which has been built around the product if it is a familiar one. However, as categorization is induced by a motivation, how can a brand identify the broader range of products which are their main competitors? For example, a benefit such as “makes me strong” or “energized” in the morning can fit with a various range of products: coffee, orange juice, granola bar, fresh dairy products. This range of products is clearly different in sensory characteristics and the choice of the consumers will be then influenced by its own translation of the benefit. For a brand that would position its products within this situation of consumption, it could be difficult to understand competitors' products and therefore the specificities the product needs to have to be identified as a member of this category and thus to be chosen. Therefore, the sorting task, as we used it in our research, can help marketing and development teams to understand how the market is perceived by the consumer and to understand the close competitors of the brand. One key part will be to choose the products through internet stage by asking to a massive set of people the associations related to the specific situation of consumption or based on ethnographical observations made by a marketing team.

Gaining access to criteria for defining the uniqueness of the product

As food perception and thus identification of the product is based on the categorization process, the sorting task can help to understand key criteria for defining the specificity of the subcategory which a product is a member of. Delivering a superior product experience relates to the congruency of the experience of the product between all of its components. In other words, finding the criteria that define the specificity of the product regarding the brand, packaging and recipe vs other competitors is a way to access a higher purchase rate from the consumer. These criteria of categorization can also be cognitive or sensory associations. However, perception of these criteria should be present in either or each of the components of the product: brand, packaging and recipe. As the brand is already well categorized in

consumers' mind most of time, it is key to assure that specificities related to the category are clearly emphasized in the pack and the recipe. Delivering a superior experience and making the product as unique is also correlated to the renovation of each component of the product. These are also results that can be provided by the sorting task through an association with fit to the situation of consumption, brand, liking assessment and purchase intent. Thus, defining properties that are unique for the product category is defining the properties needed to differentiate the ad-hoc category integrating the brand according to a given situation of consumption.

Gaining access to disconfirmation categories

Results provided by the studies in chapter 6 show that priming a benefit is priming expectations associated to an ad-hoc category. Cognitive dissonance is induced by a different association between categorization before consumption and after consumption. We had used a classical presentation in sequential monadic to screen affective items. However, once affective items are defined and related to nature and degree of sensory disconfirmation, the next step is to propose all the samples at the same time and to use a sorting task under different conditions and provide the categorization among the benefit primed. Thus, by adding a fit to expectations and brand it is possible then to screen the category with the best fit to the expectations and based on the protocol with a sensory description and association to boards of cognitive expectations.

Inter-individual differences taken into account in methodologies

Results of the research show a variability of expectations and perceptions between subjects for different cases. We apply the clusterisation of consumers on a large target allowing us to give more precision for further recruitments. We apply also the clusterisation on a more precise target, i.e. with more factors of screening. In this case we show that even for heavy users with precise motivations of consumption toward the brand, perceptions of sensory disconfirmations of expectations are different between subjects. Thus, this clusterisation aspect of the analysis is a key point to integrate in a food product design to better understand differences between consumers. Indeed, results provided in industries are based on an overall assessment of the panel. The main recommendations are then based on the mean of assessments of subjects recruited according to their age, profession and frequency of consumption, for examples. Our approach is to cluster subjects based on their perception to provide recommendations closer to the real-life experience of consumption. Giving recommendations as to the clusters of subjects does not mean necessarily to design one product for each cluster of consumers but, rather, to design them being aware of the variability

of perception and to give recommendations on consensus between clusters. Two steps are proposed as improvements for future application studies.

Extend criteria of recruitment

The first improvement regards the recruitment aspect. Indeed, integrating factors influencing perception should allow having access to consumers having almost the same perception of the product. From our results, considering ad-hoc categories as framing expectations and perceptions, it is thus of interest to recruit consumers having the same motivation to consume the product in the same context of consumption. By recruiting on the situation of consumption we can partly ensure that consumers have closer expectations and perceptions. The second aspect is regarding familiarity. As we show that some aspects of familiarity are correlated to a diversity of perceptions, recruitment screeners should integrate questions regarding usage, implication to the brand or specific components of the recipe (tea, probiotics), or knowledge. Indeed, before integrating these questions, it is worth noting that a previous step is important to deepen understanding on the factors correlated to the variability of perception among subjects.

Cluster consumers according to perception

The second improvement regards guidelines given for consumer tests. Our findings from the Actimel fieldwork, for example, show that it is clear that even for a target of consumers that are heavy users of the product, having the same motivation to consume the brand; and perception of sensory disconfirmation of expectations is different among subjects. Therefore it shows that the results provided by consumer studies should be analyzed on an individual level. We need to consider that the differences between clusters allow the industry to understand the associations between sensory and conceptual properties made by each cluster of consumers for the same situation of consumption. Only then can the best compromise regarding product screening be found. Thus, this is not a matter of providing one product per cluster of consumers but much more to adapt the communication of the same product to different clusters of consumers by focusing on the associations they made.

Furthermore, the main conclusions of this research are that cognitive and sensory associations, induced through ad-hoc categories, define expectations, perceptions and affective judgments of consumers in a given food context. Several points for discussion have already been highlighted:

- Taking into account ad-hoc categories in studies of consumers' expectations and perceptions induces contextualization not only on environmental factors,

like time, place or social context, but also on the motivation of the consumers to eat a specific food (Chapter 4).

- Associations between cognitive expectations and sensory perceptions are dependent on the familiarity of the consumer with the product. In the case of a new product, providing information as to its similarity with a familiar product, the context of consumption, or the brand helps subjects categorize the product (Chapter 5).
- Expectations defined as ad-hoc categories make the strategies to reduce a sensory disconfirmation of expectations related to the graded nature of the category (Chapter 6)

These associations are variable among individuals and, more precisely, they are correlated with the characterization of familiarity. Different items defining familiarity were explored but they were not integrated as factors explaining differences in categorization (Faye et al., 2013). Thus, future perspectives should be to integrate familiarity according to other top-down processes influencing subjects' perceptions. A perspective concerns the time-related categorization process which depends on the level of familiarity as it evolves over time.

Expectations: a dynamic process over time

Expectations are a dynamic process. In other words, expected properties of the product are constantly reassessed by the subjects depending on previous experiences. For Goering, this reassessment depends on the familiarity of the consumer with the product (Goering, 1985). Results of this PhD allow for the conclusion that expectations are defined from the cognitive and sensory associations depending on the situation of consumption through ad-hoc categories. Thus, studying the dynamic of expectations is studying the dynamic of categorization among time. Dynamic of expectations can be studied on two levels.

The first level is during the assessment of the product. Our research is based on the hypothesis that expectations are constant from the first to the last sip or mouthful of the product consumed by the subject. However, expectations are reassessed during the perceptive process. Indeed, the first sip or mouthful of the product induces an assessment of the difference between expected and perceived properties of the product. This assessment will then affect the perception of the product through the categorization process integrating sensory perceptions as well as affective judgments.

The second level is considering the dynamism of expectations from the first confrontation on the market, based on the packaging information and brand, to expectations

based on a heavy usage of the product. The more the subject is familiar with the product the more he will be able to predict his/her perceived properties (Crandall, 1967). The effect of exposure of the product on expectations is first studied through the assessment of disconfirmation of expectations on appreciation. The confirmation or disconfirmation of expectations during the first exposure changes the confidence of the consumer in the product and even the brand (Deliza and MacFie, 1996). If expectations are confirmed, his/her confidence will increase as its satisfaction and therefore its future hedonic expectations will be higher. The mechanism underlying this effect relates to the definition proposed for expectations, i.e. cognitive and sensory associations through ad-hoc categories. Indeed, any new experience, especially those with a new product, changes the subject's knowledge and therefore the categories structured in the memory. By confronting the subject to a product that could be integrated as a new member of the category, the structure of the category and the associations with this category can change. Indeed, even if ad-hoc categories are created spontaneously for use in specialized contexts, they still have a well-established representation in the memory if they are frequently used (Barsalou, 1983). This representation can thus evolve by adding new exemplar. The reverse action effect is a good exemplar. It is defined as a transfer of the properties of a product extension to the category of the brand (Wänke et al., 1998b). In other words, adding a new exemplar to a well-established category induces the attribution of cognitive and sensory associations with the brand category to the extension and vice versa. Thus, studying expectations over time is studying ad-hoc categorization of the product over time and cognitive and sensory associations inferred by the subject. Familiarity with products acquired over time has an influence on the balance between the integration of external information given on the product and the knowledge stored in the memory. Perspectives in this research should make clear, for each stage of the product usage, the ad-hoc category to which it is associated and how the associations are influenced. A study by Shifferstein et al showed that sensory modalities and emotions induced at different stages of the product experience (purchase, opening, preparation, consumption and repeated purchase) are different (Schifferstein et al., 2013). An extended approach should be to consider the cognitive and sensory associations across these different stages to define how dynamic the expectations of the subject are according to his/her increasing familiarity with the product.

Bibliography

A.

Anderson, R.E. (1973). Consumer Dissatisfaction: The Effect of Disconfirmed Expectancy on Perceived Product Performance. *Journal of Marketing Research* 10, 38–44.

Anzieu, D., and Chabert, C. (2004). *Les méthodes projectives* (Presses universitaires de France).

Ares, G., and Deliza, R. (2010). Studying the influence of package shape and colour on consumer expectations of milk desserts using word association and conjoint analysis. *Food Quality and Preference* 21, 930–937.

Ares, G., and Jaeger, S.R. (2013). Check-all-that-apply questions: Influence of attribute order on sensory product characterization. *Food Quality and Preference* 28, 141–153.

Ares, G., Besio, M., Giménez, A., and Deliza, R. (2010). Relationship between involvement and functional milk desserts intention to purchase. Influence on attitude towards packaging characteristics. *Appetite* 55, 298–304.

Arnould, E.J., Price, L., and Zinkhan, G.M. (2004). *Consumers* (McGraw-Hill/Irwin).

Auvray, M., and Spence, C. (2008). The multisensory perception of flavor. *Consciousness and Cognition* 17, 1016–1031.

B.

Ballester, J., Patris, B., Symoneaux, R., and Valentin, D. (2008). Conceptual vs. perceptual wine spaces: Does expertise matter? *Food Quality and Preference* 19, 267–276.

Barsalou, L.W. (1982). Context-independent and context-dependent information in concepts. *Mem Cognit* 10, 82–93.

Barsalou, L.W. (1983). Ad hoc categories. *Memory & Cognition* 11, 211–227.

Barsalou, L.W. (1999). Perceptual symbol systems. *Behav Brain Sci* 22, 577–609; discussion 610–660.

Barsalou, L.W. (2010). Grounded Cognition: Past, Present, and Future. *Topics in Cognitive Science* 2, 716–724.

Barsalou, L.W. (2008). Grounded Cognition. *Annual Review of Psychology* 59, 617–645.

- Barsalou, L.W., Kyle Simmons, W., Barbey, A.K., and Wilson, C.D. (2003). Grounding conceptual knowledge in modality-specific systems. *Trends in Cognitive Sciences* 7, 84–91.
- Baumgartner, H., Sujan, M., and Bettman, J.R. (1992). Autobiographical Memories, Affect, and Consumer Information Processing. *Journal of Consumer Psychology* 1, 53–82.
- Bech-Larsen, T., and Nielsen, N.A. (1999). A comparison of five elicitation techniques for elicitation of attributes of low involvement products. *Journal of Economic Psychology* 20, 315–341.
- Becker, L., van Rompay, T.J.L., Schifferstein, H.N.J., and Galetzka, M. (2011). Tough package, strong taste: The influence of packaging design on taste impressions and product evaluations. *Food Quality and Preference* 22, 17–23.
- Bertrand, A., and Garnier, P.-H. (2005). *Psychologie cognitive (Studyrama)*.
- Bourgeon, D., Cova, B., Evrard, Y., and Petr, C. (2007). Au-delà du Paradigme de “Disconfirmation” des Attentes: Quand le Lien Remplace le Bien (HAL).
- Boussoco, J. (2015). Représentations alimentaires mises en jeu lors des choix dans la préparation culinaire.
- Boutrolle, I. (2007). *Mesure de l’appréciation des aliments par les consommateurs : état des pratiques et propositions méthodologiques (Paris, AgroParisTech)*.
- Boutrolle, I., and Delarue, J. (2009). Studying meals in the home and in the laboratory A2 - Meiselman, Herbert L. In *Meals in Science and Practice*, (Woodhead Publishing), pp. 128–165.
- Boutrolle, I., Arranz, D., Rogeaux, M., and Delarue, J. (2005). Comparing central location test and home use test results: Application of a new criterion. *Food Quality and Preference* 16, 704–713.
- Boutrolle, I., Delarue, J., Arranz, D., Rogeaux, M., and Köster, E.P. (2007). Central location test vs. home use test: Contrasting results depending on product type. *Food Quality and Preference* 18, 490–499.
- Breivik, E., and Supphellen, M. (2003). Elicitation of product attributes in an evaluation context: A comparison of three elicitation techniques. *Journal of Economic Psychology* 24, 77–98.
- Brosch, T., Pourtois, G., and Sander, D. (2010). The perception and categorisation of emotional stimuli: A review. *Cognition and Emotion* 24, 377–400.

Brunel, O., and Gallen, C. (2012). “ C’est bizarre ! Ca se mange ? ” Les effets de la dissonance cognitive en consommation alimentaire. p. 27.

Bruner, J.S. (1957). On perceptual readiness. *Psychological Review* 64, 123–152.

Buck, D. (2007). 7 - Methods to understand consumer attitudes and motivations in food product development A2 - MacFie, Hal. In *Consumer-Led Food Product Development*, (Woodhead Publishing), pp. 141–157.

C.

Cain, W.S. (1974). Contribution of the Trigeminal Nerve to Perceived Odor Magnitude*. *Annals of the New York Academy of Sciences* 237, 28–34.

Caporale, G., and Monteleone, E. (2004). Influence of information about manufacturing process on beer acceptability. *Food Quality and Preference* 15, 271–278.

Caporale, G., Policastro, S., Carlucci, A., and Monteleone, E. (2006). Consumer expectations for sensory properties in virgin olive oils. *Food Quality and Preference* 17, 116–125.

Cardello, A.V. (1995). Food quality: relativity, context and consumer expectations. *Food Quality and Preference* 6, 163–170.

Cardello, A.V. (2003). Consumer concerns and expectations about novel food processing technologies: effects on product liking. *Appetite* 40, 217–233.

Cardello, A.V. (2007). 10 - Measuring consumer expectations to improve food product development A2 - MacFie, Hal. In *Consumer-Led Food Product Development*, (Woodhead Publishing), pp. 223–261.

Cardello, A.V., and Sawyer, F.M. (1992). Effects of disconfirmed consumer expectations on food acceptability. *Journal of Sensory Studies* 7, 253–277.

Cardello, A.V., Maller, O., Masor, H.B., Dubose, C., and Edelman, B. (1985). Role of Consumer Expectancies in the Acceptance of Novel Foods. *Journal of Food Science* 50, 1707–1714.

Carey, S. (2011). The Origin of Concepts: A Precis. *Behav Brain Sci* 34, 113–162.

Chemero, A. (2011). *Radical Embodied Cognitive Science* (MIT Press).

Cho, E. (2011). Development of a brand image scale and the impact of lovemarks on brand equity. *Graduate Theses and Dissertations*.

Chollet, S., and Valentin, D. (2000). Le degré d'expertise a-t-il une influence sur la perception olfactive ? Quelques éléments de réponse dans le domaine du vin. *L'année psychologique* 100, 11–36.

Christensen, C. (1980). Effects of solution viscosity on perceived saltiness and sweetness. *Perception & Psychophysics* 28, 347.

Clark, H.H., and Marshall, C.R. (1981). Definite Reference and Mutual Knowledge In Aravind K. Joshi, Bonnie L. Webber, and Ivan A. Sag, Editors. In *Elements of Discourse Understanding*, A. Joshi, B.H. Weber, and I.A. Sag, eds. (Cambridge University Press),.

Collins, A.M., and Quillian, M.R. (1969). Retrieval time from semantic memory. *Journal of Verbal Learning and Verbal Behavior* 8, 240–247.

Crandall, J.E. (1967). Familiarity, Preference, and Expectancy Arousal. *Journal of Experimental Psychology* 73, 374–381.

D.

Dany, L., and Abric, J.-C. (2007). Distance à l'objet et représentations du cannabis. *Revue internationale de psychologie sociale Tome 20*, 77–104.

Davidson, J.M., Linforth, R.S.T., Hollowood, T.A., and Taylor, A.J. (1999). Effect of Sucrose on the Perceived Flavor Intensity of Chewing Gum. *J. Agric. Food Chem.* 47, 4336–4340.

Deegan, K.C., Palmujoki, I., Isotalo, J., and Tuorila, H. (2015). Effective communication of novelty: The case of ripened cheese. *Food Quality and Preference* 40, Part A, 68–76.

Delarue, J., and Boutrolle, I. (2010). 8 - The effects of context on liking: implications for hedonic measurements in new product development A2 - Jaeger, Sara R. In *Consumer-Driven Innovation in Food and Personal Care Products*, H. MacFie, ed. (Woodhead Publishing), pp. 175–218.

Deliza, R., and MacFie, H.J.H. (1996). The Generation of Sensory Expectation by External Cues and Its Effect on Sensory Perception and Hedonic Ratings: A Review. *Journal of Sensory Studies* 11, 103–128.

Deliza, R., Macfie, H., and Hedderley, D. (2003). Use of Computer-Generated Images and Conjoint Analysis to Investigate Sensory Expectations. *Journal of Sensory Studies* 18, 465–486.

DelVecchio, D. (2001). Consumer perceptions of private label quality: the role of product category characteristics and consumer use of heuristics. *Journal of Retailing and Consumer Services* 8, 239–249.

Depledt (2009). *Évaluation sensorielle – Manuel méthodologique* (3e éd.) (Lavoisier).

Derbaix, C., and Pham, M.T. (1991). Affective reactions to consumption situations: A pilot investigation. *Journal of Economic Psychology* 12, 325–355.

Desmet, P.M.A., and Hekkert, P. (2007). Framework of Product Experience. *International Journal of Design* 1, 57–66.

Desmet, P.M.A., and Schifferstein, H.N.J. (2008). Sources of positive and negative emotions in food experience. *Appetite* 50, 290–301.

Driver, J., and Spence, C. (2000). Multisensory perception: beyond modularity and convergence.

Dubois, D. (2009). *Le sentir et le dire: Concepts et méthodes en psychologie et linguistique cognitives* (Editions L’Harmattan).

E.

Edwards, J.S.A., Hartwell, H.J., and Brown, L. (2013). The relationship between emotions, food consumption and meal acceptability when eating out of the home. *Food Quality and Preference* 30, 22–32.

El Ghaziri, A., and Qannari, E.M. (2015). Measures of association between two datasets; Application to sensory data. *Food Quality and Preference* 40, Part A, 116–124.

Escoufier, Y. (1973). Le Traitement des Variables Vectorielles. *Biometrics* 29, 751–760.

Estes, Z., Gibbert, M., Guest, D., and Mazursky, D. (2012). A dual-process model of brand extension: Taxonomic feature-based and thematic relation-based similarity independently drive brand extension evaluation. *Journal of Consumer Psychology* 22, 86–101.

F.

Faye, P., Brémaud, D., Durand Daubin, M., Courcoux, P., Giboreau, A., and Nicod, H. (2004). Perceptive free sorting and verbalization tasks with naive subjects: an alternative to descriptive mappings. *Food Quality and Preference* 15, 781–791.

Faye, P., Courcoux, P., Giboreau, A., and Qannari, E.M. (2013). Assessing and taking into account the subjects’ experience and knowledge in consumer studies. Application to the free sorting of wine glasses. *Food Quality and Preference* 28, 317–327.

Fenko, A., Leufkens, J.-M., and van Hoof, J.J. (2015). New product, familiar taste: Effects of slogans on cognitive and affective responses to an unknown food product among food neophobics and neophilics. *Food Quality and Preference* 39, 268–276.

Ferrarini, R., Carbognin, C., Casarotti, E.M., Nicolis, E., Nencini, A., and Meneghini, A.M. (2010). The emotional response to wine consumption. *Food Quality and Preference* 21, 720–725.

Festinger, L. (1962). *A Theory of Cognitive Dissonance* (Stanford University Press).

Firestone, C., and Scholl, B.J. (2015). Cognition does not affect perception: Evaluating the evidence for “top-down” effects. *Behav Brain Sci* 1–77.

G.

Gallen, C. , and Sirieix, L. (2011). Design culinaire et consommateurs: Entre rapprochement et distance perçue (French). *Décisions Marketing (Bruxelles)* 35–48.

Gallen, C., and Brunel, O. (2014). La théorie de la dissonance cognitive : un cadre unificateur pour la recherche en marketing sur les conflits.

Gallen, C., and Pantin-Sohier, G. (2012). Design et marketing des produits alimentaires : quelles sont les perspectives d’innovation ?

Giboreau, A., and Body, L. (2007). *Le marketing sensoriel: de la stratégie à la mise en oeuvre* (Vuibert).

Giboreau, A., Navarro, S., Faye, P., and Dumortier, J. (2001). Sensory evaluation of automotive fabrics: the contribution of categorization tasks and non verbal information to set-up a descriptive method of tactile properties. *Food Quality and Preference* 12, 311–322.

Gibson, J.J. (1979). *The ecological approach to visual perception /* (Boston: Houghton Mifflin).

Glenberg, A.M., Witt, J.K., and Metcalfe, J. (2013). From the Revolution to Embodiment: 25 Years of Cognitive Psychology. *Perspectives on Psychological Science* 8, 573–585.

Goering, P.A. (1985). Effects of Product Trial on Consumer Expectations, Demand, and Prices. *Journal of Consumer Research* 12, 74–82.

Goldstone, R.L., and Barsalou, L.W. (1998). Reuniting perception and conception. *Cognition* 65, 231–262.

Gomez, P. (2009). L'orientation régulatrice de santé : déterminants, mesure et conséquences sur les comportements de santé et le traitement de l'information de santé (Institut d'Économie et de Management de Nantes - IAE).

Grunert, K.G. (2002). Current issues in the understanding of consumer food choice. *Trends in Food Science & Technology* 13, 275–285.

Grunert, K.G., Bech-Larsen, T., and Bredahl, L. (2000). Three issues in consumer quality perception and acceptance of dairy products. *International Dairy Journal* 10, 575–584.

Grunert, K.G., Beckmann, S.C., and Sørensen, E. (2001). Means-end chains and laddering: an inventory of problems and an agenda for research. In *Understanding Consumer Decision-Making: The Means-End Approach to Marketing and Advertising Strategy*, (Lawrence Erlbaum Associates, Incorporated),.

Gutjar, S., Dalenberg, J.R., de Graaf, C., de Wijk, R.A., Palascha, A., Renken, R.J., and Jager, G. (2015). What reported food-evoked emotions may add: A model to predict consumer food choice. *Food Quality and Preference* 45, 140–148.

Gutman, J. (1982). A Means-End Chain Model Based on Consumer Categorization Processes. *Journal of Marketing* 46, 60.

H.

Hampton, J.A. (1979). Polymorphous concepts in semantic memory. *Journal of Verbal Learning & Verbal Behavior* 18, 441–461.

Hanna, J.G. (1980). A Typology of Consumer Needs. *Research in Marketing* 3, 83.

Harmon-Jones, E. (2000). A cognitive dissonance theory perspective on the role of emotion in the maintenance and change of beliefs and attitudes. In *Emotions and Belief: How Feelings Influence Thoughts*, N.H. Frijda, A.S.R. Manstead, and S. Bem, eds. (New York, NY, US: Cambridge University Press), pp. 185–211.

Harmon-Jones, Harmon-Jones, E., and Amodio (2009). Action-Based Model of Dissonance: A Review, Integration, and Expansion of Conceptions of Cognitive Conflict.

Hekkert, P., and Schifferstein, H.N.J. (2008). Introducing product experience. In *Product Experience*, H.N.J. Schifferstein, and P. Hekkert, eds. (San Diego: Elsevier), pp. 1–8.

Houdé, O., Kayser, D., Koenig, O., Proust, D. of R. at F.P.-G. de G.P.L.R.J., Proust, J., and Rastier, F. (2004). *Dictionary of Cognitive Science: Neuroscience, Psychology, Artificial Intelligence, Linguistics, and Philosophy* (Routledge).

Hovland, C.I., Harvey, O.J., and Sherif, M. (1957). Assimilation and contrast effects in reactions to communication and attitude change. *The Journal of Abnormal and Social Psychology* 55, 244–252.

Hubert, L., and Arabie, P. (1985). Comparing partitions. *Journal of Classification* 2, 193–218.

J.

Jaeger, S.R. (2006). Non-sensory factors in sensory science research. *Food Quality and Preference* 17, 132–144.

Joubert, O.R. (2008). Catégorisation rapide des scènes naturelles : L'objet, le contexte, et leurs interactions. phdthesis. Université Paul Sabatier - Toulouse III.

K.

Kahneman, D., and Tversky, A. (1979). Prospect Theory: an analysis of decision under risk. *Econometrica* 47, 263–292.

Karjalainen, T.-M. (2007). It Looks Like a Toyota: Educational Approaches to Designing for Visual Brand Recognition. *International Journal of Design* 1, 67–81.

King, S.C., and Meiselman, H.L. (2010). Development of a method to measure consumer emotions associated with foods. *Food Quality and Preference* 21, 168–177.

Korchia, M. (2001). Connaissances des marques stockées en mémoire par les consommateurs: modèle théorique et test empirique.

Köster, E. (2009). Diversity in the determinants of food choice: A psychological perspective. *Food Quality and Preference* 20, 70–82.

Köster, E.P. (2003). The psychology of food choice: some often encountered fallacies. *Food Quality and Preference* 14, 359–373.

Köster, E.P. (2006). Memory for food and food expectations: A special case? *Food Quality and Preference* 17, 3–5.

Köster, E., Couronne, T., Léon, F., Lévy, C., and Marcelino, A.. (2003). Repeatability in hedonic sensory measurement: a conceptual exploration. *Food Quality and Preference* 14, 165–176.

Kreuzbauer, R., and Malter, A.J. (2005). Embodied cognition and new product design: changing product form to influence brand categorization. *Journal of Product Innovation Management* 165.

Kreuzbauer, R., and Malter, A.J. (2007). Product Design Perception and Brand Categorization. *Advances in Consumer Research* 34, 240–246.

Kruskal, J.B. (1964). Nonmetric multidimensional scaling: A numerical method. *Psychometrika* 29, 115–129.

L.

Labbe, D., Ferrage, A., Rytz, A., Pace, J., and Martin, N. (2015). Pleasantness, emotions and perceptions induced by coffee beverage experience depend on the consumption motivation (hedonic or utilitarian). *Food Quality and Preference* 44, 56–61.

Ladwein, R. (1995). Catégories cognitives et jugement de typicalité en comportement du consommateur. *Recherche et Applications En Marketing* 89.

Lange, C. (2000). Etude de l'effet des caractéristiques sensorielles, des attentes induites par l'information et du prix sur l'acceptabilité et le comportement d'achat du consommateur (Dijon).

Lange, C., Rousseau, F., and Issanchou, S. (1998). Expectation, liking and purchase behaviour under economical constraint. *Food Quality and Preference* 10, 31–39.

Laros, F.J.M., and Steenkamp, J.-B.E.M. (2005). Emotions in consumer behavior: a hierarchical approach. *Journal of Business Research* 58, 1437–1445.

Lawless, H.T. (1989). Exploration of fragrance categories and ambiguous odors using multidimensional scaling and cluster analysis. *Chem. Senses* 14, 349–360.

Lebart, L., Morineau, A., Piron, M. (1997). *Statistique exploratoire multidimensionnelle*.

Lelièvre, M. (2010). De la première gorgée de bière au concept : le même processus pour tous ? Effet de l'expertise sur la catégorisation et la représentation des bières (Dijon).

Lelièvre, M., Chollet, S., Abdi, H., and Valentin, D. (2008). What is the validity of the sorting task for describing beers? A study using trained and untrained assessors. *Food Quality and Preference* 19, 697–703.

Lemaire, P. (1999). *Psychologie cognitive (De Boeck Supérieur)*.

Lenglet, F. (2014). Influence of terroir products meaning on consumer's expectations and likings. *Food Quality and Preference* 32, Part C, 264–270.

Ludden, G.D.S. (2008). Sensory incongruity and surprise in product design. Dissertation. TU Delft, Delft University of Technology.

Ludden, G.D.S., Schifferstein, H.N.J., and Hekkert, P. (2007). Surprising the Senses. *Senses & Society* 2, 353–359.

Ludden, G.D.S., Kudrowitz, B.M., Schifferstein, H.N.J., and Hekkert, P. (2012a). Surprise and humor in product design: Designing sensory metaphors in multiple modalities. *Humor: International Journal of Humor Research* 25, 285–309.

Ludden, G.D.S., Schifferstein, H.N.J., and Hekkert, P. (2012b). Beyond surprise: a longitudinal study on the experience of visual-tactual incongruities in products. *International Journal of Design* 1.

M.

MacFie, H. (2007). *Consumer-Led Food Product Development* (Elsevier).

Machery, É. (2004). *Les concepts ne sont pas une espèce naturelle : la notion de concept en psychologie cognitive* (Paris 4).

Margolis, E. (analytic) (1994). A reassessment of the shift from the classical theory of concepts to prototype theory (English). *Cognition* 51, 73–89.

Marr, D. (1982). *Vision : a computational investigation into the human representation and processing of visual information* (Freeman).

Marr, D., and Nishihara, H.K. (1978). Visual information processing: artificial intelligence and the sensorium of sight. *Technology Review* 28.

Masmoudi, S. (2010). Percept – Concept – Décision : les secrets d'un cheminement émotif et motivé. In *Neurosciences & cognition*, pp. 51–98.

Masson, J., Aurier, P., and D'Hauteville, F. (2009). Faut-il le dire ou le faire déguster ? Effet de l'information sensorielle et non-sensorielle sur la catégorisation d'un nouveau produit alimentaire. (Londres, Angleterre),.

Mcgurk, H., and Macdonald, J. (1976). Hearing lips and seeing voices. *Nature* 264, 746.

Medin, D.L., and Schaffer, M.M. (1978). Context theory of classification learning. *Psychological Review* 85, 207–238.

Medin, D.L., Lynch, E.B., Coley, J.D., and Atran, S. (1997). Categorization and reasoning among tree experts: do all roads lead to Rome? *Cogn Psychol* 32, 49–96.

Meiselman, H.L. (2013). The future in sensory/consumer research:evolving to a better science. *Food Quality and Preference* 27, 208–214.

Meiselman, H.L. (2015). A review of the current state of emotion research in product development. *Food Research International* 76, *Part 2*, 192–199.

Mellers, B., Fincher, K., Drummond, C., and Bigony, M. (2013). Chapter 1: Surprise. A belief or an emotion? *Progress in Brain Research* 202, 3–19.

Di Monaco, R., Cavella, S., Di Marzo, S., and Masi, P. (2004). The effect of expectations generated by brand name on the acceptability of dried semolina pasta. *Food Quality and Preference* 15, 429–437.

Morrot, G., Brochet, F., and Dubourdieu, D. (2001). The color of odors. *Brain Lang* 79, 309–320.

Murphy, G. (2004). *The Big Book of Concepts* (MIT Press).

Murphy, G.L., and Medin, D.L. (1985). The role of theories in conceptual coherence. *Psychological Review* 92, 289–316.

N.

Neisser, U. (1967). *Cognitive Psychology* (Englewood Cliffs, N.J: Prentice Hall).

O.

Olson, J.C., and Dover, P.A. (1979). Disconfirmation of consumer expectations through product trial. *Journal of Applied Psychology* 64, 179–189.

Olson, J.C., and Jacob, J. (1972). Cue Utilization in the Quality Perception Process.

P.

Park, C.W., and Lessig, V.P. (1981). Familiarity and Its Impact on Consumer Decision Biases and Heuristics. *Journal of Consumer Research* 8, 223–230.

Pecher, D., and Zwaan, R.A. (2005). Introduction to Grounding Cognition: The Role of Perception and Action in Memory, Language, and Thinking. In *Grounding Cognition*, (Cambridge University Press),.

Pelchat, M.L., and Pliner, P. (1995). “Try it. You’ll like it.” Effects of information on willingness to try novel foods. *Appetite* 24, 153–165.

Pineau, N., Schlich, P., Cordelle, S., Mathonnière, C., Issanchou, S., Imbert, A., Rogeaux, M., Etiévant, P., and Köster, E. (2009). Temporal Dominance of Sensations: Construction of the TDS curves and comparison with time–intensity. *Food Quality and Preference* 20, 450–455.

Piqueras-Fiszman, B., and Jaeger, S.R. (2014). The impact of the means of context evocation on consumers’ emotion associations towards eating occasions. *Food Quality and Preference* 37, 61–70.

Piqueras-Fiszman, B., and Jaeger, S.R. Emotions associated to mealtimes: Memorable meals and typical evening meals. *Food Research International*.

Piqueras-Fiszman, B., and Spence, C. (2011). Crossmodal correspondences in product packaging. Assessing color–flavor correspondences for potato chips (crisps). *Appetite* 57, 753–757.

Piqueras-Fiszman, B., and Spence, C. (2012). The influence of the feel of product packaging on the perception of the oral-somatosensory texture of food. *Food Quality and Preference* 26, 67–73.

Piqueras-Fiszman, B., and Spence, C. (2015). Sensory expectations based on product-extrinsic food cues: An interdisciplinary review of the empirical evidence and theoretical accounts. *Food Quality and Preference* 40, 165–179.

Pliner, P., and Hobden, K. (1992). Development of a scale to measure the trait of food neophobia in humans. *Appetite* 19, 105–120.

Posner, M.I., Goldsmith, R., and Welton, K.E.J. (1967). Perceived Distance and the Classification of Distorted Patterns. *Journal of Experimental Psychology* 73, 28–38.

Prinz, J.J. (2002). *Furnishing the Mind: Concepts and their perceptual basis* (Cambridge).

Puumalainen, T., Nykopp, H., and Tuorila, H. (2002). Old product in a new context: Importance of the type of dish for the acceptance of Grünkern, a spelt-based traditional cereal. *Lebensmittel - Wissenschaft + Technologie* 35, 549–553.

R.

Reed, S.K. (1972). Pattern recognition and categorization. *Cognitive Psychology* 3, 382–407.

Rivière, P. (2007). *Satisfaction et insatisfaction: Contribution asymétriques des caractéristiques sensorielles à la formation du jugement hédonique des produits alimentaires*. Thèse de doctorat. Agrocampus Rennes.

Rosch, E. (1978). Principles of Categorization []/Eleonora Rosch. In *Cognition and Categorization*, E. Rosch, and B. Lloyd, eds. (Lawrence Elbaum Associates),.

Rosch, E., and Mervis, C.B. (1975). Family resemblances: Studies in the internal structure of categories. *Cognitive Psychology* 7, 573–605.

Rosner, B. (2011). *Fundamentals of biostatistics* / Bernard Rosner (Boston, Mass. : Brooks/Cole CENGAGE Learning, c2011.).

Rozin, P., and Tuorila, H. (1993a). Simultaneous and temporal contextual influences on food acceptance. *Food Quality and Preference* 4, 11–20.

Rozin, P., and Tuorila, H. (1993b). Simultaneous and temporal contextual influences on food acceptance. *Food Quality and Preference* 4, 11–20.

S.

Sabbe, S., Verbeke, W., Deliza, R., Matta, V., and Van Damme, P. (2009). Effect of a health claim and personal characteristics on consumer acceptance of fruit juices with different concentrations of açai (*Euterpe oleracea* Mart.). *Appetite* 53, 84–92.

Schifferstein, H.N., Kole, A.P., and Mojet, J. (1999). Asymmetry in the disconfirmation of expectations for natural yogurt. *Appetite* 32, 307–329.

Schifferstein, H.N.J., Fenko, A., Desmet, P.M.A., Labbe, D., and Martin, N. (2013). Influence of package design on the dynamics of multisensory and emotional food experience. *Food Quality and Preference* 27, 18–25.

Schyns, P.G. (1997). Categories and percepts: a bi-directional framework for categorization. *Trends in Cognitive Sciences* 1, 183–189.

Sherif, M., Taub, D., and Hovland, C.I. (1958). Assimilation and contrast effects of anchoring stimuli on judgments. *Journal of Experimental Psychology* 55, 150–155.

Siegrist, M., and Cousin, M.-E. (2009). Expectations influence sensory experience in a wine tasting. *Appetite* 52, 762–765.

Siret, F., and Issanchou, S. (2000). Traditional process: influence on sensory properties and on consumers' expectation and liking Application to "pâté de campagne." *Food Quality and Preference* 11, 217–228.

Smith, E.E., Osherson, D.N., Rips, L.J., and Keane, M. (1988). Combining Prototypes: A Selective Modification Model. *Cognitive Science* 12, 485–527.

Spence, C. (2002). Multisensory attention and tactile information-processing. *Behav. Brain Res.* 135, 57–64.

Spence, C.-F., Betina (2012). Dining in the dark. *Psychologist* 25, 888–891.

Spence, C., and Deroy, O. (2013). How automatic are crossmodal correspondences?. *Consciousness and Cognition* 22, 245–260.

Steenkamp, J.-B.E.M. (1989). Product quality : an investigation into the concept and how it is perceived by consumers / Jan-Benedict E.K. Steenkamp (Assen/Maastricht, The Netherlands: Van Gorcum).

Steenkamp, J.-B.E.M. (1990). Conceptual model of the quality perception process. *Journal of Business Research* 21, 309–333.

Stevenson, R.J., Prescott, J., and Boakes, R.A. (1999). Confusing Tastes and Smells: How Odours can Influence the Perception of Sweet and Sour Tastes. *Chem. Senses* 24, 627–635.

T.

Teigen, K.H., and Keren, G. (2003). Surprises: low probabilities or high contrasts? *Cognition* 87, 55–71.

Thomson, D. (2007). SensoEmotional optimisation of food products and brands. In *Consumer-Led Food Product Development*, (MacFie H.), pp. 281–303.

Thomson, D. (2010). 9 - Going beyond liking: measuring emotional and conceptual profiles to make better new products A2 - Jaeger, Sara R. In *Consumer-Driven Innovation in Food and Personal Care Products*, H. MacFie, ed. (Woodhead Publishing), pp. 219–274.

Thomson, D.M.H., and Crocker, C. (2015). Application of conceptual profiling in brand, packaging and product development. *Food Quality and Preference* 40, 343–353.

Thomson, D.M.H., Crocker, C., and Marketo, C.G. (2010). Linking sensory characteristics to emotions: An example using dark chocolate. *Food Quality and Preference* 21, 1117–1125.

Tulving, E. (1985). How many memory systems are there? *American Psychologist* 40, 385–398.

Tuorila, H.M., Meiselman, H.L., Cardello, A.V., and Leshner, L.L. (1998). Effect of expectations and the definition of product category on the acceptance of unfamiliar foods¹². *Food Quality and Preference* 9, 421–430.

V.

Varela, F.J., Rosch, E., and Thompson, E. (1992). *The Embodied Mind: Cognitive Science and Human Experience* (MIT Press).

Varela, P., Ares, G., Giménez, A., and Gámbaro, A. (2010). Influence of brand information on consumers' expectations and liking of powdered drinks in central location tests. *Food Quality and Preference* 21, 873–880.

Versace, R., Labeye, E., Badard, G., and Rose, M. (2009). The contents of long-term memory and the emergence of knowledge. *European Journal of Cognitive Psychology* 21, 522–560.

Versace, R., Vallet, G.T., Riou, B., Lesourd, M., Labeye, É., and Brunel, L. (2014). Act-In: An integrated view of memory mechanisms. *Journal of Cognitive Psychology* 26, 280–306.

W.

Wänke, M., Bless, H., and Schwarz, N. (1998). Context Effects in Product Line Extensions: Context Is Not Destiny. *Journal of Consumer Psychology* 7, 299–322.

Wilson, M. (2002). Six views of embodied cognition. *Psychonomic Bulletin & Review* 9, 625–636.

Wilson, A.D., and Golonka, S. (2013). Embodied Cognition is Not What you Think it is. *Front Psychol* 4.

Wu, L., and Barsalou, L.W. (2009). Perceptual simulation in conceptual combination: Evidence from property generation. *Acta Psychologica* 132, 173–189.

Y.

Yeh, W., and Barsalou, L.W. (2006). The Situated Nature of Concepts. *The American Journal of Psychology* 349.

Z.

Zampini, M., Wantling, E., Phillips, N., and Spence, C. (2008). Multisensory flavor perception: Assessing the influence of fruit acids and color cues on the perception of fruit-flavored beverages. *Food Quality and Preference*.

Appendices

Appendix 1: study 1B, differences of categorization between subjects

Methodology

The methodology is the same as for study 1b focused on the differences between contexts in the concept condition.

Statistical analysis run are the same than for study 2B.

Results

Analysis on Adjusted Rand Index matrices leads to 5 groups of subjects. We will take into account only the first two groups of 30 and 8 subjects, the other groups being too small. Configuration obtained for each of the two groups was compared with the configuration of all the range of subjects. The ARV coefficient allow concluding on a dissimilarity between the Group 2 and the overall panel (ARV = 0.488) and the Group 1 (ARV = 0.372) (Table 16).

Table 16: Table of ARV coefficients between configurations for each cluster and the whole set (global)

	Global	Groupe 1	Groupe 2
Global	1,000	0,939	0,488
Groupe 1	0,939	1,000	0,372
Groupe 2	0,488	0,372	1,000

The configuration obtained from combinations of the first segment of subject shows four distinct groups of products (Figure 39).

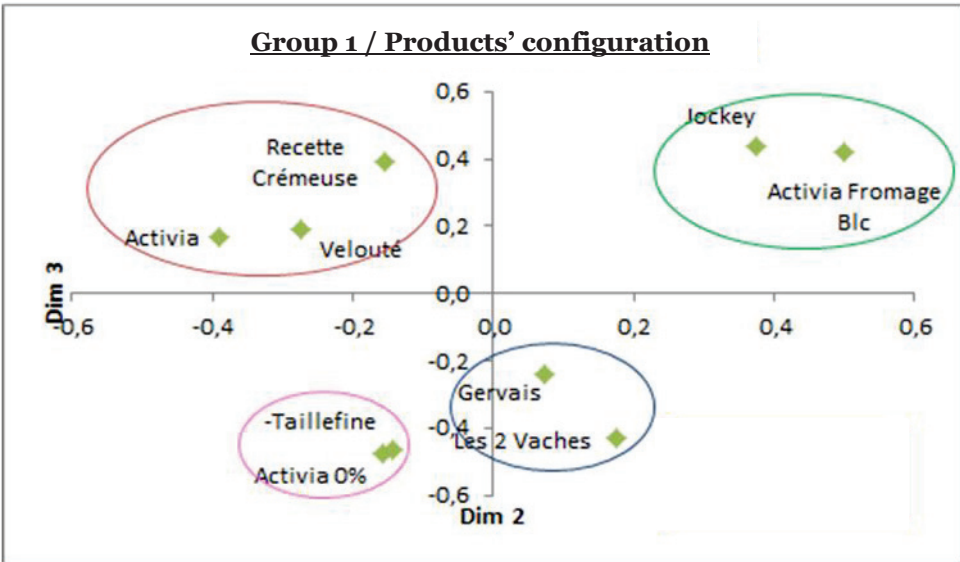


Figure 39: Configuration of products for group 1 of subjects (Kruskal's stress = 0.045)

The first group of subjects made a difference between low-fat products (lower sugar and fat content), white cheeses (thicker, fatty and sweet) and yoghurts.

Group 2 of subjects made three distinct groups of products (*Figure 40*) differentiating Activia brand from other products of the range. However, Gervais and Les 2 Vaches were categorized apart.

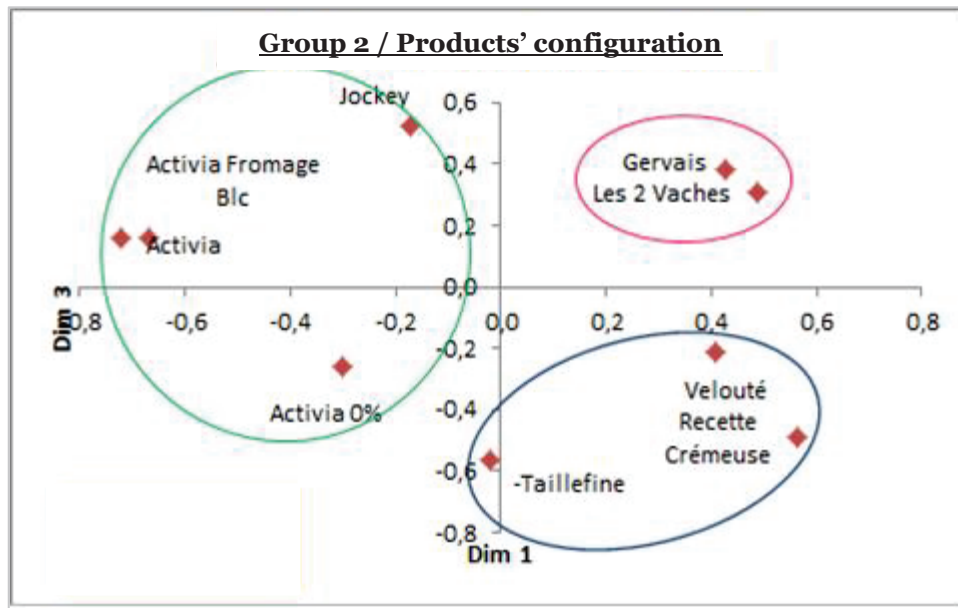


Figure 40: Configuration of products for group 2 of subjects (Kruskral's stress = 0.045)

Associations between products are different between the two clusters of subjects. Only Gervais and Les 2 Vaches were grouped together by both clusters of subjects.

Appendix 2: pre-study to define sensory and conceptual expectations of “a cold tea based on Zywiec Zdroj water”

Methodology






The methodology used is extended focus-groups (EGD). Four focus-groups were planned with 5 polish participants each. Each interview was a 3h-discussion. The consumers were grouped among the age and the drink they were used to consume (flavored water and cold tea) (Figure 41).

Users of ready-made beverages	
Younger (25-35 y.o.) 50/50 Men/Women	Older (36-50 y.o.) 50/50 Men/Women
• 1 EGD cold tea users	• 1 EGD cold Tea users
• 1 EGD flavoured water users	• 1 EGD flavoured water users
TOTAL: 4 EGD	

Figure 41: Description of each EGD

The interview was planned in two steps:

- The first part was dedicated to investigate expectations toward “cold tea” category and based on memory of consumers without tangible stimuli. First, general associations were collected, meaning top associations with “cold tea”. Then each aspect of expectations was detailed by consumers: context of consumptions, product characteristics and sensations expected and then benefits. During the session, consumers could explain associations between conceptual and sensory expectations.
- The second part was dedicated to a blind tasting session. Ten products were selected from an expert tasting session of 80 products (Figure 42). The aim was to propose a variety of sensorial stimuli in a few numbers of samples in order to avoid saturation of consumers. Sensory modalities explored were the following: visual (colors), flavor and basic tastes, somesthesia (texture), and odor. For each product and for each sensory modality subjects had to assess the fit with the cold tea category discussed in the first part. The aim of this part was to select real stimuli for the following studies that fit with consumers expectations.

Samples	Sensory key points
 Honey Tea Half and Half	Strong acidity Honey notes (sweet enough)
 Little Miracles White Tea	Strong sweetness Strong cherry intensity with almond notes Red in visual
 Mangajo Baie de Goji	Opacity Fermented notes Strong acidity Yellow visual
 Sangaria Oolong Vitamine C	Strong Tea intensity Without sugar
 Tao Kombucha Guarana	Floral notes Strong acidity Sparkling Fermented notes Pink visual






Samples	Sensory key points
 Ceylon Tea with 9g sugar/33cL	Strong bitterness Strong black tea intensity Dark color
 Mint Tea with 4g sugar/33cL	Strong astringency Light brown Mint taste
 Elisabethen Quelle Rooibos Strawberry	Transparent Strong fruit notes Without acidity Low tea intensity
 Infusion London	Cloudy Strong sweetness Herbal notes dominant with few fruit notes in aftertaste
 Chamomile with 4g sugar/33cL	Herbal notes Without tea notes Clarity

Figure 42 : Ten products presented for the tasting session (Name of the sample on the left, sensory description made by expert on the key sensory modalities on the right)

Results

First associations collected from “cold tea” category were various in nature of knowledge: from contextual information as “hot countries, summer, friends’ party”, to functional benefits as “quenches thirst, freshness”, to emotional benefits “joy”, to sensations “peach flavor, sweet taste, amber”. The name of a food category activates different kind of knowledge spontaneously.

Six situations of consumption have been elicited by consumers. For each situation they have associated one motivation to consume the product to a specific context of consumption. Based on memory, they also have associated sensations that emphasize the perception of the benefits in the products. The six situations are the following:

- **“On the go”**: it’s an on-the-go situation, an impulsive situation while the subject is walking in the street, and get thirsty. The related benefits are the sense of freshness, the refreshment, and the cooling down. *“Buying ice tea is a quite spontaneous thing... I’m walking down the street,*

suddenly feel thirsty, so I go to the store and buy a small ice tea...". The product need to be not too sweet to emphasis this cooling down effect with lime, lemon or mint aromas.

- **“Exotic”**: the context is during the summer, or holidays, when the subject wants to relax. Benefits related to the products are the pleasure of taste, the relaxation and the summer laziness and the motivation to try something new or exotic. *“When you drink ice tea you feel more refreshed. You just grab an ice tea from the fridge in the summer and you’re good...”*. Therefore, key sensations associated to the situation are the sweeter flavor, the intensive taste of fruit and also unusual fruit aromas as mango, acerola or acai berry.
- **“Energy”**: the situation is focused on the social context, meaning going out with friends on a party or on barbecues for example. The main motivation is to get some energy, stimulation. The product has also a specific role of image-related benefits because the subject is in a specific social context. *“I’m in a club, it’s really hot, there’s music playing. It’s a non-alcoholic party. People just have tea with lots of ice and lemon in their glasses and are having fun.”* Expected sensations are an intensive taste of tea associated to energy with “invigorating” flavors as lemon or mint.
- **“Physical activities”**: the motivation for the subject is to hydrate itself and replenish in minerals after a physical activity. This situation is focused on the quality of the product and the mineral content. *“More refreshment from the water, there are more minerals – it’s something you drink e.g. after bicycle riding”*. Therefore, the water is important in the product because it brings all the minerals and electrolytes to the subject. The product is, so, expected to be less intensive in color, taste and sweetness to emphasis the presence of the water.
- **“Family”**: the context of consumption is during a meal, with the family and the children. Conceptual associations are related to healthiness and naturality because the targeted consumers are the family members. *“For me it’s a tea that’s good for a meal... because how much Coca-Cola can one drink? At home, I drink ice tea, with fries, with dinner in general...”* As the product is more natural, then the sweetness comes from the fruit and it is cloudier with “real” fruit fragments and with polish fruit aromas namely homely flavor.
- **“My moment”**: the aim of this situation is to have a moment just for ourselves, to relax, after work. The situation is associated to the pleasure of taste (and more specifically of the fruit) and to the relaxation, chilling out benefits. *“I’m on the porch and I’m happy. I’m sitting in a chair, and there is all of this heat around, crickets buzzing, and I’m sitting with cold tea and I’m relishing with taste. You can see green, garden, shrubs, trees...”* The product attributes expected by the subject to emphasis this pleasure of taste are the rich flavor and the slight sweetness added and the homely fruit taste.

From the first part, understand sensory expectations are more difficult. For each subject, expectations are based on an individual reference in memory. Therefore, understand what could be a “slight sweetness”, or what could be acceptable as “cloudy” for the consumers is difficult. This is why the second part based on real stimuli is helping us providing a referential for each sensory modality.

Results based on memory for expected sensations have shown that a “cold tea” is a product based on tea and fruit and structured by three main sensory dimensions: the sweetness, the intensity of fruit and the intensity of tea (Figure 43). Based on the tasting, results have highlighted that some specific sensory modalities are rejected and don't fit with the category: non-sweet product, sparkling product, herbal aroma as chamomile. These kinds of rejections can be discussed as the influence of the memory in the product perception even for non familiar products. Therefore, a stimulus is never perceived as new, but always associated to an existent stimulus. Products with an intensive taste of fruit without tea are also rejected. Furthermore, even if the slight sweetness has been mentioned in the first part as a criterion that fits with the category, in the tasting part the sweetest product have been elicited by the consumers as fitting the best on the sweetness modality with the “cold tea category”. This result highlight the role of the memory and more precisely of the referential inducing a bias in the perception of consumer. Some other modalities have shown this gap between the first and second part as the visual criterion: the intensive color and cloudiness elicited in the first part, are not fitting in real with the category even if the product is based on fruit juice.

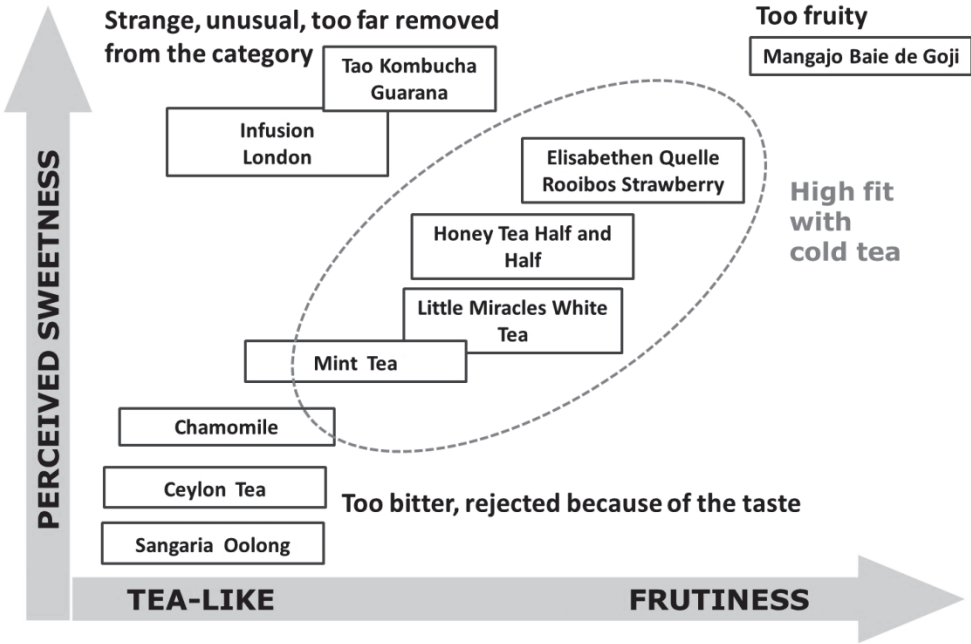
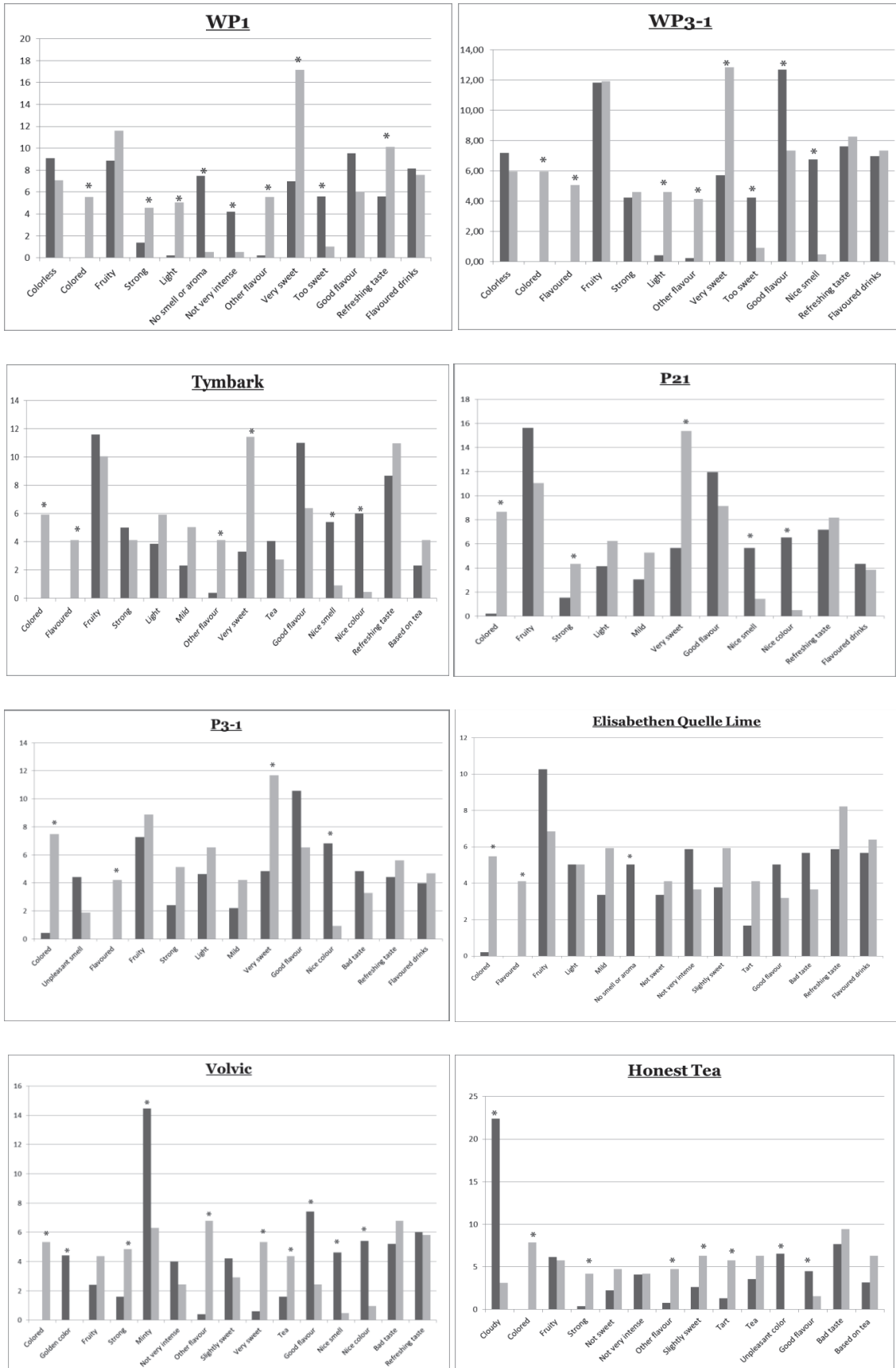
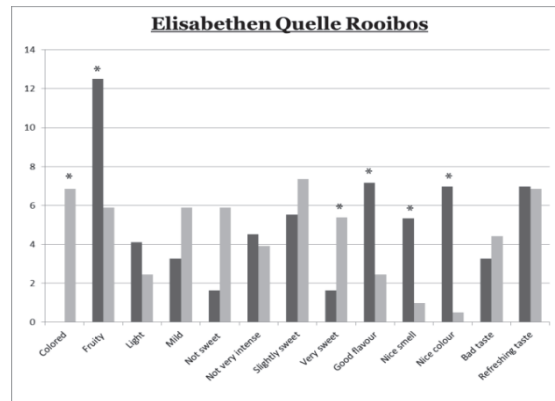


Figure 43 : Sensory perception of consumers for each product among three main sensory modalities (sweetness, tea intensity and fruit intensity)

Appendix 3: study 3A, analysis of verbatim





For WP1:

- Case 1: “strong”, “light”, “other flavor”, “very sweet”, “refreshing taste”
- Case 2: “no smell or aroma”, “not very intense”, “too sweet”
- Case 3: “colored”

For WP31:

- Case 1: “light”, “other flavor”, “very sweet”
- Case 2: “too sweet”, “good flavor”, “nice smell”
- Case 3: “colored”, “flavoured”

For Tymbark:

- Case 1: “other flavor”, “very sweet”
- Case 2: “nice smell”, “nice color”
- Case 3: “colored”, “flavored”

For P2-1:

- Case 1: “colored”, “strong”, “very sweet”
- Case 2: “nice smell”, “nice color”

For P3-1:

- Case 1: “colored”, “very sweet”
- Case 2: “nice color”
- Case 3: “flavoured”

For Elisabethen Quelle Lime:

- Case 1: “colored”
- Case 3: “flavored”
- Case 4: “No smell or aroma”

For Volvic Mint Tea:

- Case 1: “strong”, “other flavor”, “very sweet”, “tea”
- Case 2: “Minty”, “good flavor”, “nice smell”, “nice color”
- Case 3: “colored”
- Case 4: “golden color”

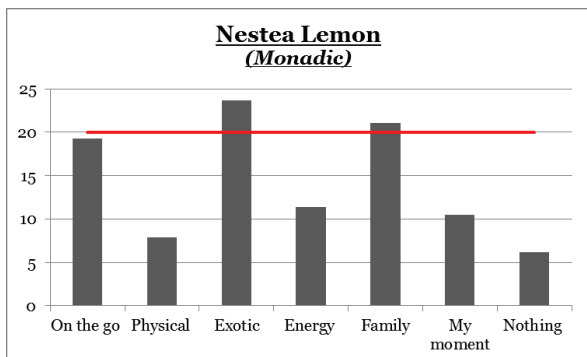
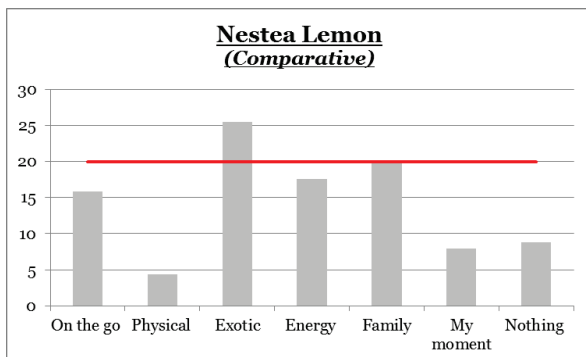
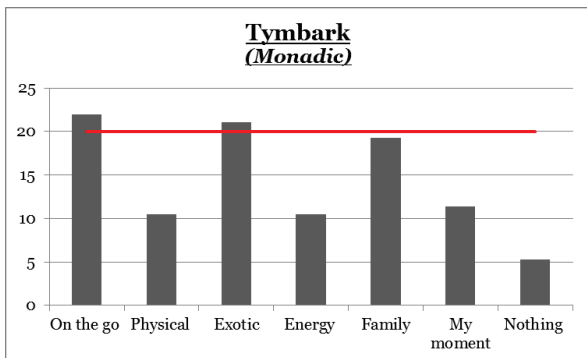
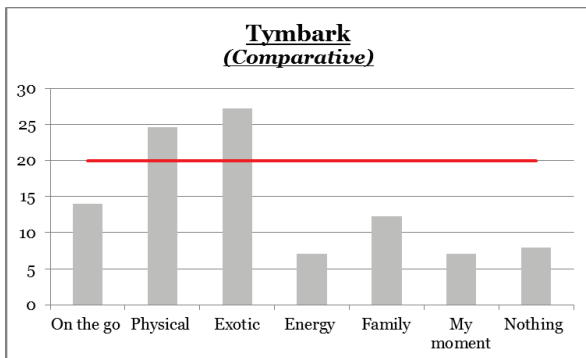
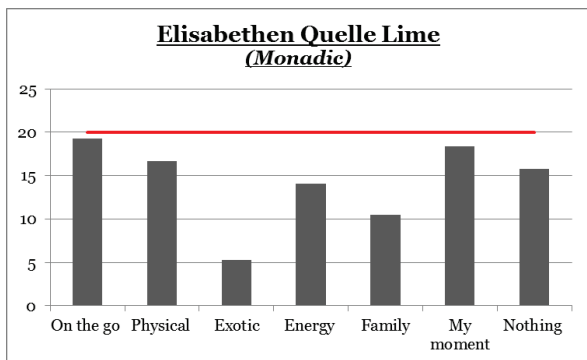
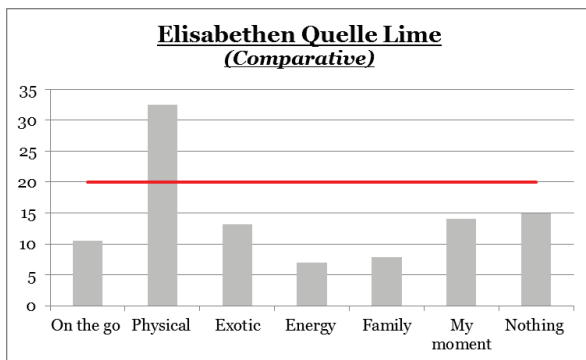
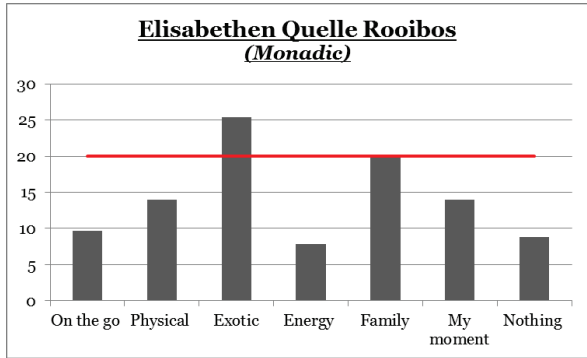
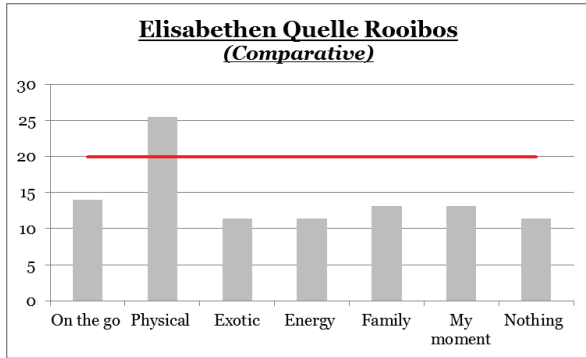
For Honest Tea:

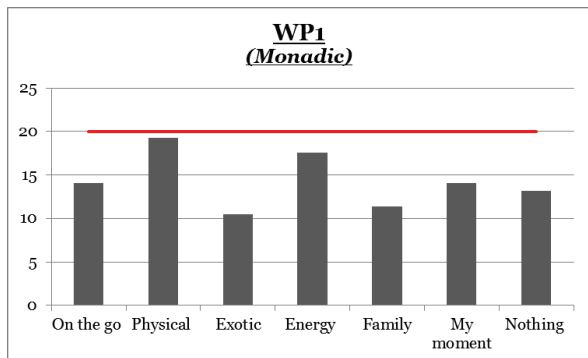
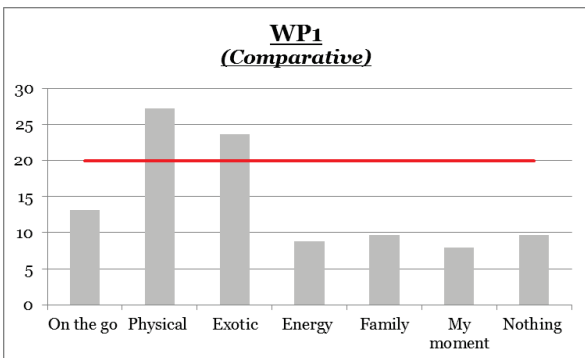
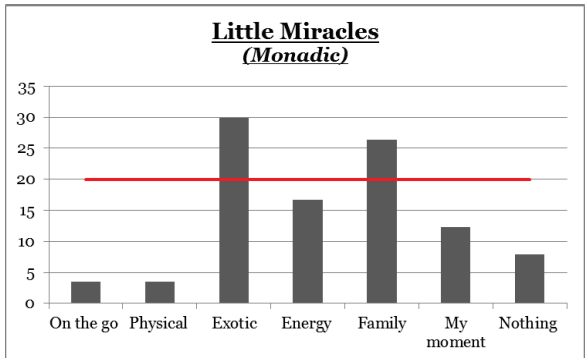
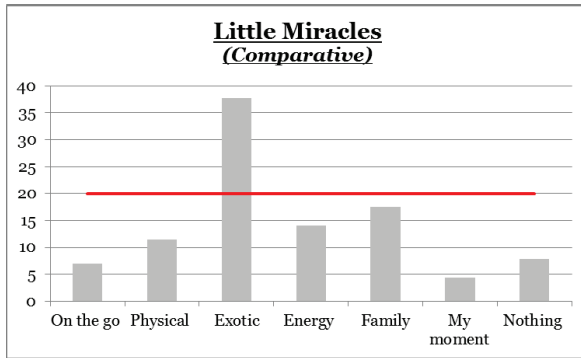
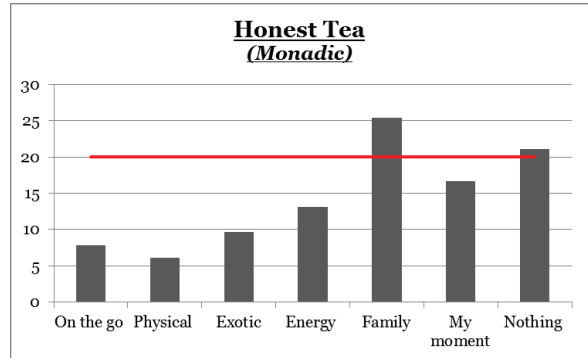
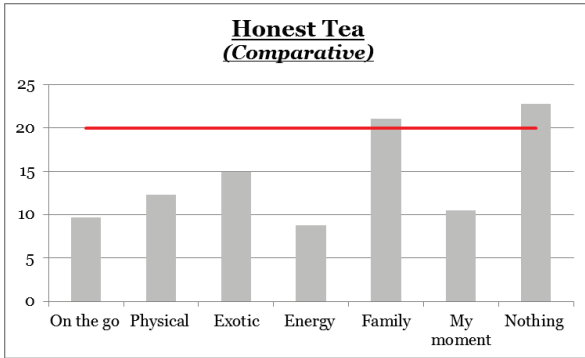
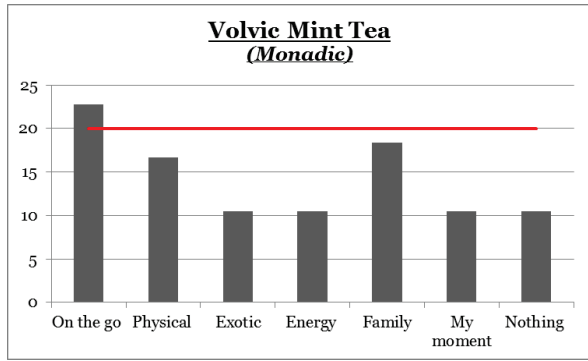
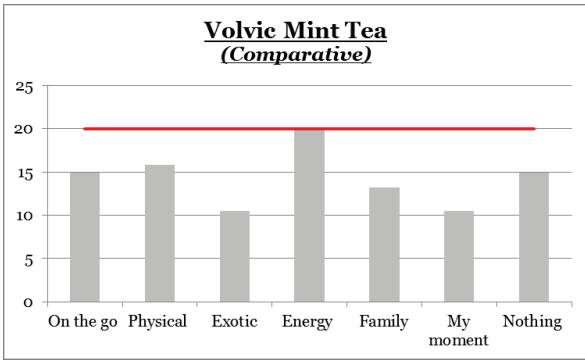
- Case 1: “strong”, “other flavor”, slightly sweet”, “tart”,
- Case 2: “cloudy”, “good flavor”
- Case 3: “colored”
- Case 4: “unpleasant color”

For Elizabethen Quelle Rooibos:

- Case 1: “very sweet”
- Case 2: “fruity”, “good flavor”, “nice flavor”, “nice color”
- Case 3: “colored”

Appendix 4: study 3A, analysis of conceptual expectations





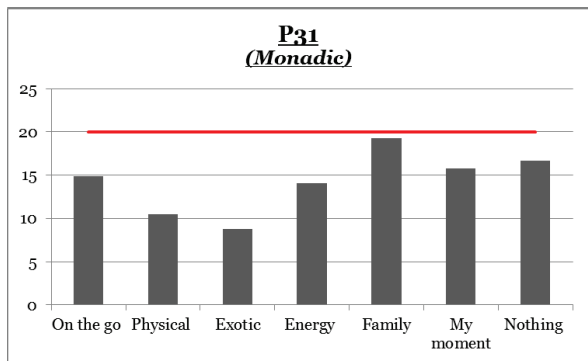
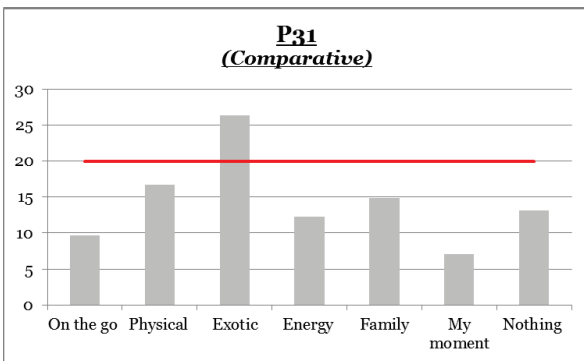
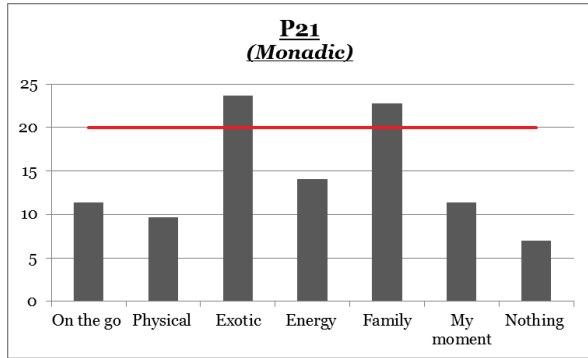
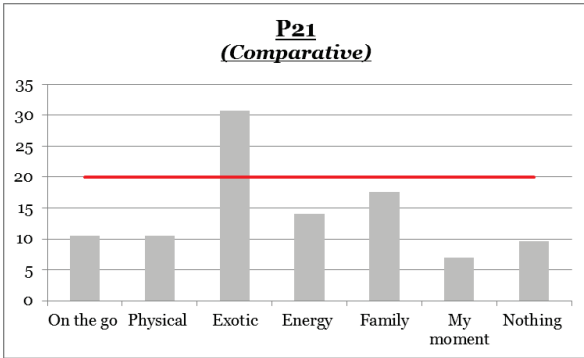
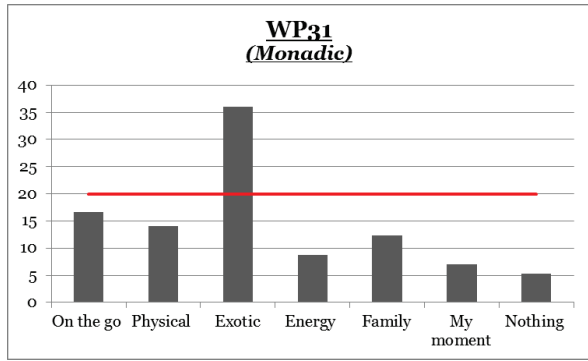
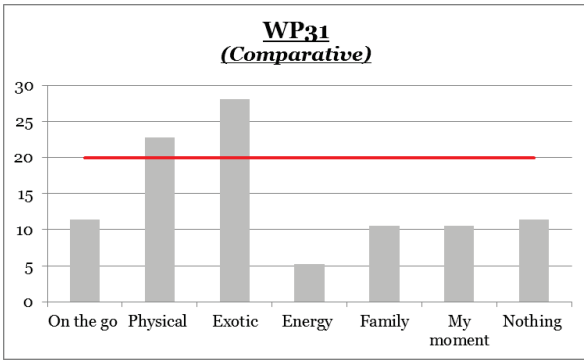


Figure 44: Frequency of associations for each board of expectation and product. The red straight line indicates the significance level.

Appendix 5: Study 2B – Questionnaire of familiarity

Q1. Distance to tea range

Q1.1. Knowledge of tea range

Q1.1.1. Perceived knowledge (scale from 0 (I strongly disagree) to 4 (I strongly agree))

- I feel competent about in my knowledge of tea
- Among my friends, I am the one who is the tea expert
- Compared to others, I know less about the subject of tea
- I don't understand much about tea

Q1.1.2. Objective knowledge (codage 0 (wrong answer or I don't know)/1(right answer))

- Which country is the largest producer of tea in the world?

Bazil China Colombia Vietnam I don't know

- Before consumption, tea is :

Spice Leave Herb Root I don't know

- Main kind of tea (black, white, green) come from different :

Botanical varieties Geographic origins

Processes of transformation I don't know

- Tea is coming from the botanical variety *Camellia*.... :

Japonica Sasanquas Sinensis I don't know

- Do you know the difference between Green Tea, Black Tea and White Tea?

Not at all Yes, a little

- If you do, check for each descriptor which kind of tea fit the best :

The most oxydised: Green Tea Black Tea I don't know

The richer in antioxydants: Green Tea Black Tea I don't know

The most consumed in the word: Green Tea Black Tea I don't know

English Tea: Green Tea Black Tea I don't know

Q1.2. Implication to tea range

(scale from 0 (I strongly disagree) to 4 (I strongly agree))

- For me, tea is something really important
- Tea concerns me personally
- I am able to make tea drinks by myself

Q1.3. Consumption habits

Q1.3.1. Frequency of consumption of tea

How often do you consume tea drinks?

- Never or rarely
 Several times a month
 Several times a week
 Once a day
 Two to three times a day
 Four to five times a day
 More than five times a day

How often do you consume homemade tea drinks?

- Never or rarely
 Several times a month
 Several times a week
 Once a day
 Two to three times a day
 Four to five times a day
 More than five times a day

How often do you buy tea drinks?

- Never or rarely
 Several times a month
 Several times a week
 Once a day
 Two to three times a day
 Four to five times a day
 More than five times a day

Q1.3.2. Consumption Usage and Habits for tea range

(scale from 0 (Never) to 4 (Daily))

- Do you discuss about tea with your friends?
- Do you go for tea shopping yourself?
- Have you take lessons on tea?
- Do you read books on tea?
- Do you go on website or blogs on tea?

In which proportion do you drink tea alone or with other people?

Mostly alone Mostly with other people

Do you use to consume infusion prepared at home, with friends or family, with the following things:

	Never	Rarely	Sometime	Often
Tea or herbal bag	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tea or herbal leaves	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Instant tea	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Electric kettle	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Casserole	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Teapot with a filter	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tea filter in ball or teaspoon	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Other :

At home, you have:

- Tea bags Yes No
Tea leaves Yes No
Herbal tea bags Yes No
Herbal tea leaves Yes No

Have you already buy tea for your own consumption in:

- A supermarket: Yes No
A tea shop: Yes No
A delicatessen: Yes No
A fair trade or organic specialised shop: Yes No

Which are your criterias to select tea in a shop for your own consumption?

-

Give some brands of tea you know:

-

Which brand do you consume most often?

-

Q1.3.3. Consumption Usage and Habits for cold tea range

In which proportion do you drink cold tea alone or with other people?

Mostly alone Mostly with other people

Do you use to consume cold infusion prepared at home, with friends or family, with the following things:

	Never	Rarely	Sometime	Often
Tea or herbal bag	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tea or herbal leaves	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Instant tea	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Teapot with a filter	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tea filter in ball or teaspoon	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Other :

Have you already buy cold tea for your own consumption in:

- A supermarket: Yes No
A tea shop: Yes No
A delicatessen: Yes No
A fair trade or organic specialised shop: Yes No

Which are your criterias to select a cold tea drink in a shop for your own consumption?

-

Give some brands of cold tea drink you know:

-

Which brand do you consume most often?

-

Q2. Brand implication

(scale from 0 (I strongly disagree) to 4 (I strongly agree))

Brand involvement

- This brand is important to me
- This brand is relevant to me
- This brand means a lot to me
- This brand is useless to me
- This brand is trivial
- This brand is beneficial
- This brand is valuable
- This brand is uninterested
- This brand is exciting
- This brand is undesirable
- This brand is appealing

Brand loyalty

- I consider myself loyal to this brand
- I consider this is the only brand of water drinks I need
- I buy this brand whenever I can
- I buy as much of this brand as I can
- This is the one brand I would prefer to buy or use
- I would go out of my way to use this brand
- If this brand was not available, it would make little difference to me

Q3. Food Neophobia Scale

(scale from 0 (I strongly disagree) to 6 (I strongly agree))

- I am constantly sampling new and different foods
- I don't trust new foods
- If I don't know what is in a food, I won't try it.
- I like foods from different countries
- Ethnic food looks too weird to eat
- At dinner parties, I will try a new food
- I am afraid to eat things I have never had before
- I am very particular about the foods I will eat
- I will eat almost anything
- I like to try new ethnic restaurants

Appendix 6: Qualitative pre-study defining affective judgment relating to sensory disconfirmation of expectations

Research question

The purpose of the study is **to investigate the affective states induced by a sensory disconfirmation of expectations in a food consumption context**. This exploratory study is defined to:

- Check that sensory disconfirmation of expectations relating to food consumption induces the same affective states as those found in the literature.
- List the affective states induced by the different nature and degree of sensory disconfirmation of expectations (sensory characteristic, benefit, and brand).
- List the affective states integrating the variability of subjects regarding the usage of the product.

Methodology

Procedure of interviews

Interviews are focus-groups of two-hours duration following three steps (Figure 45).

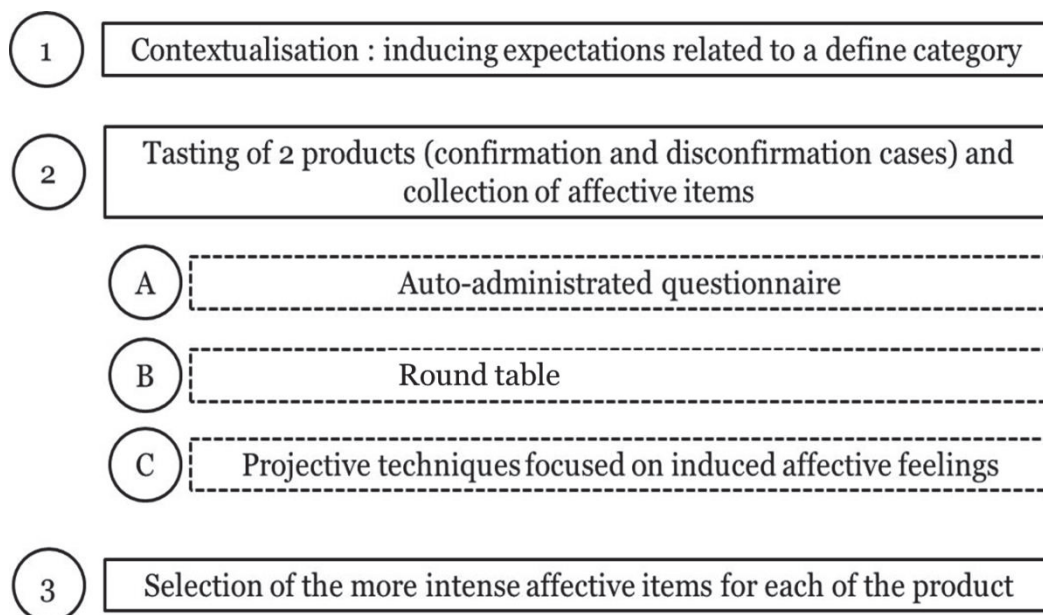


Figure 45: Steps followed during the focus-group

The first step is dedicated to activate expectations. The moderator reads a sentence inducing activation of a define ad-hoc category. No visual stimuli are given at this step. Subjects have to then explain the characteristics that they imagine about the product. The description is focused on the expected sensations. No consensus between subjects is required.

In the second step, two products are tasted, one after the other, in the same order of presentation for all the subjects. The first product is intended to illustrate a disconfirmation of expectations. The second product is closer to expectations. The purpose of this order is to reinforce affective states relating to confirmation. For each sample, following the tasting, subjects have to fill in a self-administrated questionnaire with the affective states they felt after consuming the product compared to what they had imagined. The aim is to collect individual spontaneous reactions just after consumption without the bias of discussion and social influence. Then a round table is organized to collect reactions and induce discussion about affective states. The purpose is to understand differences of descriptions of affective states among subjects. Then projective techniques are used to get access more easily to affective aspects that could be difficult for subjects to explain. The first projective technique is to describe the product through a creature that is not real (description and interaction with the subject, what he thinks about it, what it inspires, etc.).

The third step is dedicated to identifying the most intense feelings each subject experienced through the projective technique of the planets. The purpose is to imagine that each of the three products (expected, first and second tasted) is a planet. Subjects have to describe the planet, the environment, and the people that live there and how they feel about living there. At the end of the exercise subjects are asked to choose the planet that is closest to the planet of the expected product.

The nature of sensory disconfirmation and products

Different parameters are taken into account to induce the different natures of sensory disconfirmations of expectations: the source of the disconfirmation, the kind of stimulus (to cover all the different ranges of products, the given information to activate the category and the degree of disconfirmation (Table 17).

Table 17: Description of the nature of sensory disconfirmation of expectations for each group of subjects

Focus-groups	Group 1	Group 2	Group 3
Source of the sensory disconfirmation	Generic category	Benefit	Brand
Contextualization	White cheese category	Actimel to prepare his/her day	Concept of the brand “light drink”
Tasted products	Product 1: stirred yoghurt Product 2 : white cheese	Product 1: Actimel Product 2 : Diluted YOP under brand Actimel	Product 1: Taillefine Fiz Product 2: Coca-Cola 0%
Hypothesis of degree of disconfirmation	Product1 : High Product 2: None	Product 1: Low Product 2: High	Product 1: None Product 2: Low

Hypothesis of sensory disconfirmation of expectations:

- For group 1: the nature of sensory disconfirmation of expectations is induced by a lack of texture of the stirred yoghurt.
- For group 2: the benefit “be stronger and prepare for his/her day at breakfast” is translated into sensory properties: an intense strawberry aroma with lemon notes. Therefore the sensory disconfirmation is induced by proposing a product which has a less intense in strawberry aroma and without lemon notes, e.g. a diluted YOP. Previous marketing studies also have shown that actual Actimel is not exactly fitting with this benefit.
- For group 3: the concept associated with the brand Taillefine is a light, sparkling drink portraying the image of pleasure and well-being; a natural product that provides hydration. This concept is translated into a product: Taillefine Fiz , a drink with a fruit aroma with an intense taste of water. Therefore based on the knowledge provided by the marketing team, Coca Cola 0% was proposed as an alternative inducing a disconfirmation.

Subjects

The recruitment of subjects was made following these criterions:

- For group 1: 50% were frequent consumers of white cheese, namely twice a week, of any brand.

- For group 2: 50% of the subjects were consumers of Actimel for the motivation and the context of consumption presented at the beginning of the study ,i.e. to be stronger and be prepared for the day ahead at breakfast. The remainders of the subjects consumed a similar drink to Actimel, but a different brand, but for the same reasons and context. For group 3: 100% of the subjects were consumers of light drinks, and 50% of them were consumers of Taillefine Fiz, the other 50% were consumers of Coca Cola 0%. The frequency of consumption was at least twice a week.

Contextualization

The first part of the focus-group is dedicated to contextualizing the tasting, namely to activate expectations in consumers' mind related to the category we want to address.

- For group 1, contextualization is made with the sentence « *White Cheese* » without a specific context associated.
- For group 2, contextualization is made by evoking the situation of consumption through the following sentence: « *Think about a product that you consume in the morning at home after getting up, a product that strengthen your immunity and better prepares you for your day. Now imagine that you are consuming an Actimel for this purpose.* »
- For group 3, contextualization is made by evoking the concept attached to the brand Taillefine Fiz through the following sentence: “*Imagine that you are drinking a light, sparkling beverage. This drink contains 0% calories to mix pleasure and well-being. This beverage is based on mineral water with thousands of fine bubbles, adapted to the pleasure of the moment without sacrificing its nutritional balance. This is a natural beverage, ensuring hydration and facilitating the consumption of 1.5 liter of water per day while maintaining its nutritional balance*”.

Products

For each group, two cases of sensory disconfirmation are proposed through the tasting of two different products.

- For the first group, the product selected for the disconfirmation case is stirred yoghurt and the product selected for the confirmation case is white cheese. The products were presented for tasting in white plastic cups without brand names or markings.
- For the second group, the two products were selected for the tasting and were assessed before the session by sensory experts. The light disconfirmation case was illustrated by using the actual strawberry Actimel. The high disconfirmation case

was illustrated by using a Yop diluted with full-cream milk. This mix is described by sensory experts as less strawberry intense without lemon notes and sweeter. There were no differences in the texture between the samples. The two samples were served in white plastic cups under the same brand Actimel.

- For the third group, the first product illustrating the confirmation case was Taillefine Fiz, fruitier and more watery. The second product illustrating a disconfirmation case was Coca Cola 0%. Both have the same lemon aromatization. The two samples were served in clear glass bottles with the brands marked on them.

Moderation and analysis

Moderation and analysis were done by external professionals in qualitative research.

As the purpose of the study was to provide an exhaustive list of affective reactions, no quantification of elicitations was made. A transcription of each group's interview was made, allowing us to understand each affective item elicited by consumers and also relating them to a defined context.

For each feeling, a description based on criteria of categorization of emotions was made: intensity of the feeling, intensity of the stimulus (or degree of disconfirmation) and valency.

Results

Main affective states induced by sensory disconfirmation of expectations

The initial outcome of these interviews is an exhaustive list of affective items explaining the nature of sensory disconfirmation of expectations. The final list is compared and homogenized with literature. From the whole set of affective items elicited by subjects, the following are selected:

- surprise : allows to detect a sensory disconfirmation of expectations
- serenity : translating a confirmation of expectations
- satisfaction: translating a confirmation of expectations related to the whole product experience
- pleasure translating a confirmation of expectations related to an organoleptic aspect of the product
- frustration translating a negative disconfirmation of expectations related to previous experiences of the product, and more precisely to the benefit or the motivation to consume the product
- deception translating a negative disconfirmation of expectations related to an organoleptic aspect of the product

- confusion translating a negative disconfirmation of expectations related to a non-recognition of the product
- perturbation translating a negative disconfirmation of expectations related to the motivation to consume the product, i.e. the ad-hoc category.
- Indifference translating boredom, more precisely a negative disconfirmation of expectations for subjects that don't recognize the benefit in the product.

'Sadness' is suppressed from the list. Indeed interviews are a more effective way of accessing more intense affective states compared to an auto-administrated questionnaire. 'Oppression' and 'apprehension' are renamed 'confusion' because of the closeness of these two items.

As affective states are related to context, the list is set out in sentences (Table 18).

Table 18: list of affective items induced by a sensory disconfirmation of expectations

Surprise
I'm disappointed by this product
I feel confused because I can't recognize the product
I feel perturbed by this product
I feel frustrated after eating this product
I took pleasure eating this product
I am indifferent to this product
This product makes me feel serene
I feel satisfied with this experience

Variability of affective items among the nature of disconfirmation

Different categories of affective feelings are elicited by consumers.

For the first group of subjects, disconfirmation of expectations is induced only by one sensory property necessary to define category « White cheese »: the thick texture. Therefore, affective items specific to this group are induced by a sensory disconfirmation of expectation without the influence of other information and directly related to the recipe.

The first product, stirred yoghurt, induces deception in subjects as a first affective state. This feeling is related systematically to the taste of the product by consumers and more

precisely to the texture of the product: *“I’m disappointed, this product is not likeable and lacks of texture”*. Subjects emphasize the large gap between what they expected and the actual product proposed for the tasting. This result shows that deception is associated with a difference between expectations and perception focused on sensory information only. Deception has a negative valence: *“When I taste the white cheese, it’s a con, a deception. We don’t deserve that »*. This item is elicited by 5 subjects out of 6 in the group and perceived as the most intense. To sum-up on deception: deception is a negative item perceived as intense and induced by a high degree of sensory disconfirmation and focuses on the sensory characteristic of the recipe.

The second product, white cheese, induces pleasure for subjects and is perceived as being closer to what they were expecting than the first product. Among subjects, depending on their usage this product, it matches their expectations, or is a light disconfirmation to their expectations. The valence of this item is positive: *« it’s a pleasure; it’s perfect, as thick as I like it”*. In the same way as for deception, it relates to the organoleptic aspect of the product *“I want to put my finger in it because it is smooth [...] it’s a pleasure, the greediness”*. This feeling is stated as the most intense, as a positive one, by the entire group of consumers. Pleasure is also associated with the context of the consumption of the product, as the subjects elicit this verbatim by referring to the specific context of consumption. Indeed, the link with the sensory dimension, the thick texture, influences the moment of consumption more generically which becomes a moment of plenitude *« atmosphere of relaxation », « it makes me serene »*. To sum-up, pleasure is a positive item perceived as intense and induced by a high degree of confirmation of expectations focused on the sensory characteristics of the recipe.

Recognition of the taste is also elicited by a large number of subjects. However, this aspect is not taken into account because this is less a feeling than the expression of a discomfort that the product is not congruent with the expectations, namely the category activated in the minds of subjects before consumption. Nonetheless this item allows us to check the fact that the disconfirmation we wanted to induce by presenting the stirred yoghurt was a success. Moreover, it also ensures the nature of the disconfirmation focused only on the sensory characteristic of the recipe: the texture.

For the second group sensory disconfirmation relates to the association between sensory properties perceived in the recipe and the situation of the consumption of the Actimel brand. The first product tasted is Actimel inducing among subjects, depending on their usage, either a confirmation of their expectations or a light positive or negative disconfirmation of their expectations. The mix with YOP induces for all the subjects a high negative disconfirmation of expectations. Several affective items are specific to this group.

The first feeling is perturbation induced by the discrepancy between the expectations related to previous experiences with the product in the situation primed at the beginning of the session: *“I think that this is because I was thinking about my usual Actimel, and maybe unconsciously I expected to feel the same sensation”*. This is a negative item translating to the non-recognition of the primed benefit in the recipe *« I’m disoriented », « This is contradictory with the taste and the freshness I have imagined », « I feel disturbed because I can’t recognize the taste », « It is difficult to identify the brand »*. This feeling is the most intense that 4 subjects out of 6 related to the mix with YOP. To sum-up, perturbation is an affective state induced by a sensory disconfirmation of expectations related to association between conceptual (benefit) and sensory property. It is the most intense negative state.

The second feeling is satisfaction: *“this is hollow, tasteless, it leaves us unsatisfied”, “a feeling of satisfaction because I really enjoy the taste and the freshness”, “I’m satisfied with the taste”*. This item is related by the subjects to the whole product experience, mixing the brand, context, benefit and the taste, but it is expressed as a sensory satisfaction. Satisfaction is the positive feeling that is the most elicited by subjects.

The third feeling is frustration elicited mostly by users of the product (3 subjects out of 6). Furthermore, these consumers have a strong ritual associated with the consumption of the product : *“it’s a change compared to my eating habits and as it is a bit like a ritual in my work”, “I feel frustrated”, “I feel like withdrawn”*. This is a negative item induced by a discrepancy between the brand Actimel that is recognized and the non-recognition of the sensory pattern related to the primed situation of consumption. In other words, the category Actimel is well identified by the subject, but sensory information perceived is not congruent with the usual situation of consumption.

The fourth feeling is sadness which has a negative valence and is induced by a high disconfirmation of expectations related to a discrepancy of sensation translating to the benefit. In other words, the benefit is not recognized in the recipe through the sensory characteristics. Intensity of feeling is high: *“I feel sad with this product”, “inhabitants of this planet are all sad people, forced to live”*. This item is not consensual (1 subject out of 6) and is only induced for subjects that have strong expectations related to the product.

Deception is also evoked in this group but is still related to a sensory characteristic defining the generic category: *« deception for me [...] the strawberry aroma is a too big change compared to my habits »*. Here the sensory disconfirmation of expectations relates to the presence of the strawberry aroma and not to the situation of consumption. Deception has the same effect as described above for the first group, as a negative item relating to an organoleptic aspect of the product.

Indifference is mentioned through the verbatim « *boredom* , “*indifferent*» by 4 subjects out of 6 that don't recognize the expected benefit in the product “*I don't understand it and I don't care, I'm indifferent*”, “*this product lack of intensity [...] it makes me bored*”. This feeling is negative and translates to a sensory disconfirmation of expectations.

The comparison with the usual eating habits of several subjects and the expression in the first step of strong expectations toward the benefits energizing and good for health, allow checking that feelings elicited after the consumption of the product are related to non-recognition of the benefit in the product during the consumption.

For the third group, sensory disconfirmation of expectations is related to the concept associated to the brand and translated through the sensory pattern of the recipe. Affective feelings are induced by this nature of sensory disconfirmation, namely related to the benefit associated with the brand and associated with sensory characteristics. Taking into account the contextualization made in the first step, the analysis was more complex to dissociate feelings induced by the benefits themselves “*pleasure and well-being*” from the feelings induced by the consumption of each sample. This group was a specific one because it was the the only one to be consensual on the case of confirmation. Therefore, feelings induced by the tasting of the sample Taillefine Fiz remain as reflecting a confirmation of expectations.

Serenity is evoked by all the subjects and described as a positive item induced by a state of appeasement and rest for the subject which correlates with the absence of cognitive dissonance after consuming the product. Several words are used to describe this state; “*serenity*”, “*zenitude*” “*relax*”.

Apprehension or oppression are also elicited but as negative items induced by the presentation of the sample Coca Cola to the subjects. This product is not fitting with the category of sparkling water and therefore is induced by non-recognition of the category “*it's unpredictable because this is not a sparkling water*”, “*it's a moment of apprehension*”, and “*I feel attacked, oppressed*”. This item is felt intense by the subjects.

Surprise as a common item

Surprise is induced by all the subjects from the three groups and elicited whatever the nature or the degree of the sensory disconfirmation. Each time this item is evoked by a subject, they then provide a more detailed and precise explanation as to whether the reaction is negative or positive. Indeed surprise is without valence and therefore needs an association to another affective item: “*I am pleasantly surprised* ». This feeling has been evoked by different words such as ‘astonishment’. During the interviews, surprise was the first feeling elicited by

the subjects after the tasting of products. This is visible through facial expression on video camera, but also with verbal expression such as « *surprising compared to others* ».

Variability of affective items among subjects

The small number of subjects does not allow for a more general conclusion on the process of affective feelings and on subjects' variability. However, the analysis of results provided between consumers allows for a hypothesis on the link between expectations and categories activated in mind, and also on the influence of sensory disconfirmation on affective judgment. Looking at the first group, two processes are described depending on the familiarity of the subjects. For non-familiar subjects, sensory expectations related to the category remain generic and based on a criterion that is necessary to define the structure of the category: the thick texture. Activation of previous and old experiences (from the childhood for example) is mentioned and acts as an aid to building expectations. For familiar subjects, the definition of the category is related to a precise context. Mentioning the concept "white cheese" refers to a precise category in mind based on a ritual experience of consumption in a defined context (for example at breakfast or for dessert), with a given benefit (eating something pleasant without feeling guilty) and completed by an affective dimension (my moment of pleasure). From this result it is possible to make a hypothesis on an individual variability of associations between the pattern of sensory information and the concept activated in mind inducing different affective judgment. In addition, further results allow making a hypothesis on the fact that a sensory disconfirmation can also address a disconfirmation of concept related to context, benefit or affective dimension, because of the structural inferences of the categories.

Regarding the brand, a distinction is made between familiar and non-familiar subjects. A familiar subject has many experiences relating to the same situation of consumption stored in the memory which induces strong expectations because the category defined in mind is specific and not generic. A non-familiar subject builds their expectations on the image associated with the brand (Actimel is a good product for strengthen their immunity, so this is an alicament and therefore, it has an unpleasant taste). In these cases, associations are made depending on the understanding of the benefit carried by the brand for the subject.

To sum-up, results provided by the first hypothesis on an individual variability of affective judgment, related to differences of structures of categories activated in the mind of consumers before consumption, based on association between concepts and sensory patterns.

Methodological discussion

The main difficulty of the study is to capture the emotions felt by the subjects. Indeed, feelings are submitted by a process of normative assessment inducing a bias when the axis of study is focused on declarative expression. Studies emphasize the behavioral component of

emotions through several methods such as the study of facial expressions and physiological variables (e.g. skin conduction measure or heartbeat frequency). Moreover discussing feelings with a consumer may be difficult because of the main definition of the term. Feelings can be understood to be an emotion, but also to be a sensation or a functional benefit (I feel freshness, acidity). Therefore, working with projective techniques helps the subject to express emotional feelings through the projection of an image he has built (Anzieu and Chabert, 2004). This methodology can nonetheless be criticized as subjects can elicit emotional feelings during the interview that they wouldn't express in an everyday situation. Therefore the results provided by this kind of methodology should be used carefully.

Finally, the difficulty defining the nature of the affective item felt by the subjects can be a possible bias. Indeed it is necessary to distinguish the emotions that relate to the primed expectations and the related benefits, from the emotions induced by the tasting of the product and therefore the sensory disconfirmation. Indeed conceptual expectations can retrieve a set of emotions (Thomson et al., 2010). Therefore feelings elicited by the consumers should be also carefully analyzed to ensure that they are induced by the sensory disconfirmation and not by the benefit itself.

Appendix 7: Study 3B / Questionnaire of familiarity

Q1. Health-related promotion and prevention measure

(scale from 1 (I strongly disagree) to 7 (I strongly agree))

- I often take pleasure to try improving my health
- Being successful in achieving my healthy objectives drives me to do more (ex: lose weight, reach a fitness level)
- I don't hesitate to make new experiences (ex: buying a new product) if I think that it can improve my health
- I have an opportunity to improve my health, I take the advantage of it right away
- I see myself as somebody that don't hesitate to do his best to improve his health
- I often think about health issues that could happen to me in the future
- I am often worried thinking about doing the wrong thing about my health
- When I am acting for my health, it's often because I am seeking to avoid risk of disease

Q2. Distance to food with probiotics

Q2.1. Knowledge of food with probiotics

Q2.1.1. Perceived knowledge (scale from 0 (I strongly disagree) to 4 (I strongly agree))

- I feel competent about in my knowledge of food with probiotics
- Among my friends, I am the one who know the best of food with probiotics
- Compared to others, I know less about the subject of food with probiotics
- I don't understand much about food with probiotics

Q2.1.2. Objective knowledge (codage 0 (wrong answer or I don't know)/1(right answer))

- All good bacteria are probiotics
 Yes No I don't know
- Probiotics are living bacteria
 Yes No I don't know
- All of the dairy products contain probiotics
 Yes No I don't know
- Most of our immune cells are :
 In the brain In the wall of the intestine In the blood I don't know
- Probiotics are only used in the intestine
 Yes No I don't know
- Some probiotics can alleviate effectively diarrhea
 Yes No I don't know
- Everybody can consume probiotics, there is no contraindication
 Yes No Yes with one exception I don't know

- A regular and adequate consumption of probiotics is enough to remain healthy
 - Yes No I don't know

Q2.2. Implication to food with probiotics

(scale from 0 (I strongly disagree) to 4 (I strongly agree))

- For me, food with probiotics is something really important
- Choosing food with probiotics concerns me personally
- I am able to choose food with probiotics by myself

Q2.3. Consumption habits of food with probiotics

Q2.3.1. Frequency of consumption of food with probiotics

How often do you consume food with probiotics?

- Never or rarely
- Several times a month
- Several times a week
- Once a day
- Two to three times a day
- Four to five times a day
- More than five times a day

How often do you buy food with probiotics?

- Never or rarely
- Several times a month
- Several times a week
- Once a day
- Two to three times a day
- Four to five times a day
- More than five times a day

Q2.3.2. Consumption U&A for food with probiotics

(scale from 0 (Never) to 4 (Daily))

- Do you discuss about food with probiotics with your friends?
- Do you go for food with probiotics shopping yourself?
- Have you take lessons on food with probiotics?
- Do you read books on food with probiotics?
- Do you go on website or blogs on food with probiotics?

In which proportion do you consume food with probiotics alone or with other people?

- Mostly alone Mostly with other people

Q3. Familiarity with Actimel product (ATM)

Q3.1. Objective knowledge of Actimel product (codage 0 (wrong answer or I don't know)/1(right answer))

- Actimel is made from fresh milk :
 - Yes No I don't know
- Actimel is a fermented yoghurt :

Yes No I don't know

- Which specific *Lactobacillus* is contained in Actimel?

Ramnhosus *Acidophilus* *Casei* I don't know

- How many of these specific ferments are contained in Actimel?

10 thousands 10 millions 10 billions I don't know

Q3.2. Frequency of consumption of Actimel

How often do you consume ATM?

Never or rarely Several times a month Several times a week Once a day Two to three times a day Four to five times a day More than five times a day

How often do you consume Strawberry ATM?

Never or rarely Several times a month Several times a week Once a day Two to three times a day Four to five times a day More than five times a day

Q3.3. Consumption U&A for Actimel

(scale from 0 (Never) to 4 (Daily))

- Do you go on website or blogs on ATM?
- In which proportion do you drink Actimel alone or with other people?

Mostly alone Mostly with other people

- When do you drink ATM?(cf screener)

When I get up At breakfast On the go to work In the morning before lunch At lunch In the afternoon At diner or after

Other :_____

- Where do you drink ATM?(cf screener)

At home In public transport In my car At work At the cafeteria Other :_____

- Why do you drink Actimel ? (cf screener)

Q4. Brand implication (put here ATM logo + ATM name)

(scale from 0 (I strongly disagree) to 4 (I strongly agree))

Brand involvement

- This brand is important to me
- This brand is relevant to me
- This brand means a lot to me
- This brand is useless to me
- This brand is trivial
- This brand is beneficial
- This brand is valuable
- This brand is uninterested
- This brand is exciting
- This brand is undesirable
- This brand is appealing

Brand loyalty

- I consider myself loyal to this brand
- I consider this is the only brand of water drinks I need
- I buy this brand whenever I can
- I buy as much of this brand as I can
- This is the one brand I would prefer to buy or use
- I would go out of my way to use this brand
- If this brand was not available, it would make little difference to me

Appendix 8: Detailed analysis of study 3C

A second step is to analyze affective items for the cluster 2 (*Figure 46* **Erreur ! Source du renvoi introuvable.**).

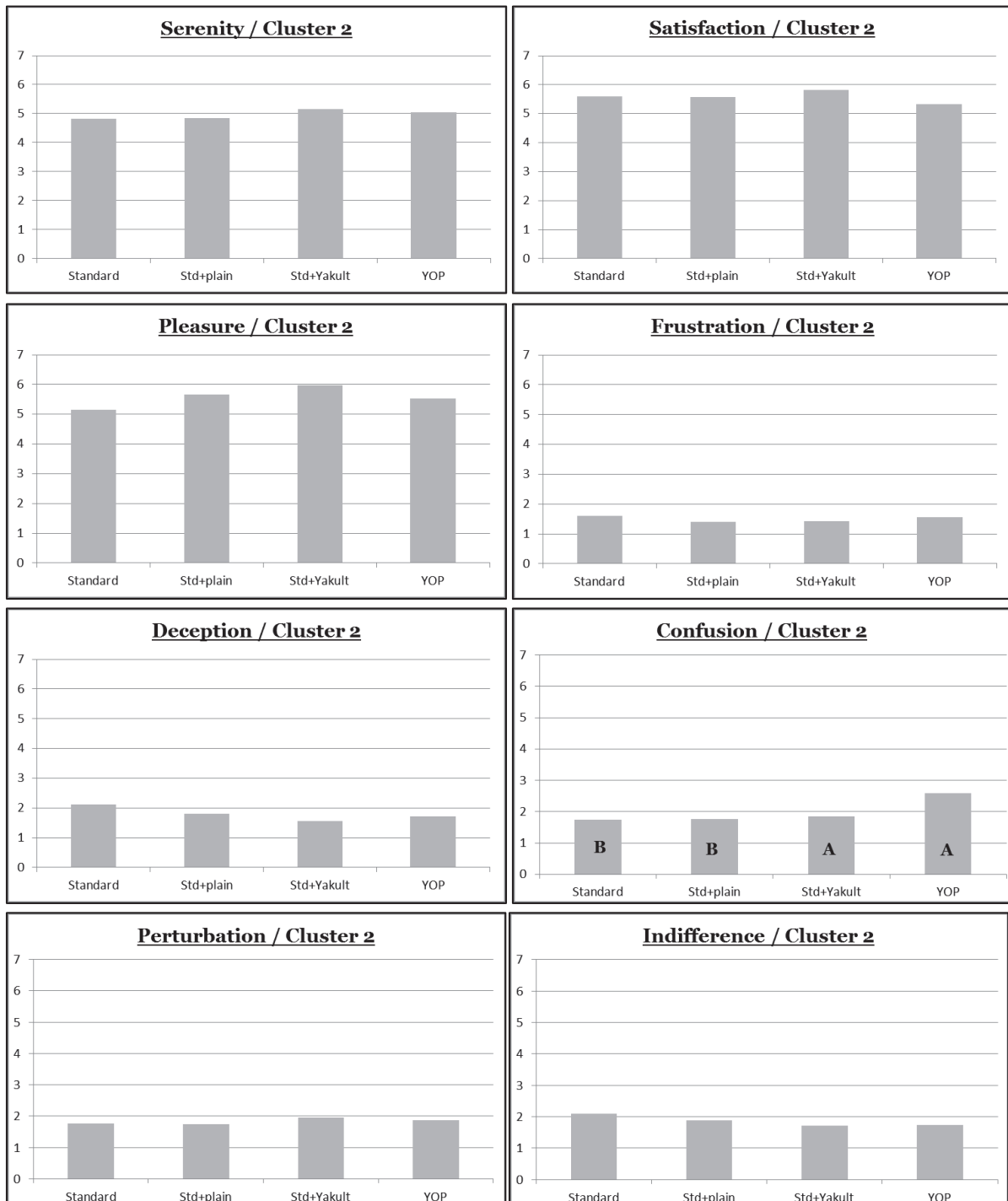
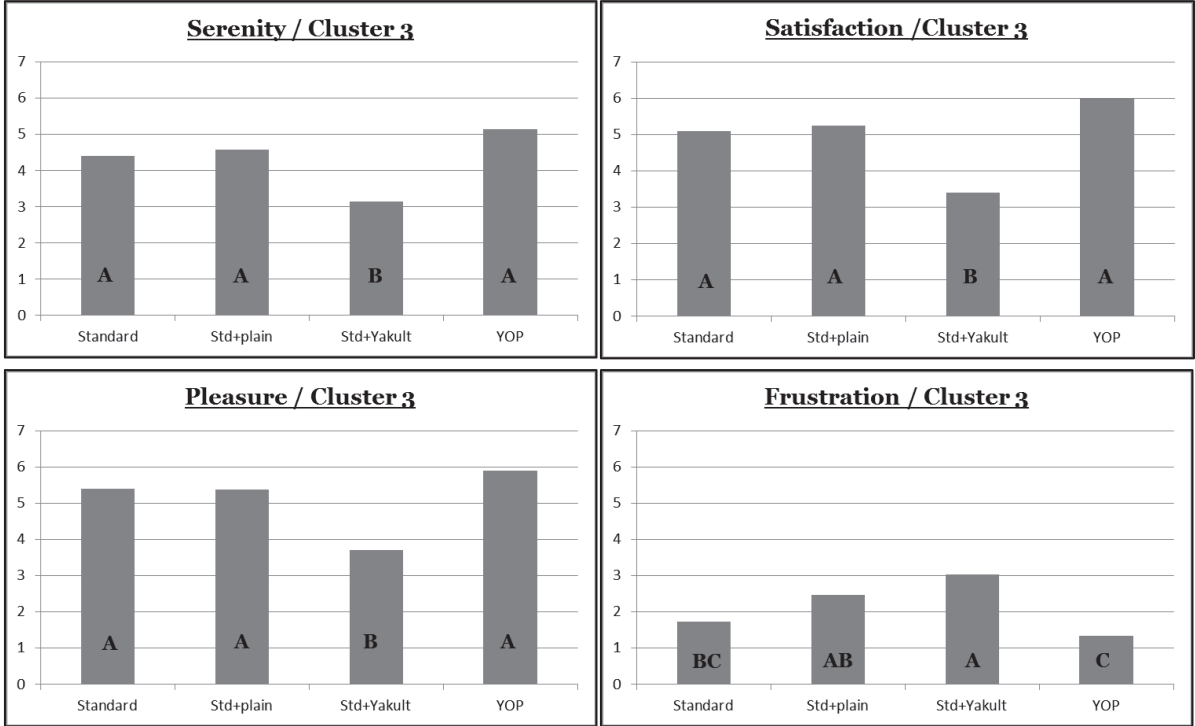


Figure 46: Means of assessment of affective items for each product for cluster 2. Letters in bold show significant differences among products at $\alpha = 10\%$

An analysis of the quotations for affective items provided by cluster 2 show no significant differences between products, except for confusion. For this negative item, ranking of the products is not equivalent to the fitting with expectations. YOP and the mix Yakult have significantly higher quotations for the confusion item, but also for the fitting with expectations. In conclusion, this cluster of subjects is not discriminative for affective items. Regarding the few differences between products for the fit with expectations, almost all the products are close and fit with expectations, this could explain the fact that only one affective item, confusion, is discriminative among products.

Thus, for cluster 2, as there is no disconfirmation of expectations, so there is no discrimination among products by affective states.

Third step is the analysis of affective items for the cluster 3 (*Figure 47* Erreur ! Source du renvoi introuvable.).



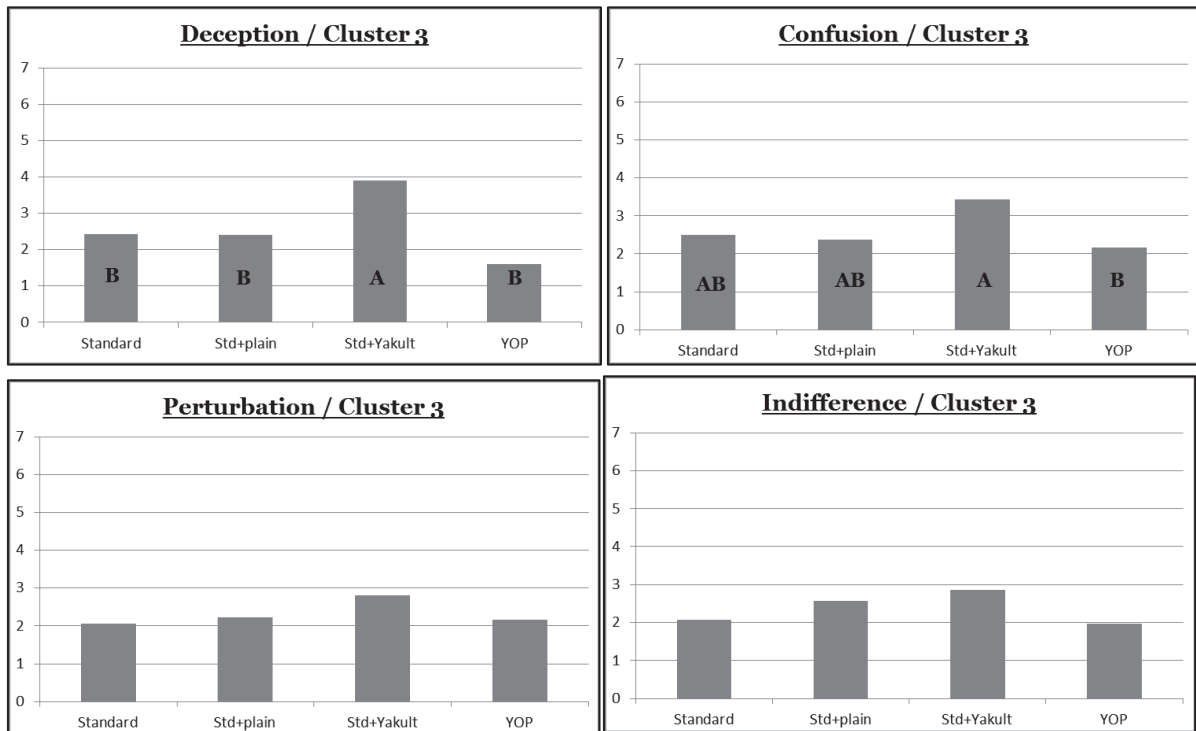


Figure 47: Means of assessment of affective items for each product for cluster 3. Letters in bold show significant differences among products at $\alpha = 10\%$

Regarding cluster 3, results show significant differences among the products for 6 items out of 8. For the three positive items: serenity, satisfaction, and pleasure, significant differences can be shown between the three products: standard, mix with plain and YOP having the highest quotations and the mix with Yakult having the lowest quotation. This is aligned with the results from the analysis of fitting with expectations. The same order of products has been highlighted. However, these three items are less discriminative for the three products (YOP, standard and mix with plain). This can be explained by the low gap between these products on the fit with expectations. Regarding the negative items, only the item deception follows a reverse pattern of quotation compared to positive items, namely the mix with Yakult which has the highest quotation on deception and the lowest fit with expectations. Regarding frustration and confusion, the ranking of products does not reflect a reverse pattern of the fit with expectations. The chart on confusion highlights significant differences between the mix with Yakult and YOP, namely the product fitting the best and the product fitting the least well with the expectations. Frustration is a more discriminative item showing the same significant differences for confusion, but also between standard and the mix with Yakult and also mix with plain and YOP. The ranking of the products is not identical, but is almost the same. Therefore, frustration is better to discriminate samples and more sensitive to the degree of disconfirmation of expectations. Regarding perturbation and indifference, there are no significant differences among products.

To sum-up on cluster 3, most of affective states allow discriminating samples aligned with analysis from fitting to expectations.

The influence of the nature of the disconfirmation on the affective judgment (H3)

Analysis of sensory characteristics

The second analysis for cluster 2 is shown in *Figure 48* and explains the sensory perception inducing the disconfirmation.

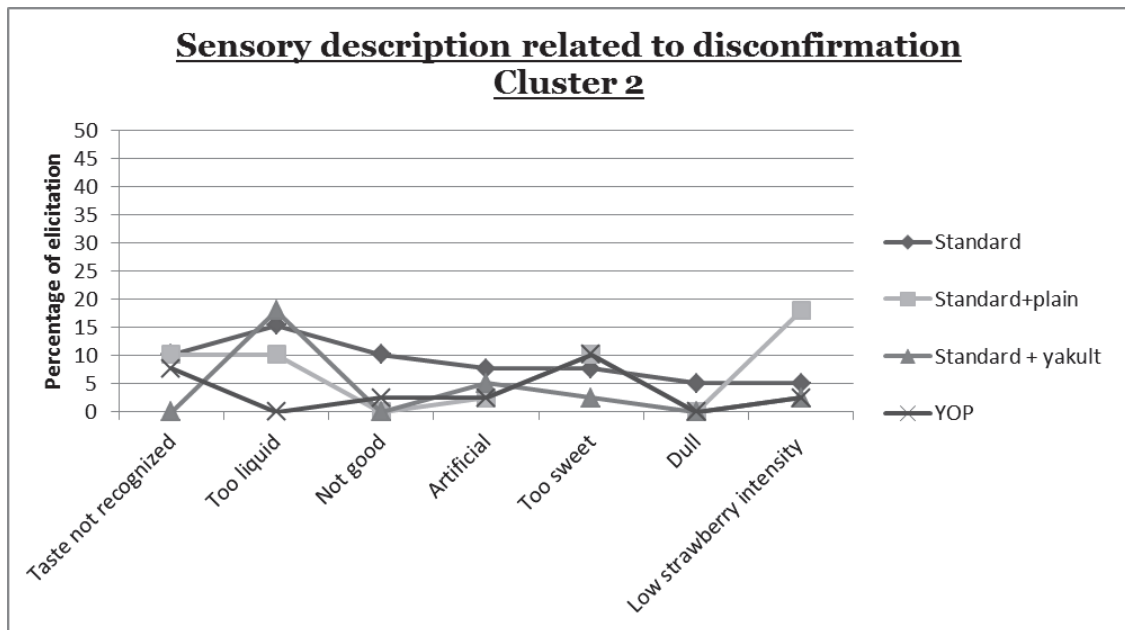


Figure 48: Percentage of elicitations of the reasons why the product does not fit with expectations. Percentage of descriptors superior to 5% have been retained.

For cluster 2, there is no higher percentage of elicitation than 20% for one specific product. There is no sensory disconfirmation of expectations for all the product set. Therefore, results provided by the description are aligned with these conclusions.

The third analysis for cluster 3 can be shown in *Figure 49* and it explains the sensory perception inducing the disconfirmation.

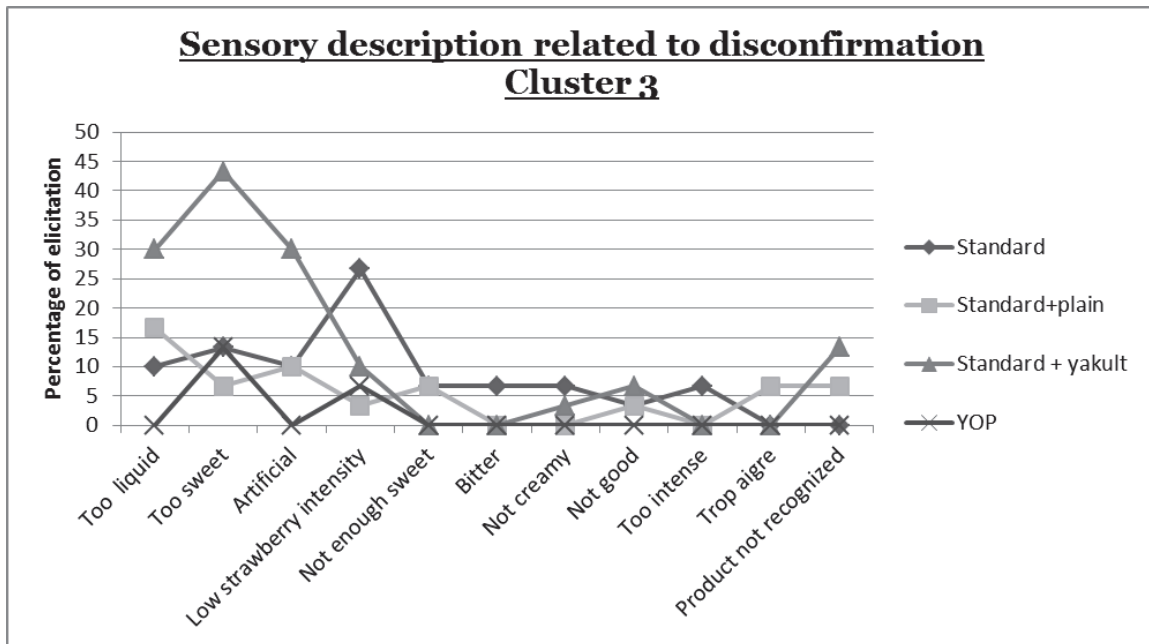


Figure 49: Percentage of elicitations of the reasons why the product does not fit with expectations. Percentage of descriptors superior to 5% have been kept.

The mix with Yakult is described as too sweet (44%), too liquid (30%) and artificial (30%). Moreover, the standard is described by 27% of the subjects as low strawberry intense. The mix with Yakult has the highest degree of sensory disconfirmation of expectations explained by a high sweetness perceived in the product, the texture and the artificial property. The standard has a lower degree of disconfirmation explained by a too low strawberry intensity perceived in the product. However there is no clear higher frequency of elicitation for YOP and the mix with the plain.

[Analysis of benefits](#)

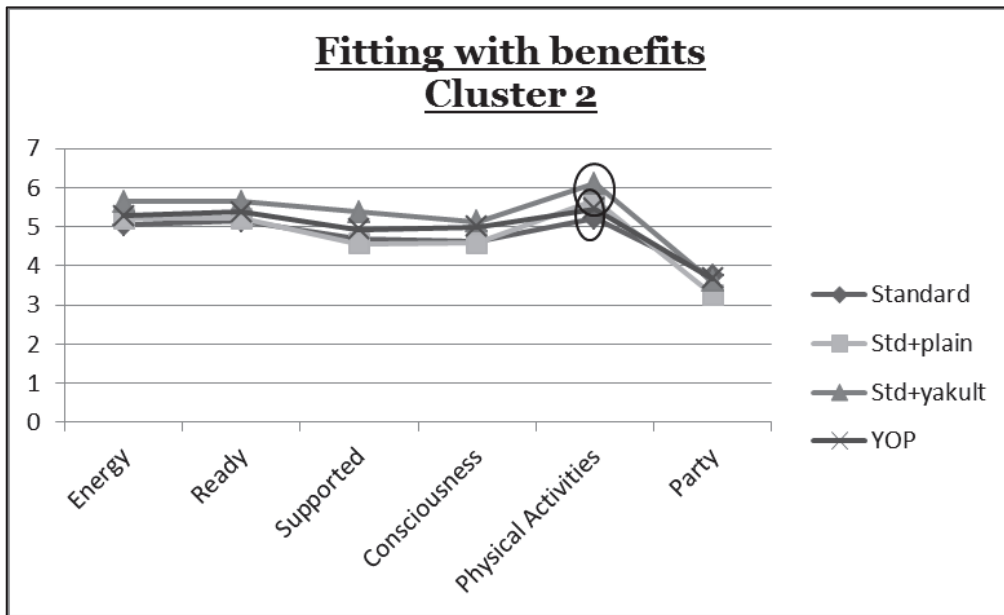


Figure 50: Means of assessment of fitting with benefits for each product for cluster 2. Significant differences at 10% are illustrated by circles

For cluster 2, significant differences on assessment are only visible for the board “Physical activities”. These results are aligned with the absence of the disconfirmation of expectations for these consumers.

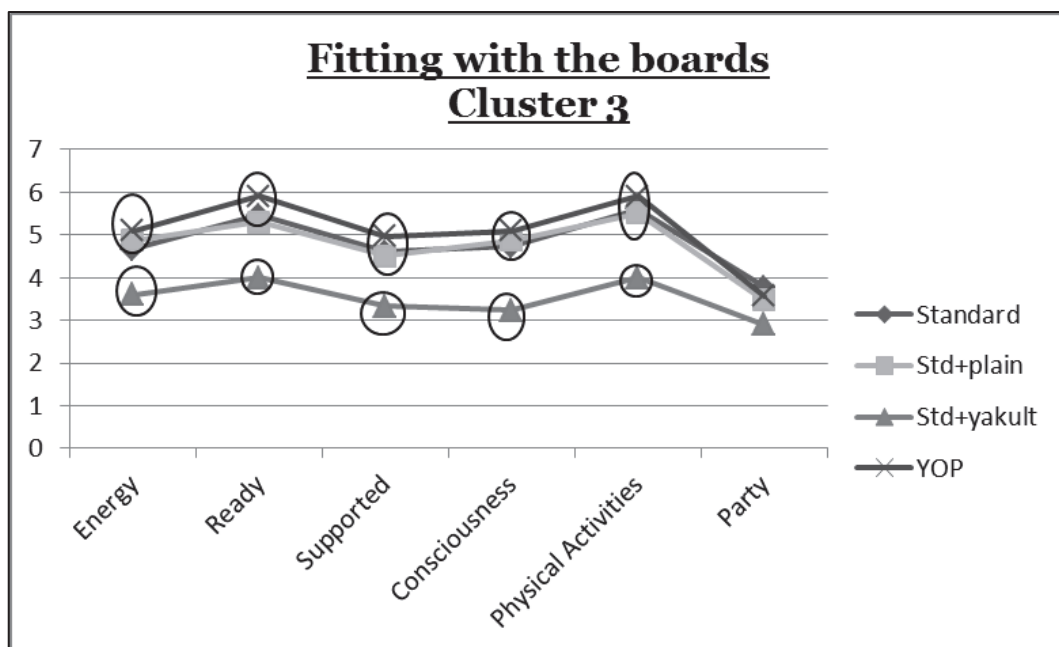


Figure 51: Means of assessment of fitting with benefits for each product for cluster 3. Significant differences at 10% are illustrated by circles

For cluster 3, the results show a significantly lower assessment for the match with the five first benefits for the mix with Yakult. This aligns with the results provided by the analysis of the fitting with expectations.

Analysis of contexts

For cluster 2, analyses provide the same answer as for cluster 1.

Table 19 : Frequencies of check for each product and each context for cluster 2
 Coloration: significant higher frequencies per product between contexts.
 Bold letter: significant differences per context between products.

Cluster 2	Usage just after getting up	Usage for breakfast	Usage on the go before work	Usage during the morning	Usage at lunch	Usage after sports	Usage in the afternoon	Usage during dinner	Usage after dinner	Usage other
Standard	14	32	13	13	6	10	7	1	5	3
Standard + plain	12	37	17	16	2	9	6	1	3	2
Standard + Yakult	15	37	16	16	4	9	5	0	5	2
Yop	13	35	10	18	5	8	4	1	5	5

“Usage for breakfast” is the only context showing a significantly higher frequency of association. The same conclusion can be made about the priming. There are no differences among the products on context fitting which aligns with the fact there are no clear disconfirmant product for this cluster of consumers.

For cluster 3, the same conclusion can be made based on the significant differences among contexts (Table 20).

Table 20: Frequencies of check for each product and each context for cluster 3.
 Coloration: significant higher frequencies per product between contexts.
 Bold letter: significant differences per context between products.

Cluster 2	Usage just after getting up	Usage for breakfast	Usage on the go before work	Usage during the morning	Usage at lunch	Usage after sports	Usage in the afternoon	Usage during dinner	Usage after dinner	Usage other
Standard	13	27	11	14	2	10	6	2	5	2
Standard + plain	11	23	10	10	2	9	3	0	3	0
Standard + Yakult	7	18	5	8	0	8	3	1	2	4
Yop	10	27	12	15	2	12	5	2	6	4

« Usage for breakfast » has a significantly higher association to all the products highlighting the success of the contextualization. Regarding differences among products, the mix with Yakult has the lowest frequency for « Usage for breakfast » which is aligned with the ranking of products on the fit with expectations. Indeed, as cluster 3 is a group of consumers rejecting the mix with Yakult as a clear disconfirmant product, this explains why this product has been significantly less associated with the primed context. Another point is that even if YOP and the standard have been significantly discriminated on the fit with expectations, they have the same frequencies of association with the right context.

Appendix 9: Article submitted in Food Quality and Preference

What can consumers really do in a sorting task of strawberry fresh dairy products?

Rizzo-Ivanoff Sabine^{1,2,3}, Rogeaux Michel¹, Boesen-Mariani Sabine¹, Giboreau Agnès^{2,3}

1. Sensory and Behavior Science

Danone Research

RD 128, 91767 Palaiseau Cedex

France

2. Research Center for Food and Hospitality Research

Institut Paul Bocuse

69130 Ecully

France

3. Université Lyon 1, CRNL

Abstract

Industries currently run tests with consumers in order to get their insights on the perceptions of a product range. Asking the consumer to follow a complete procedure has implications on their attention span. When the consumer is dealing with different kinds of tasks, this attention is somewhat flexible. Thus, the reliability of the information obtained by these consumer tests can be challenged. The Free sorting task is frequently used in sensory evaluation of products in industry in order to understand consumers' perception of a product space. The aim of this research is to assess the reliability of results when dealing with repetitive procedures applied to the sorting task. The relevancy will be assessed through the study of the repeatability of the sorting task by naïve subjects in blinded presentation. 36 subjects were recruited to sort 9 different strawberry yoghurts. Three sorting tasks were realized on intervals of 30 minutes and one week. Results show a good repeatability on long term delay. On the contrary, repeatability on short term interval is not conclusive. To conclude, the results allow us to provide recommendations on what we can ask of consumers in respect to their time of required attention, the difficulty of the task and the lapses of time between sessions.

Key-words

Sorting; Repeatability; Consumer; Yoghurts; Description

Highlights

- We discuss the ability of consumers to follow three sorting tasks on fresh dairy products at different delays
- We highlight the poor repeatability of subjects especially on a short-term delay
- We provide recommendations on consumer test designs to avoid attentional bias

1. Introduction

Consumer tests are applied in order to better understand perception and predict future choices in real life (Köster, 2009). Consumers have to taste products and assess at the same time several sensory and conceptual aspects. In other words, naïve subjects have to follow a procedure that they are not used to. This induces an expense of cognitive effort and time for them. More and more methods are involving consumers with the ultimate objective of getting clear recommendations on their sensory perceptions (Ares et al., 2014; Delarue and Sieffermann, 2004; Meyners, 2016; Moussaoui and Varela, 2010; Vidal et al., 2014). These studies show that naïve subjects are able to provide almost the same results as experts. However, experts are highly trained on description and on specific product ranges, meaning that they are used to staying concentrated for a specific length of time while tasting and assessing the products simultaneously. Asking the consumer to follow the whole procedure requires their selective attention, meaning that the subject has to focus on specific attributes of the stimulus (Masmoudi et al., 2010). This sustained attention is described as the concentration needed for the subjects to accomplish the task (Spence, 2002). This type of attention is quite consuming of cognitive resources.

Thus, a possible bias due to a lack of consumers' attention (Jaeger, 2014) is the induction of wrong predictive answers. Jaeger presented at the end of the 6th Eurosense conference (2014) a study showing the poor commitment of consumers at the end of a test (Jaeger, 2014). Simple instructions were given to subjects: a scale was presented with a square below. Consumers were asked to not write on the scale but to tick the square. Results showed that most of them still wrote on the scale. Therefore, even for a simple task and taking into account the length of the procedure and the attention subjects have to pay to the assessment, it seems necessary to challenge what can be asked of consumers to keep the results closer to their real perception.

To illustrate this idea, we use as an example one of the easiest tasks: free sorting. The reliability of the results was assessed through the study of the repeatability of the sorting task with naïve subjects under blinded presentation.

The Sorting task is a methodology frequently used in consumer studies (Faye et al., 2004; Mielby et al., 2014), having psychological foundations (Pothos et al., 2011). It reveals the categories in subjects' minds in a quick way. This methodology is intuitive and easy to apply, even with children (Varela and Salvador, 2014). Many studies show that consumers, naïve subjects not trained in description, can follow the procedure quite easily and we can see the same results as expert panelists (Valentin and Chollet, 2000). Subjects are asked to group products according to their perceived similarities and dissimilarities. The method has been applied on odors (MacRae et al., 1992), beers (Chollet et al., 2011), water (Falahee and MacRae, 1997), virgin oil (Santosa et al., 2010), solid foods such as cereals (Cartier et al., 2006), or yoghurts (Cruz et al., 2013). It has also been applied to non-food products such as tissues (Faye et al., 2004).

The repeatability of the sorting task with consumers has already been studied on 17 odors with eight naïve subjects (*MacRae et al., 1992*). Participants went through four repetitions in one week. Results highlighted a consistent grouping of the molecules and an easiness to achieve the task. It was also studied on waters (*Falahee and MacRae, 1997*): mineral, tap water and distilled proposed with blended samples. Twenty subjects assessed nine blinded products. Results showed a grouping of duplicates and a good repeatability between the five sessions done by the subjects. Regarding the results on the consistency of assessors, only three assessors showed at least a fair agreement on the five sessions. Another study was realized on beer (*Chollet et al., 2011*). Sixty-eight naïve subjects did two repetitions with a 15 minute interval where products were presented blindly. The results showed good repeatability and a stability of assessors' categorization among sessions.

Therefore, sorting task seems to be repeatable with naïve subjects for drinks but without consensual results on agreement between sessions. However, drinks or odors are perceived less satiating than solid food (Hogenkamp et al., 2012). In fact for the same amount of calories, a drink is consumed more quickly and bypasses the association between sensory signals sent

to the brain and the satiety effect. Moreover, expectations linked to satiety are higher for a solid food than a drink related to sensory cues (Hogenkamp et al., 2012). The implication for the sorting task with solid food can be a difficulty tasting and discriminating all of the samples because of saturation. Another repeatability study on cereal products (Cartier et al., 2006) features 24 consumers who sorted 14 kinds of cereals. They ate them dry in blind. Five repetitions were planned during the course of one week. Results proved the repeatability of the sorting task on solid dry food. However, as texture is an important driver of satiety, it can impact the results of repeatability on more textured wet food.

The repeatability of the sorting task on solid food taking into account individual reliability among sessions is still under investigation. Moreover, the addition of fruit specific aromas can also have an impact on the results. As *Chollet et al* highlighted in their study (Chollet et al., 2011), contamination between products can impact the results. For example, drinking a stronger beer before a lighter one can explain the limited grouping of duplicates. In other words, strong aroma notes coming from the first sample can be a source of saturation and may distort the perception of the second sample.

We aimed at studying the repeatability of free sorting task with naïve consumers on strawberry dairy products. In addition, we studied consumers' ability to manage the procedure in a more difficult situation. Repeatability was assessed at two different intervals: long-term (one week) and a short term (half an hour). The short-term interval is a way to assess the relevance of the results obtained after one hour of concentration.

2. Method

2.1. Procedure

The experiment was divided into three sessions (figure 1). Between the first and the second sessions, 30 a minute delay was imposed. Between the second and the third sessions, a one week delay was implemented.

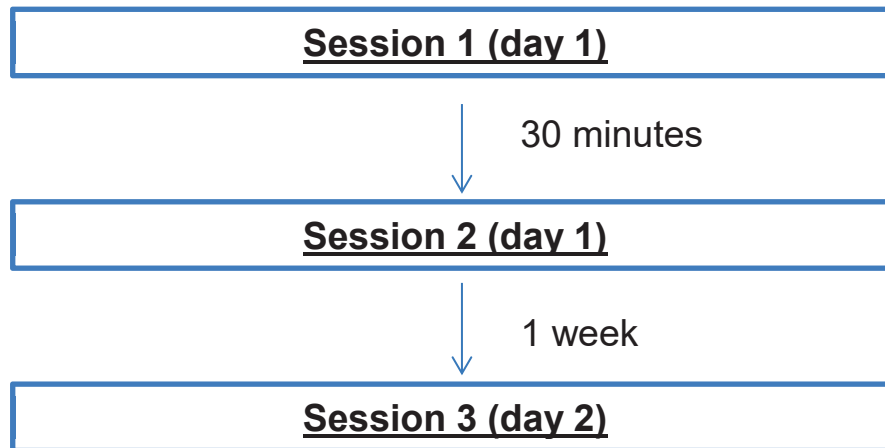


Figure 1. Global Scheme of the study

2.2. Sorting task procedure

In each session, subjects performed a free sorting task according to the following instructions: *“Look at all the products in front of you, smell and taste all of them. Then sort them according to the similarities you perceive. You are free to make between 2 and 9 groups of products”*. The products were presented all together in a random order between subjects.

2.3. Sample selection

A pre-test was run on eleven products to select the product range. We first verified that the product space was not too difficult to assess. In other words, we checked to make sure the consumers were able to make more than two groups of products. We also checked to make sure some of the products were not too easy to discriminate. To do this, we removed two products

that were systematically grouped alone by all the consumers in the pre-test. Nine strawberry dairy products were selected out of eleven. In parallel, a sensory descriptive profile was made by an expert panel of assessors. The following products were selected:

- Three fresh cheeses called “fromage blanc” in French market, highly textured: Jockey and Activia Fromage Blanc containing fruit pieces, and Gervais with a specific pink color and without pieces.
- Four yoghurts with not as thick of a texture texture: Activia, Recette Crémeuse with fruit pieces, Les 2 Vaches with little fruit fibers, almost like puré and Velouté fruit without fruit pieces.
- Two low fat dairy products: Taillefine and Activia 0% with fruit pieces and low sweetness.

A standard product was chosen to be duplicated: Activia. Ten products were tasted by consumers.

2.4. Subjects

36 naïve consumers were recruited from the database of the Research Center of the Paul Bocuse Institute. All the consumers were consumers of strawberry dairy products at least once a month. The partition of gender was 70% women and 30% men. About 34% of the participants were between 18 and 30 years of age, 30% between 31 and 50 years old and 36% were more than 51 years old.

2.5. Statistical analysis

Three criteria were assessed to check the validity of the repeatability of the free sorting task. The first criteria is the validity of the sorting replication, means the test of similarity between the three configurations of the samples by the whole panel of assessors. The second criteria is the validity of sorting replication at an individual level meaning the variability between sessions for each assessor. The third criteria is the grouping of duplicates in order to check the quality of discrimination of the assessors.

For each subject, a similarity matrix was calculated. This matrix was a binary matrix, product x product where a 0 was indicated if the products were not in the same group. The individual matrices are aggregated to give an overall similarity matrix.

The overall matrix of similarities was analyzed by Multidimensional Scaling (MDS) (Faye et al., 2004; Kruskal, 1964). Configurations were selected for optimal Kruskal stress i.e. less than 0.02 (Faye et al., 2004). Coordinates of the best configuration on MDS dimensions were analyzed by a Hierarchical Ascending Classification (HAC) with square Euclidian distance and Ward's method (Giboreau et al., 2001; Lawless, 1989). The histogram of the level index indicated the index corresponding to the number of classes that must be kept (Lebart, 1997).

Analysis of global sorting repeatability: Computation of the three tables of dimensions calculated by MDS from the three sessions were analyzed by Multifactorial Analysis in order to obtain the average position of the samples for the three sessions and the distance for each product between sessions. We also calculated Adjusted RV coefficients (ARV) in order to assess the repeatability between the three sessions (Chollet et al., 2011; El Ghaziri and Qannari, 2015; Escoufier, 1973; Faye et al., 2004). The coefficient had to be superior than 0.7 to conclude that the configurations were close.

- Analysis of individual variability between sessions: Adjusted Rand Index (ARI) was calculated for each subject between two sessions to assess the individual repeatability, i.e the proximity between the two partitions (Faye et al., 2004; Hubert and Arabie, 1985). The index ranged from -1 to 1. When ARI takes negative values partitions are completely different. When

ARI equals to 0 the agreement between partitions is due to chance only. When the two partitions are exactly the same, the index is equal to 1(Courcoux et al., 2014).

- Analysis of duplicate: Percentages of subjects who grouped together the two identical products for each session were calculated.

3. Results

3.1. Global sorting repeatability

Session 1 and session 3 provide close configurations of products (ARV coefficient = 0.772, p-value<0,001). Regarding comparison between session 2 and sessions 1 and 3, RV coefficients are below 0.7 preventing us from concluding on a similarity of products configurations (table 1).

Table 1. Adjusted RV coefficients calculated between each session of repetition on coordinates of configurations obtained with MDS.

RV coefficient	Session 1	Session 2	Session 3
Session 1	1,00		
Session 2	0,343	1,00	
Session 3	0,772	0,080	1,00

Therefore, based on these indices we can conclude that:

- Subjects made almost the same sorting of products in sessions 1 and 3.
- Sorting made by subjects in session 2 is different from the other sessions.

From MFA analysis (figure 2), the positioning of the products for the three sessions shows that most of the samples have a preferential spreading of the session two opposite to sessions one

and three. Only Gervais and Velouté have a closer positioning of sessions two and three opposite to session one.

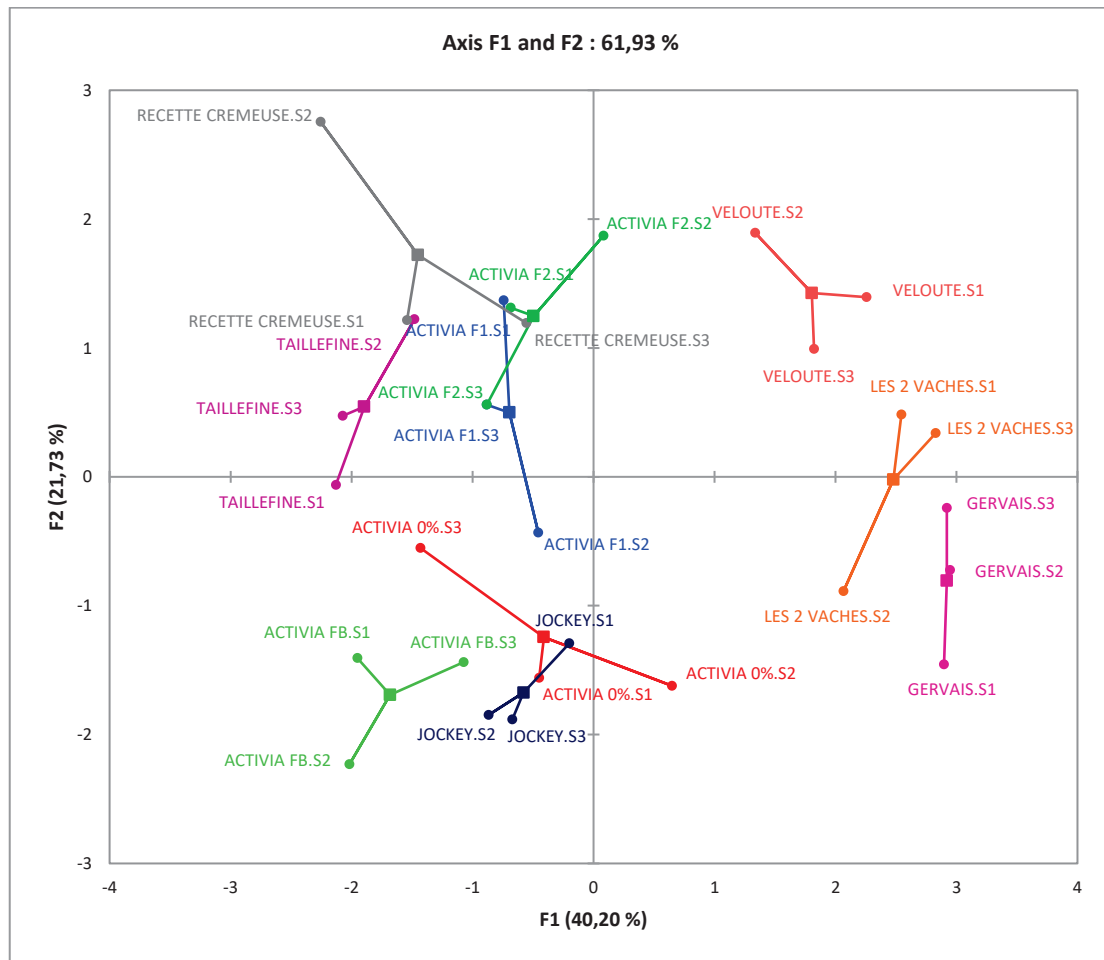


Figure 2. Average configuration calculated by FMA. For each product, the position of each session is specified on the mapping.

These results allow us to conclude that, for most of the samples, consumers seem to show strong repeatability on the sorting task with blind samples between sessions one and three. Opposition of the sample positioning in session two allows us to conclude that subjects show limited repeatability on the sorting task in session two. Thus, after one hour of procedure (30 minutes for the first session plus 30 minutes of wait until the second), assessors are not anymore able to provide a stable categorization of the product range even with a pause. We can

also observe that the range of products tasted during the sessions is highly homogeneous and therefore the product space was quite difficult to differentiate.

3.2. Individual sorting repeatability

Individual repeatability across the three sessions was assessed by calculating ARI. In the figure 3, results show that the percentage of ARI superior to 0 is significantly much higher in session one versus session three ($p < 0,05$). This observation demonstrates that assessors are more repeatable between session one and session three at an individual level, confirming the first results obtained through the global analysis.

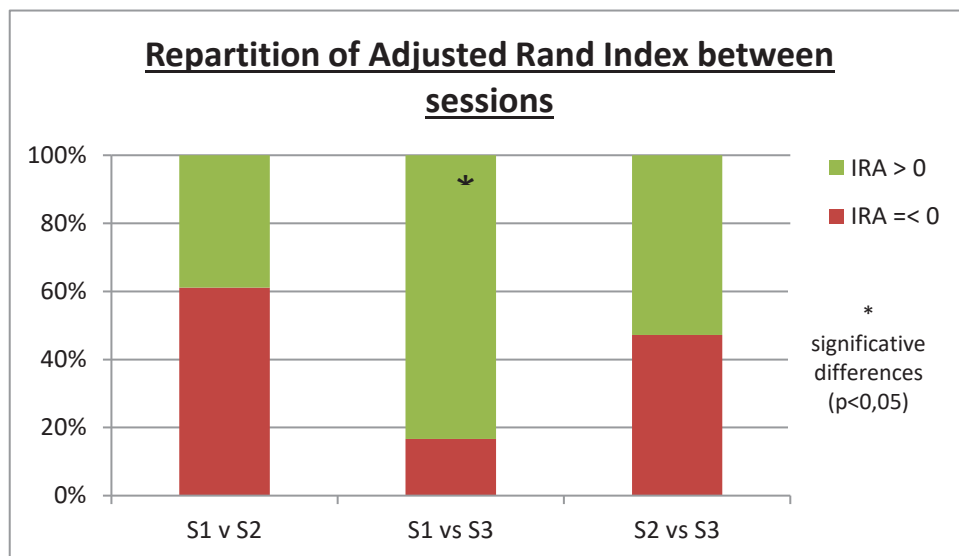


Figure 3. Percentage of subjects that grouped together the two duplicated samples.

However, less than 10% of the subjects obtained an ARI superior to 0,5, meaning that there is not a high percentage of almost identical partitions. Thus, observation on a good repeatability between sessions one and three made through a global analysis cannot be confirmed on an individual level. In other words, even if comparison between percentages of ARI allows us to conclude that subjects were more repeatable on a long-term delay than in the short term, we cannot conclude on the good repeatability of the free sorting task among the three sessions.

3.3. Sorting of duplicate samples

The percentage of subjects that grouped together identical samples for each session can be seen in figure 4.

There are no significant differences between the three sessions. Nevertheless, the lowest percentage (below 50%) is performed on session two which is congruent with previous results. In the three sessions the percentage is quite low showing that consumers had some difficulties discriminating the samples.

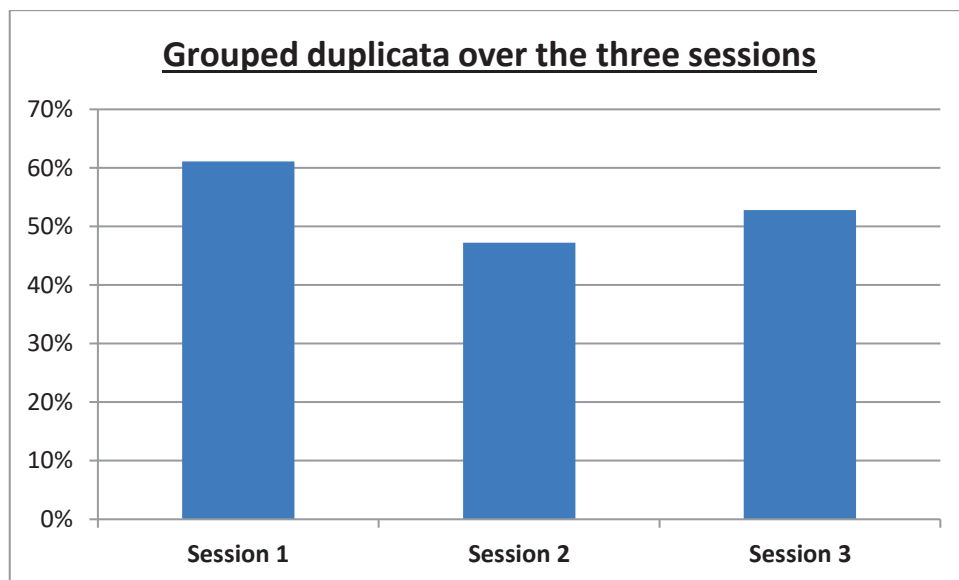


Figure 4. Percentage of ARI in function of their value for all the subjects.

4. Discussion

The purpose of this research was to challenge the quality of responses provided by subjects regarding attentional biases through the assessment of the repeatability of a free sorting task over three sessions. By comparing the first session with the second session, the results proved the poor relevancy of results obtained after one hour and a half of sustained attention (session

one and session two). Looking at the long-term repeatability, i.e comparison between sessions one and three, results are closer to session one. However, the results prevent us from concluding on a good repeatability between sessions one and three.

4.1. Saturating effect due to the short delay

The lower quality of repeatability between sessions one and two can be explained by the short interval between them. In the study on beer (Chollet et al., 2011), only 15 minutes separated the two sessions. The products tested were liquid and could be spat out by consumers, limiting the satiating effect compared to tasting yoghurts. In fact, the range of products tasted by the consumers in our study can have two saturating effects. Firstly, the strong lasting component in the strawberry aroma may have impacted the tasting, even 30 minutes after. Secondly, some of the samples were highly textured inducing a covering effect after swallowing. This interpretation is supported by the conclusions given through duplication analysis. The low percentage of subjects that grouped together duplicate samples can be interpreted as Chollet et al (Chollet et al., 2011) : the strong aroma of a product and the texture in the mouth may have impacted the tasting. Indeed, Chollet et al conclude in their study on a possible contamination between the beers (around 40% of subjects categorized together the identical samples). When a strong beer was tasted before a lighter one, it became difficult for the consumer to categorize them because the intensity of the aroma of the first beer can saturate the receptors in the mouth and modify the perception of the second one. In the same way for the strawberry aroma, some products may have contaminated the full range. Moreover, this reinforces the idea that the range of products was quite close in terms of texture and taste and so quite hard to discriminate. This is congruent with the fact that we didn't find any link between frequencies of consumption and individual repeatability or regrouping of duplicate samples. The first hypothesis was that if subjects are used to consuming the products, they may differentiate them more easily. This hypothesis is not confirmed here. However, these physiological effects that induce tiredness have already been quite thoroughly studied, especially in expert subject cases (Depledge, 2009).

4.2. Difficulties related to the length of product range

Ten products were tasted by the consumers. This can be considered as too difficult for a consumer and inducing early saturation. However, sorting results show that for the three sessions, consumers were able to discriminate samples in three or four groups. Moreover, results provided on the duplicate positioning on the first sessions show that 60% of the subjects were able to group together the two duplicates. Thus, the length of the product range is not per se a limit in the quality of responses provided by subjects but more related to a saturation effect for sessions two and three.

4.3. Number of consumers

The size of the consumer panel can be a limit. Indeed, most of the studies on consumer perceptions are made on large panels of subjects in order to have good quality of statistical criteria. Rather, the test was conducted with 36 naïve subjects. In comparison to previous research on repeatability of free sorting task, the number of subjects is higher than most of the studies. In addition, for the global assessment of the product range, use of the Adjusted RV coefficient counteract the effects of small numbers of individuals (El Ghaziri and Qannari, 2015).

4.4. Using a warm-up

Differences between sessions one and two can be explained through the warm-up effect. Indeed, our consumers had never done a sorting task before. Thus, session one acted as a warm-up for them to understand the methodology. Consumers should therefore have been more skilled in the methodology during sessions two and three. However, the closer proximity of results provided by sessions one and three than by sessions two and three dismisses this hypothesis. Nevertheless, providing a first example of the task on tissues, for example, to better understand the methodology could improve the quality of the results. This could also induce a higher use of attentional resources spent by the consumers.

4.5. Memorization effect

Looking at the results obtained for the comparison of repeatability between sessions three and two and sessions one and two, the RV coefficient is not sufficient to investigate the stability of the sorting map. Taking a deeper look at individual results can give other insights into the results. In other words, the results on individual repeatability for the comparison of sessions two and one and sessions two and three can be explained by the memorization of the samples by the consumers. As Mojet and Koster show, thickness and creaminess, two important criteria in texture assessment, are well remembered by consumers for the yoghurt category (*Mojet et al, 2005*). Results from session one show a grouping of products among fruit pieces with a clear distinction between Les 2 Vaches, Gervais, Velouté (without big fruit pieces) and the others. Results from session three show a clear distinction among texture first and then among fruit pieces. These results can be interpreted as an example of memorization by the consumers of the range of samples among the criteria enhanced by Mojet et al (*Mojet et al, 2005*).

4.6. Warnings for the design of consumer tests

This result can be also taken as a warning for the design of consumer tests. Indeed, when some are dealing with consumer insights, precautions are necessary when deciding on the number of tasks, range of products to be tasted or the delay imposed on the assessors. In this study, even with the same cognitive task, results through short intervals are poor. The more the tasks asked to the consumers are different, the more flexible they needed to be. In the next few years of sensory research, using consumers as sensory assessors will be an advancement (Meiselman, 2013). More and more sensory studies are being explored with consumers in order to save in training time. This gain should not decrease the quality of results. Key points of control should be observed to design the procedure:

- Clear instructions must be given to consumers. Pre-tests on the sorting task for the study have been implemented and showed that clear objective details on the procedure

consumers have to follow should be given. Even with a rework of the instruction, one consumer was removed from the set because of a lack of understanding of the task required. Additionally, quitting is an important adaptive behavior when the task is judged as too complex for the subject (Silvia et al., 2014).

- Time spent by the subjects is key. The more that is asked of the consumers, even with a pause, the higher the risk to have a bias in the results. Results on short-term interval emphasize this aspect. A recommendation is therefore to alert the consumer to the multiple tasks that they will have to follow. Their expectations of the task demand will influence the attentional allocations they will follow and also increase the efficiency of memory retrieval during the task (Rummel and Meiser, 2013).
- The difficulty and variability of cognitive tasks. Attention is a top-down process influencing the perception of consumers. Inducing a bias by reducing their level of attention will bias their perception and therefore impact the results.

On the other hand, this study provides also a warning when we want to know more about consumers' perception. To manage the saturation issue, easiness of the methodology or timeliness can ensure avoiding biases on the results and can lead the results closer to the reality of perception.

4.7. Providing results based on individuals

The conclusions provided based on the overall panel of subjects and based on the interindividual analysis are not completely similar. Indeed, the analysis made on ARI highlighted the fact that subjects were not repeatable compared to the overall analysis showing that configurations of both sessions were closed. This is also a warning regarding the analysis of the consumer test displayed on the overall panel without taking into account the differences of assessment between subjects.

To conclude, the results allow us to provide recommendations on what we can ask of consumers. This research should be continued. For example, adding a session four at a 30

minute delay after session three should be a way to validate the poor level of quality of session two. Some questions could also be added during the test to provide more information on the level of concentration of the consumers.

Results obtained in this study could be expanded to a wider range of methodologies. Even if sorting task is an easy methodology to be used with consumers because it's time-efficient and quite robust, the comparative way of presenting the samples is more difficult than for monadic.

Acknowledgments

The authors would like to thanks Rachida, Ivanna, Marie, and Elodie students in Lyon 3 university, for their support in the field. We would like to thanks also for the support on English translation Dr. Carol-Anne Hartwick.

References

- Ares, G., Antúnez, L., Giménez, A., Roigard, C.M., Pineau, B., Hunter, D.C., and Jaeger, S.R. (2014). Further investigations into the reproducibility of check-all-that-apply (CATA) questions for sensory product characterization elicited by consumers. *Food Qual. Prefer.* *36*, 111–121.
- Cartier, R., Rytz, A., Lecomte, A., Poblete, F., Krystlik, J., Belin, E., and Martin, N. (2006). Sorting procedure as an alternative to quantitative descriptive analysis to obtain a product sensory map. *Food Qual. Prefer.* *17*, 562–571.
- Chollet, S., Lelièvre, M., Abdi, H., and Valentin, D. (2011). Sort and beer: Everything you wanted to know about the sorting task but did not dare to ask. *Food Qual. Prefer.* *22*, 507–520.
- Courcoux, P., Faye, P., and Qannari, E.M. (2014). Determination of the consensus partition and cluster analysis of subjects in a free sorting task experiment. *Food Qual. Prefer.* *32, Part A*, 107–112.
- Cruz, A.G., Cadena, R.S., Castro, W.F., Esmerino, E.A., Rodrigues, J.B., Gaze, L., Faria, J.A.F., Freitas, M.Q., DELIZA, R., and Bolini, H.M.A. (2013). Consumer perception of probiotic yogurt: Performance of check all that apply (CATA), projective mapping, sorting and intensity scale. *Food Res. Int.* *54*, 601–610.
- Delarue, J., and Sieffermann, J.-M. (2004). Sensory mapping using Flash profile. Comparison with a conventional descriptive method for the evaluation of the flavour of fruit dairy products. *Food Qual. Prefer.* *15*, 383–392.

- Depledt (2009). Évaluation sensorielle – Manuel méthodologique (3e éd.) (Lavoisier).
- El Ghaziri, A., and Qannari, E.M. (2015). Measures of association between two datasets; Application to sensory data. *Food Qual. Prefer.* 40, *Part A*, 116–124.
- Escoufier, Y. (1973). Le Traitement des Variables Vectorielles. *Biometrics* 29, 751–760.
- Falahee, M., and MacRae, A.W. (1997). Perceptual variation among drinking waters: The reliability of sorting and ranking data for multidimensional scaling. *Food Qual. Prefer.* 8, 389–394.
- Faye, P., Brémaud, D., Durand Daubin, M., Courcoux, P., Giboreau, A., and Nicod, H. (2004). Perceptive free sorting and verbalization tasks with naive subjects: an alternative to descriptive mappings. *Food Qual. Prefer.* 15, 781–791.
- Hogenkamp, P.S., Mars, M., Stafleu, A., and de Graaf, C. (2012). Repeated consumption of a large volume of liquid and semi-solid foods increases ad libitum intake, but does not change expected satiety. *Appetite* 59, 419–424.
- Hubert, L., and Arabie, P. (1985). Comparing partitions. *J. Classif.* 2, 193–218.
- Jaeger, S.R. (2014). *Sensory & Consumer Research anno 2014: What's next?* (Copenhagen, Denmark).
- Köster, E. (2009). Diversity in the determinants of food choice: A psychological perspective. *Food Qual. Prefer.* 20, 70–82.
- MacRae, A.W., Rawcliffe, T., Howgate, P., and Geelhoed, E.N. (1992). Patterns of odour similarity among carbonyls and their mixtures. *Chem. Senses* 17, 119–125.
- Masmoudi, S., Rim+©, B., Naceur, A., Baddeley, A., Lafortune, L., and Reeve, J. (2010). Du percept à la décision: Intégration de la cognition, l'émotion et la motivation (De Boeck Sup+©rieur).
- Meyners, M. (2016). Temporal liking and CATA analysis of TDS data on flavored fresh cheese. *Food Qual. Prefer.* 47, *Part A*, 101–108.
- Mielby, L.H., Hopfer, H., Jensen, S., Thybo, A.K., and Heymann, H. (2014). Comparison of descriptive analysis, projective mapping and sorting performed on pictures of fruit and vegetable mixes. *Food Qual. Prefer.* 35, 86–94.
- Moussaoui, K.A., and Varela, P. (2010). Exploring consumer product profiling techniques and their linkage to a quantitative descriptive analysis. *Food Qual. Prefer.* 21, 1088–1099.
- Pothos, E.M., Perlman, A., Bailey, T.M., Kurtz, K., Edwards, D.J., Hines, P., and McDonnell, J.V. (2011). Measuring category intuitiveness in unconstrained categorization tasks. *Cognition* 121, 83–100.

Rummel, J., and Meiser, T. (2013). The role of metacognition in prospective memory: Anticipated task demands influence attention allocation strategies. *Conscious. Cogn.* *22*, 931–943.

Santosa, M., Abdi, H., and Guinard, J.-X. (2010). A modified sorting task to investigate consumer perceptions of extra virgin olive oils. *Food Qual. Prefer.* *21*, 881–892.

Silvia, P.J., Moore, L.C., and Nardello, J.L. (2014). Trying and Quitting: How Self-focused Attention Influences Effort During Difficult and Impossible Tasks. *Self Identity* *13*, 231–242.

Spence, C. (2002). Multisensory attention and tactile information-processing. *Behav. Brain Res.* *135*, 57–64.

Valentin, D., and Chollet, S. (2000). Le degré d'expertise a-t-il une influence sur la perception olfactive ? Quelques éléments de réponse dans le domaine du vin. *Année Psychol.* *100*, 11–36.

Varela, P., and Salvador, A. (2014). Structured sorting using pictures as a way to study nutritional and hedonic perception in children. *Food Qual. Prefer.* *37*, 27–34.

Vidal, L., Silva Cadena, R., Correa, S., Ábalos, R.A., Gómez, B., Giménez, A., Varela, P., and Ares, G. (2014). Assessment of Global and Individual Reproducibility of Projective Mapping with Consumers. *J. Sens. Stud.* *29*, 74–87.

Résumé

Le lancement d'un nouveau produit sur le marché est une étape à risque pour l'entreprise qui peut se conclure par un échec. Une raison partielle de cet échec est que le produit ne correspond pas aux attentes des consommateurs. L'enjeu consiste donc à mieux comprendre et intégrer dans le design de produits les attentes des consommateurs.

Les théories contemporaines en psychologie cognitive nous permettent d'améliorer les méthodologies actuelles de tests consommateurs et à concevoir les produits sur la base des connaissances des consommateurs. L'objectif de cette recherche est de mieux comprendre l'influence d'une adéquation entre les attentes des consommateurs et leurs perceptions sur leurs jugements affectifs dans le contexte de consommation alimentaire. Dans le champ de la cognition incarnée et située, nous avons utilisé la théorie du Perceptual Symbol System qui suppose une forte relation entre les concepts et les propriétés sensorielles. Trois études ont été menées sur des gammes de produits familiers et non familiers. Les résultats nous permettent de conclure que les attentes des consommateurs sont des catégories ad-hoc dépendantes d'une situation de consommation, c'est-à-dire une motivation à consommer le produit dans un contexte de consommation donné. Les propriétés de la catégorie définissent les attentes de type concepts et les propriétés sensorielles attendues du produit. Ainsi, nous avons mis en évidence que les concepts et les propriétés sensorielles sont associées à travers les catégories réactivées en mémoire.

Les résultats de cette thèse ont aussi permis de proposer des améliorations aux méthodologies de tests consommateurs. Plus particulièrement, ces méthodologies permettent d'une part d'explicitier les attentes des consommateurs à travers une tâche de catégorisation et d'autre part de sélectionner les produits les plus adéquats aux attentes des consommateurs à travers l'évaluation de leurs jugements affectifs.

Mots-clés : Catégorisation, Attentes, Aliment, Disconfirmation sensorielle des attentes, Jugement Affectif

Abstract

One challenge when dealing with the launching of new products is to understand consumers' expectations towards the product experience. Many innovations fail because they do not address the right expectations, for the right consumers, and for the right product.

Theories in cognitive psychology allow us to improve current methodologies of consumer tests and to design food products based on the knowledge of consumers. The objective of this research is to better understand the influence of the discrepancy between consumers' expectations and perceptions on the affective judgment in the context of food consumption. Within the framework of Grounded and Embodied cognition, we use theories developed on Perceptual Symbol System assuming a strong relationship between concepts and sensory perceptions. Three studies were conducted on familiar and non-familiar product ranges. Results allow us to conclude that consumers' expectations are defined as ad-hoc categories dependent on a situation of consumption, i.e. a motivation to consume the product in a determined context of consumption. Properties of the category define cognitive expectations and sensory expectations of the product. Thus, we provide evidence that concepts and sensory perceptions are strongly related through retrieval of categories.

The results of this thesis also provide methodological improvements to elicit consumers' expectations through categorization tasks and to screen samples fitting the best with consumers' expectations through affective judgment.

Keywords: Categorization, Expectations, Food, Sensory Disconfirmation of Expectations, Affective Judgment

