

# 1 Sensory Analysis and Consumer Mind-Sets and Emotions for Dairy Products

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## 1.1 Introduction

### 1.1.1 *History of the sensory analysis of dairy products*

Examination of food with human senses is contemporaneous with humanity, since its appearance, colour, odour, texture and flavour convey important information about its composition and quality. Human senses can, therefore, help avoid the consumption of unsafe materials, such as toxins, pathogenic microorganisms or other perceptible contaminations.

With the development of civilisation, people's demands were changing; in addition to survival, the enjoyment value began to matter more and more, and the production of high-quality, more expensive products had begun. Nevertheless, scientific research into the sensory properties of foods, consumer acceptance and liking did not begin until the twentieth century (Kemp et al. 2009).

From the beginning of the 1900's, food manufacturers started to use professionals for sensory evaluation, specialised in particular product categories, such as dairy products. The first quality standard on dairy products was developed by the International Dairy Federation (IDF), in 1903. The first grading standard about dairy products was established by the US Government in 1913, for butter. Shortly after, in 1916, the first national Collegiate Butter Judging Contest was held in the US, by the American Dairy Science Association (ADSA), which was expanded with the judgement of milk and cheddar cheese only a year later. In 1934, the first edition of *Judging Dairy Products* was published by Nelson and Trout.

After 1940, the scientific interest in sensory analysis seemed to grow even more. The Triangle test was developed by Bengtsson and Helm, while the US Army Quartermaster Food and Container Institute started research work on food acceptance and developed the hedonic scale.

As a result, the food industry discovered the potential of sensory evaluation quickly, and the field became an important part of the research and development processes and

laid the foundations for university-level research. In the following years, new methods were developed and books that formed the basis of the discipline were also published.

In 1968, the American Society for Testing and Materials (ASTM) published the first manual (STP433 – Basic Principles of Sensory Evaluation), which was followed by the first ISO standard (ISO 3591 – Sensory analysis protocol – standardised apparatus – a wine tasting glass design) 1977 (Clark et al. 2009).

Since the sensory attributes of food products affect willingness to pay greatly, newer evaluation methods are needed to be developed to help maintain consistent quality. According to several experts, the sensory evaluation of dairy products must be based on scientific principles, it requires experience and the acquisition of certain skills.

The first steps for sensory analysis of dairy products were the previously mentioned annual Collegial Dairy Products Evaluation Competitions in the early 1900s. These events brought the development of scorecards for evaluating different product types with numbers, which were further developed and used by United States Department of Agriculture (USDA), as a tool for education. The Competition is still held annually to this day (Website: <http://dairyproductscontest.org>) (Bodyfelt et al. 2008).

In Europe, during the second half of the twentieth century, the IDF played an important role in the conception of the Codex Alimentarius Commission (CAC) in 1961. The task of the CAC is to create worldwide standards related to food, including dairy products, but these do not contain recommendations and instructions on sensory evaluation (Tietje and Brouder 2009).

Due to the people's demands and the developments of the last century, the dairy industry has grown into one of the most quality-oriented industries. Nowadays, instrumental test methods (chromatography, electronic nose and tongue, mass spectrometry) and sensory evaluation are used together in quality management and quality assurance (Clark et al. 2009).

The currently used methods cover the entire field of sensory evaluation: analytical sensory tests (descriptive sensory analysis, discrimination tests, threshold tests), traditional judging/grading (by ADSA and USDA) and consumer tests. With the application of analytical sensory tests, taste profiles and aroma wheels can be created, which facilitate the performing of traditional judging and consumer tests (Drake 2004, 2007).

Since the 1940s, numerous new methods have been developed for consumer sensory testing, which are often performed with newly developed dairy products. The 9-point hedonic scale and its adaptations, the labelled affective magnitude (LAM) scale and the just-about-right (JAR) scale shall be highlighted, which were performed with, for example, probiotic yoghurts (Hekmat and Reid 2006), drinking yoghurts (Pohjanheimo and Sandell 2009) and flavoured kefir (Gere et al. 2017). The hedonic scale-based preference mapping is widely used with dairy products, such as milk-fruit beverages or cheese (Fernández-Vázquez et al. 2018; Meals et al. 2020). Conjoint analysis is also a well-used method for testing dairy products and milk-based beverages (Jervis et al. 2012; Maurice et al. 2004). From the novel describing consumer sensory methods in the 2000s, many tests are performed on different dairy products, such as flash profiling (Delarue and Sieffermann 2004), check-all-that-apply (CATA) questionnaires (Esmerino et al. 2017a), temporal-check-all-that-apply (TCATA), temporal dominance of

sensation (TDS), progressive profile (PP) (Esmerino et al. 2017b) or rate-all-that-apply (RATA) questionnaires with emoji scales (Pinto et al. 2020).

Based on the experience of the last more than 100 years, sensory analysis has been an essential part of the development of the food industry, including the dairy industry. Moreover, based on the published literature, the dairy industry has contributed significantly to the development of the science of sensory evaluation.

### 1.1.2 *Changes in consumer habits*

Consumer habits and tastes constantly change. This continuous evolution forces the product world to follow. With each generation, new ways of living, eating, and working evolve, and so must foods and meals. The increasingly brisk transition period of one generation to the next is accompanied by changes in lifestyles, ideas and thinking styles, each evolving and demanding that the world of food production and merchandising shift to keep step. The evolution occurs in the world of the product, and in the less tangible but equally important world of the perceived nutrition world. It is obvious, then, that in order to meet the requirements of the new generation, dairy companies must identify these consumer needs.

Traditional efforts in the world of food product development have focused on product acceptance, as well as the fit of the product to an underlying concept, whether that concept be the 'product idea' or the basis for advertising to consumers why they should buy the product. The concepts are the product and the positioning, respectively.

Methods for testing the attractiveness of a concept vary from the simple evaluation of the ideas underlying the concept (so-called 'promise testing'), all the way the evaluation of complete paragraphs, of the type one might read in a magazine, as a full page or half page advertisement. Sometimes the ideas are presented without prices, sometime ideas are presented with prices and so on. In the end, the objective is to identify those ideas, those messages, which 'drive' an individual to say that she or he will buy the product.

Acceptance and usage occasion, as well as price, have been enriched by new areas of focus in the world of responses to food. The traditional study of products in terms of acceptance and use-occasions has been enriched in the last two decades by the introduction of a third dimension beyond acceptance and occasion. That third dimension is 'emotion', a dimension that would not normally occur to the businessperson interested in the product as something to be sold. Yet, researchers have made a convincing argument that emotions are intimately tied to food and worthy of study. To that end, a variety of papers have appeared which reveal the linkage between well-known emotions and certain kinds of food (Desmet and Schifferstein 2008; Rousset et al. 2005; Schouteten et al. 2015; Torben 2005).

During the past 20 years, the notion has become popular that through systematic experimentation with messages or ideas that the researcher can learn a great deal about how people react to ideas about food. The approach is generically known as conjoint measurement (Luce and Tukey 1964), a heritage of efforts in mathematical psychology to create better forms of measurement. Business professor Paul Green at Wharton School of Business, University of Pennsylvania, brought conjoint measurement to the

business and applications literature (Green and Rao 1971; Green and Srinivasan 1990). Moskowitz and Gofman wrote a best-selling business book on the application of conjoint measurement to business issues (Moskowitz and Gofman 2007). Many papers have appeared detailing the method, a number referred to in Moskowitz (2012).

The fundamentals of conjoint measurement come from the world of experimental design (Box et al. 2005). Experimental design is a well-known field of statistical endeavour, allows the researcher to understand how different variables combine to generate a response. Experimental design of mixtures differs from the typical research approach of isolating one variable, exploring that variable in depth, and from that exploration done on several different variables.

The specific instantiation of experimental design applied here is known as Mind Genomics (MG), an offshoot of the approaches presented by Moskowitz over the past 20+ years. MG deals with the science of judgement of the everyday. Many scientific experiments are conducted with so-called ‘model systems’, namely stimuli that are pure, without cognitive meaning. In contrast, we experience life with stimuli filled with cognitive meaning. A science of perception and decision-making focusing on the experience of daily life thus provides a new way to understand how we perceive, and how we decide. We are not looking for aberrant situations to teach us interesting ‘factoids’ about people, but rather erecting a science of what we experience during the normal course of being and doing within a society which communicates, and which expects certain types of social behaviours.

## 1.2 How MG approaches the problem of understanding new versus traditional in cheese

The specific steps of an MG study have been laid out in a number of previous publications’ go back virtually to more than three and a half decades, when the approach was laid out by Moskowitz and Martin (1993) at an ESOMAR conference in Copenhagen Denmark. The approach is illustrated showing the data as examples.

- a. Define the topic and create the raw materials. The first step of an MG study design defines the topic in as much detail as possible, and then creates the raw materials. The raw materials for this study begin with four questions which are linked together to ‘tell a story’, and then four answers for each question. The answers are simple, once the questions have been created. The hard part is to think about the story, rather than simply to identify a variable, isolate it, measure and report the results. The researcher must pose the four questions and provide the 16 answers. Table 1.1 shows four questions, each having four answers. In this study, the questions and answers are specific to cheese.
- b. Combine the answers into small vignettes or ‘test concepts’ using experimental design. The test stimuli comprise small, easy-to-read combinations of answers, vignettes. The vignettes, created in the format shown in Figure 1.1, comprise one or no answers from a question. The vignette tells a story. The story is incomplete, however, for some of the vignettes, a fact which does not hinder the respondent

**Table 1.1** The four questions and the four answers for each question. The topic is cheese.

<p><b>Question 1: What is the nutritional benefit of the cheese?</b></p> <p>A1 Calcium fortification of traditional cheese products helps to strengthen bones</p> <p>A2 Reducing fat content of traditional cheeses helps lose weight</p> <p>A3 Vitamin fortification of traditional cheese products keeps vitality</p> <p>A4 Probiotics in traditional cheese products have health-preserving effects</p> <p><b>Question 2: What is the origin of the cheese</b></p> <p>B1 Only organic ingredients allowed</p> <p>B2 Local ingredients should be used for the most part</p> <p>B3 Origin of ingredients not important when ingredients have SAME sensory characteristics</p> <p>B4 Production should follow traditional recopies . . . history very important, no need for NEW</p> <p><b>Question 3: What are the sensory characteristics of the cheese?</b></p> <p>C1 Traditional products with new, unusual flavourings . . . nothing wrong with that</p> <p>C2 Flavour enhancers to enhance the special flavours of the traditional products</p> <p>C3 Colourings make products more appealing</p> <p>C4 Traditional products taste better compared to the commercial ones</p> <p><b>Question 4: What are the economic effects?</b></p> <p>D1 Traditional cheese products support local labour market . . . job creation</p> <p>D2 Innovation is key for traditional cheese makers to stay on the market</p> <p>D3 Traditional cheese makers cannot compete with low-cost and large-scale production of cheese</p> <p>D4 Rural life and national traditions are supported by purchasing traditional products</p>
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Calcium fortification of traditional cheese products helps to strengthen bones

Origin of ingredients not important when ingredients have SAME sensory characteristics

Traditional products taste better compared to the commercial ones

Traditional cheese makers cannot compete with expensive and large-scale production of traditional cheese

How much do you AGREE on these phrases together?

1 2 3 4 5 6 7 8 9

1 – do not agree at all; 9 – completely agree

**Figure 1.1** Example of a four-element vignette. The elements appear at the top, without connectives, making the vignette easy to read. Each vignette requires two answers, a rating and a selection of emotion. Source: Microsoft Corporation.

from evaluating the combination and assigning a rating. The participants were not shown the questions, but only the answers in certain combinations. The 16 answers were combined into a total of 24 vignettes, which were presented to paid US participants, recruited by an online panel provider. Although the combinations might seem ‘random’ to a respondent (an often-heard comment), the reality is that the combinations are carefully designed according to an underlying experiment design, which ensures that each answer appears equally often, and independent, in a statistical sense, of the other answers. Each respondent evaluated a *unique* set of 24 vignettes, constructed according to the same basic design, but with the elements permuted so that the elements, i.e. answers, remained the same, but the specific combinations varied across respondents. The experimental design ensures that a wide number of combinations are covered across the respondents, rather than a simple set of 24 combinations appearing again and again (Gofman and Moskowitz 2010).

- c. Select the rating question(s). The respondent reads the presented elements and rates the elements on the vignette as a whole story or concept and answers the rating question (1 – do not agree at all; 9 – completely agree). The rating scale is phrased as follows: *How much do you AGREE on these phrases together?* To capture the emotions of the participants after reading the vignette, an additional question was asked. The question was phrased as follows: *How do you personally FEEL when you read the combination of these phrases together?* The options are assorted so that emotions are not placed in order of intensity (happy versus sad). These seven emotions are the following: 1 = curious, 2 = amused, 3 = don’t care, 4 = disappointed, 5 = surprised, 6 = irritated, 7 = disinterested. The seven emotions are presented in an irregular order, interspersing positive, neutral and negative feelings.
- d. Prepare ratings for analysis by converting from the Likert Scale to a binary scale. The 9-point rating scale/Likert Scale (Question 1) is easy to use, but very hard to understand when the data finally come back from the analyst. For example, a user of the results might well ask ‘*what does the 7.5 mean*’ or similarly, ‘*what does a 4.5 mean*’ and so forth. Managers who use these data want to have simple data to ponder, not scaled data. To simplify the results for managers, but really for everyone, we convert the ratings to a binary scale, with ratings of 1–6 converted to 0, ratings 7–9 converted to 100. As we add a very small random number to each binary value (0 or 100), in order to prevent a crash during analysis by OLS (ordinary least squares) regression, this conversion makes the results easier to understand and to interpret.
- e. Prepare the data from the second question (select the emotion felt when reading this vignette). The seven emotions comprise a so-called ‘nominal scale’, where the scale points do not have numerical value, per se, but are rather placeholders for different ideas. It is impossible to do more than analyse the frequency of use, unless one transforms the nominal scale to a form that a computer program can understand. The analysis comprises the conversion of the scale of seven choices into seven new variables, each variable corresponding to one of the choices. For a given vignette, each of the seven variables begins with the value ‘0’. When the vignette is assigned a specific emotion, the initial assignment of ‘0’ is converted to the value ‘100’, but the

remaining six variables remain at '0'. Thus, the scale generates seven, presumably unrelated variables, but we 'know' the origin of these variables. For this analysis, we produce two new variables, the positive emotions and the negative emotions. We do so by summing the values of the variables corresponding to the positive emotions and summing the values of the variables corresponding to the negative emotions, respectively.

- f. Create a model or linear equation relating the presence/absence of the 16 answers or elements to the binary response. The equation is expressed by the simple linear model, showing the contribution of each element to the binary rating:  $\text{Rating} = k_0 + k_1(A1) + k_2(A2) \dots k_{16}(D4)$ . The elements are represented as A1, A2 . . . D4, the additive constant is  $k_0$ , and the 16 coefficients are denoted by  $k_i$ . Each parameter of the regression equation (additive constant, 16 coefficients, one per element of answer) has meaning, as will be shown in the explanation of the results. The 16 coefficients are particularly important because they reveal the contribution of the corresponding element to the rating.
- g. Interpret the model in terms of 'meaning' for cheese. Table 1.2 shows the parameters of the model.

**Table 1.2** Parameters for the relation between Question 1 (binary transformation of 'Agree') and the presence/absence of the individual elements. The table is sorted in descending order of coefficient.

Statement	Coeff	T-Stat	P-Val
<b>Additive constant</b>	55.05	7.23	0.00
A4 Probiotics in traditional cheese products have health-preserving effects	5.92	1.28	0.20
A1 Calcium fortification of traditional cheese products helps to strengthen bones	4.30	0.93	0.35
D4 Rural life and national traditions are supported by purchasing traditional products	3.00	0.65	0.52
D2 Innovation is key for traditional cheese makers to stay in the market	2.50	0.54	0.59
D1 Traditional cheese products support local labour market . . . job creation	0.63	0.14	0.89
B4 Production should follow traditional recopies . . . history very important, no need for NEW	-1.02	-0.22	0.83
C4 Traditional products taste better compared to the commercial ones	-1.76	-0.38	0.71
C2 Flavour enhancers to enhance the special flavours of the traditional products	-1.96	-0.42	0.67
A2 Reducing fat content of traditional cheeses helps lose weight	-2.88	-0.62	0.53
B2 Local ingredients should be used for the most part	-4.04	-0.87	0.39
A3 Vitamin fortification of traditional cheese products keeps vitality	-4.21	-0.91	0.37
C1 Traditional products with new, unusual flavourings . . . nothing wrong with that	-4.41	-0.95	0.35
C3 Colourings make products more appealing	-6.58	-1.42	0.16
D3 Traditional cheese makers cannot compete with low-cost and large-scale production of cheese	-8.29	-1.78	0.08
B1 Only organic ingredients allowed	-9.61	-2.04	0.04
B3 Origin of ingredients not important when ingredients have SAME sensory characteristics	-13.94	-2.98	0.00

1. The additive constant is the estimate percent of times that a rating would receive a 7–9 in the absence of elements. Clearly, all vignettes comprised a minimum of two elements, and a maximum of four elements, so the additive constant is a purely estimate value. Nonetheless, it has meaning. It is basic likelihood that the respondent will agree to the vignette, i.e. that the respondent will feel that the vignette ‘makes sense’, and that the respondent likes what is read. The additive constant is 55.05, meaning that they tend to start off positive, at least half the time or half the respondents. The rest will be the task of the elements to drive more ‘agreement’, i.e. more acceptance.
2. The coefficient for each element, which tells the additional percent of the responses that are likely to be 7–9 when the particular element is inserted into the vignette. When the coefficient is positive, the elements add a certain percent. Thus, element A4 (probiotics in traditional cheese products have health-preserving effects) has a coefficient of 5.92, meaning that when added to the vignette an extra 5.92% of the ratings will be 7–9. In contrast, some elements are negative, such as B3 (origin of ingredients not important when ingredients have SAME sensory characteristics.) This element has a strong negative effect, -13.94. When this element is inserted into the vignette, almost 14% fewer ratings of 7–9 are to be expected.
3. There are also two statistics worth noting, statistics which emerge automatically from today’s off-the-shelf (so-called ‘canned’) statistical software. The first is the student t-statistic, a measure of the value of the coefficient divided by the standard error of the coefficient. The t-statistic is a measure of signal (the value of the coefficient) to noise (the expected variability of the coefficient if the study were to be run many times.) The t-statistic should be high, meaning that the value of the coefficient is more believable, the higher the t-statistic. Furthermore, a t-statistic closer to 0 means that upon replications of this same experiment, with the same conditions, we might find coefficients much closer to 0.
4. The second statistic of interest is the p-value, the likelihood or probability that the coefficient is different from 0. The lower the p-value, the more likely it is that the coefficient we observe is truly not 0.
5. It is important to note that despite the statistical measures associated with the coefficient (the student t-statistic and the p-value), our learning comes from the magnitude of the coefficient. Big positive numbers suggest a more likely positive response, that the respondent ‘agrees’ with the combination. Big negative numbers suggest a non-positive response, that the respondent does not ‘agree’ with the combination. We do not yet know whether the respondent disagrees with the combination, or simply does not agree.
6. Finally, the coefficients are additive. One can estimate the likely response to the vignette by combining the elements and estimating their sum of additive constant and individual coefficient.
7. The total panel data suggest that respondents diverge from the concept of using organic ingredients in traditional cheese, oppose the notion of importance of the origin of ingredients and disagree with the suggestion that traditional cheese makers cannot compete with larger companies. However, respondents from the

total panel agree with the ideas of probiotics and calcium fortification. Both concepts are suitable options for traditional cheese makers to increase the health benefits of their products, and to give some added value. From the results provided by the total panel we propose that for cheese, respondents are looking to purchase something that is innovative, and full of health benefits; something which moves beyond just traditional.

### 1.3 Looking at different groups of respondents

A key benefit of the MG approach is that it uses the structure of a ‘within-subjects’ design. That is, each respondent evaluates the ‘right’ set of combinations of messages so that one can build an individual-level model. That property has two major benefits:

1. When looking at key subgroups, one need not worry about ‘balancing’ the appearance of the different elements. Each respondent brings in the appropriate set of statistically independent elements.
2. When dividing the respondent population into basic groups, based upon the pattern of responses, one can use the pattern of coefficients generated by each respondent as the basis for the mind-set segmentation.

The focus of this study was to explore the total panel and to uncover any emergent mind-sets, these mind-sets comprising individuals who perceive the world in the same way, for the specific topic (innovation in cheese.). MG typically works with relatively small samples of 25–100, recognising that the experiments are exploratory. By exploratory, we mean that the focus is to demonstrate the existence of different mind-sets, but not to estimate the proportion of these mind-sets in a population. Such estimates can be made, and discussed later, but the bigger discovery is the nature of the mind-sets, should they exist.

Mind-sets based upon the pattern of responses emerge from the statistical method of k-means clustering (Hastie et al. 2001). In simple terms, each respondent generates a vector of 16 coefficients. Clustering divides these respondents into two or more groups, based upon a criterion defined ahead of time. The criterion is that the differences or variability of patterns within a cluster or mind-set is small, whereas the differences or variability of the averages of the mind-sets is large across the 16 elements (Dubes and Jain 1980).

Based upon thousands of studies over the past 35 years, a good rule of thumb has emerged. Regression coefficients above 8 are relevant ‘positives’, whereas regression coefficients below -8 are relevant ‘negatives’, again based on these thousands of previous studies. By relevant, we mean that the element pertains to something which occurs with the product in the ‘outside’ world. By looking at relevance rather than statistical significance, we move away from purely statistical considerations of ‘difference’ to ‘meaningfulness’.

There are at least two interpretable groups, as revealed by the MG clustering. These mind-sets appear in Table 1.3. It is important to keep in mind that the clustering or segmentation is done as a purely mathematical/statistical procedure, and without

**Table 1.3** Coefficients for total panel and two mind-set segments for question #1 (agree). The table shows the coefficients estimated for the top of the scale (actively agree) and for the bottom of the scale (actively disagree).

Statement	Tot		Mind-Set1		Mind-Set2		Tot		Mind-Set1		Mind-Set2	
	Top3	Bot3	Top3	Bot3	Top3	Bot3	Top3	Bot3	Top3	Bot3	Top3	Bot3
Base size	53	29	24	53	24	53	29	24	29	24	24	24
CONSTANT	55	60	47	18	14	18	14	14	14	14	23	23
A4 Probiotics in traditional cheese products have health-preserving effects	6	1	13	-4	2	-4	2	2	2	2	-11	-11
A1 Calcium fortification of traditional cheese products helps to strengthen bones	4	1	10	-3	0	-3	0	0	0	0	-8	-8
D2 Innovation of key for traditional cheese makers to stay on the market	3	-3	10	-6	1	-6	1	1	1	1	-15	-15
D4 Rural life and national traditions are supported by purchasing traditional products	3	1	6	-5	-5	-5	-5	-5	-5	-5	-7	-7
D1 Traditional cheese products support local labour market . . . job creation	1	-2	5	-6	-7	-6	-7	-7	-7	-7	-5	-5
B4 Production should follow traditional recipes . . . history very important, no need for NEW	-1	-6	5	0	-1	0	-1	-1	-1	-1	1	1
A2 Reducing fat content of traditional cheeses helps lose weight	-3	-4	0	0	2	0	2	2	2	2	-3	-3
A3 Vitamin fortification of traditional cheese products keeps vitality	-4	-7	0	0	2	0	2	2	2	2	-3	-3
C1 Traditional products with new, unusual flavourings . . . nothing wrong with that	-4	-9	0	3	3	3	3	3	3	3	3	3
C2 Flavour enhancers to enhance the special flavours of the traditional products	-2	-3	-1	0	1	0	1	1	1	1	-1	-1
C4 Traditional products taste better compared to the commercial ones	-2	-2	-2	4	5	4	5	5	5	5	3	3
B2 Local ingredients should be used for the most part	-4	-5	-3	-2	-4	-2	-4	-4	-4	-4	-1	-1
D3 Traditional cheese makers cannot compete with expensive and large-scale production of traditional cheese	-8	-11	-4	-4	-2	-4	-2	-2	-2	-2	-8	-8
B1 Only organic ingredients allowed	-10	-13	-5	4	2	4	2	2	2	2	5	5
C3 Colourings make products more appealing	-7	-5	-9	6	5	6	5	5	5	5	7	7
B3 Origin of ingredients not important when ingredients have SAME sensory characteristics	-14	-12	-17	5	4	5	4	4	4	4	5	5

understanding WHAT the clusters really signify. That is, the clustering procedure is ‘agnostic’, doing its mathematical work without interpretation.

Table 1.3 shows the coefficients for the total panel and the two mind-sets. Table 1.3 divides into two sections. The columns marked **Top3** correspond to the analysis of strong positive responses, where ratings of 7–9 are converted to 100, whereas ratings of 1–6 are converted to 0. These are the degree to which the respondent ‘agrees’ with the element, when the element is in the vignette. The columns marked **Bot3** correspond to the analysis of the strong negative responses, where ratings of 1–3 are converted to 100 whereas ratings of 4–9 are converted to 0. These are the degree to which the respondent ‘disagrees’ with the element, when the element is in the vignette. It is important to stress here that when we look at a binary scale, the low end of the scale, converted to 0, does not mean ‘disagree’ or ‘agree’ but rather ‘lack agreement (not disagree) or lack of disagreement (not agree)’.

Table 1.3 suggests that when it comes to cheese, there are two key mind-sets. Mind-Set1 tends to agree with the elements (additive constant 60 for Top3), tends not to disagree with the elements (additive constant 14 for Bot3), but really does not pay attention to the elements, Mind-Set1 is simply not really involved. In contrast, Mind-Set2 tends to agree less (additive constant 47 for Top3), tends to disagree more (additive constant 23 for Bot 3) and responds strongly about health and innovation. We might label Mind-Set1 ‘traditionalists’, and Mind-Set2 ‘Innovators’.

What surprises is the low values of the coefficients for total panel, and for the mind-sets, except for three elements for Mind-Set2. Many previous studies with MG suggest that the mind-set segmentation is more profound. On the other hand, the typical segmentation generating strong large positive coefficients finds its crux in flavour-based messages, and not in health-oriented or heritage-oriented message.

*Probiotics in traditional cheese products have health-preserving effects*  
*Calcium fortification of traditional cheese products helps to strengthen bones*  
*Innovation is key for traditional cheese makers to stay on the market*

## 1.4 Linking emotions to messages

The second question required the respondent to select one of seven feelings/emotions. The feelings/emotions were presented in irregular order, to prevent the respondent from choosing a similar point on the scale for the two ratings. The analysis of the results by OLS regression proceeds in the same way as the analysis of the ratings from question #1. The only differences are the nature of the dependent variable and the nature of the regression model:

**Two dependent variables:** The seven emotions were reduced to the three positive emotions (curious, amused, surprise) and the three negative emotions (disappointed, irritated, disinterested). When a respondent selected a positive emotion, the new variable, PosEm was coded 1, and the other new variable, NegEm was coded 0. The opposite coding was done when respondent selected a negative emotion. NegEm was coded 1, and PosEm was coded 0. Both PosEm and NegEm was coded 0 when the respondent selected ‘Don’t care’.

Table 1.4 shows that there are strong positive emotions, but these are not the emotions that drive agreement. Rather, the strong positive emotions linking to the elements tend to be more ‘cause-related’, and less to ‘self-related’.

*Rural life and national traditions are supported by purchasing traditional products  
Only organic ingredients allowed  
Traditional cheese products support local labour market . . . job creation*

Both mind-sets, Mind-Set1 (Traditionalist) and Mind-Set2 (Innovator) respond with emotion, but the Innovator appears to have slightly greater emotional linkages to elements than the Traditionalist.

## 1.5 Finding mind-sets in the population for future communication, research and sales efforts

A continuing issue, or perhaps better a continuing opportunity, arises from the need to capitalise on the mind-sets for either social or business reasons. In terms of social reasons, working with Innovators allows a country, a company, a school or really any social group to change patterns of food consumption, to reduce neophobia and perhaps to eat better. The obesity epidemic, for example, is raging through the world. Finding Innovators, willing to try new foods, perhaps better-for-you foods, may be the first step.

How can one discover these new groups or mind-sets in the population and work with them? MG studies suggest both two mind-sets, at least when we talk about the health benefits. These mind-sets are spread through the population. In most MG studies, the data suggest that conventional subgroups of consumers may not allow one to assign a given individual to a mind-set unless the individual participates in a version of the study, devoted to the specific topic. That is, the mind-sets emerge as relevant to a topic, and not as general descriptions of a population. In this respect, the granularity of MG proceeds from the specific to the general. There is never the problem of discovering the ‘proper message’ to a member of a mind-set uncovered by MG, for it is from the reactions to the messaging that these mind-sets emerge for the particular topic.

Author Gere has created the PVI, the personal viewpoint identifier, a set of questions, directly related to the study. The pattern of the responses to these questions automatically assigns the person into the appropriate mind-set. The PVI works in either case to assign a new person to a mind-set, after which the new person can become part of the health movement or receive advertisements and coupon appropriate for her/his mind-set with respect to cheese.

Figure 1.2 presents the personal viewpoint identifier, which as of this writing resides at: <https://www.pvi360.com/TypingToolPage.aspx?projectid=164&userid=2008>. The top of Figure 1.2 presents the six questions. The bottom presents the feedback, simple web-based material that is automatically incorporated into the respondent’s data file for a loyalty programme to guide further sales efforts or presented to the respondent as an information ‘reward’.

**Table 1.4** Linking between elements, emotions, and mind-sets.

Element	Tot		Mind-Set1		Mind-Set2		Tot		Mind-Set1		Mind-Set2	
	PosEm	NegEm	PosEm	NegEm	PosEm	NegEm	PosEm	NegEm	PosEm	NegEm	PosEm	NegEm
D4	22	8	22	11	22	8	22	11	6			
B1	20	14	23	12	18	14	18	12	16			
D1	20	13	19	16	21	13	21	16	10			
C1	19	10	20	10	17	10	17	10	8			
A1	17	10	12	6	23	10	23	6	15			
B4	17	12	14	10	20	12	20	10	14			
C4	17	9	23	9	11	9	11	9	8			
A4	16	5	16	0	16	5	16	0	10			
D2	16	12	13	15	19	12	19	15	9			
A3	14	9	9	6	20	9	20	6	13			
B2	14	10	12	7	17	10	17	7	14			
C2	14	10	12	9	16	10	16	9	11			
D3	14	14	13	20	15	14	15	20	8			
A2	13	7	8	2	19	7	19	2	13			
B3	12	16	8	16	16	16	16	16	17			
C3	10	14	11	16	8	14	8	16	10			

The information I am giving you is about my attitudes towards a specific topic(s). As part of the exercise, I am giving you information about myself. This information will be used to provide better choices in products and services, based on your answers.

I Agree to Participate  I Do Not Agree to Participate

CHEESE	
DO YOU EAT CHEESE?	<input checked="" type="radio"/> YES <input type="radio"/> NO
WHAT CHEESE DO YOU EAT?	<input type="radio"/> AMERICAN <input checked="" type="radio"/> CHEDDAR <input type="radio"/> SWISS <input type="radio"/> PROVOLONE
PROBIOTICS IN TRADITIONAL CHEESE PRODUCTS HAVE HEALTH-PRESERVING EFFECTS	<input checked="" type="radio"/> AGREE <input type="radio"/> DISAGREE
ORIGIN OF INGREDIENTS NOT IMPORTANT WHEN INGREDIENTS HAVE SAME SENSORY CHARACTERISTICS	<input checked="" type="radio"/> AGREE <input type="radio"/> DISAGREE
COLORINGS MAKE PRODUCTS MORE APPEALING	<input checked="" type="radio"/> AGREE <input type="radio"/> DISAGREE
INNOVATION OF KEY FOR TRADITIONAL CHEESE MAKERS TO STAY ON THE MARKET	<input type="radio"/> AGREE <input checked="" type="radio"/> DISAGREE
CALCIUM FORTIFICATION OF TRADITIONAL CHEESE PRODUCTS HELPS TO STRENGTHEN BONES	<input type="radio"/> AGREE <input checked="" type="radio"/> DISAGREE
RURAL LIFE AND NATIONAL TRADITIONS ARE SUPPORTED BY PURCHASING TRADITIONAL PRODUCTS	<input checked="" type="radio"/> AGREE <input type="radio"/> DISAGREE

**Submit Answers**

Figure 1.2 The personal viewpoint identifier for cheese.

### 1.6 The multiple contributions of MG to scientific investigation

The focus of this chapter has been on the methodological advances in MG, and specifically its contribution to the world of product evaluation. Traditional research on the evaluation of products uses either product names or actual products, requiring the respondent to evaluate the product name in terms of a battery of attributes. The consequence of traditional work is that a dairy product such as ‘cheese’ often remains simply that, ‘cheese’. The reality of experience, however, is that the experience of the product ‘cheese’ is much more detailed, much more filled with texture and nuance. Those involved in the description of cheese products know this as a fact of everyday life. Those involved in the study of cheese in the context of daily life, either observing behaviour or recording answers from surveys, often do not have the luxury to probe into the different aspects of cheese, be these aspects sensory, or as shown here, experiential and attitudinal. Further, the current science of consumer research often stops at the level of the general product, simply because the demands of the research and/or the proclivities of the research focus on the bigger picture, cheese as cheese in the large world of food-related behaviours.

There is another major contribution of MG to understanding how people react to messages about the ordinary aspects of their daily lives, such as dairy products. That contribution is the ability of MG to move beyond the mental editor of a person. Typically, when it comes to questionnaires, people like to please the interviewer, often changing what they say, and even believing what they say, in order to get approval from the interviewer.

MG as we have discussed here provides the researcher with a flexible microscope, magnifying glass or a telescope – or all three. When the research wants to look at cheese, focusing on a detail that is not product related such as the innovations we have here, we have a microscope to go into the details, or a magnifying glass to look at general areas in some detail. Yet, MG can work at the level of a telescope, looking at dairy-product-related messages in the constellation or galaxy of food behaviour on the one hand, or food innovation behaviour on the other.

## 1.7 The role of emotions

As noted in the introduction to this chapter, emotions are becoming of increasing interest to food researchers, which should not surprise. Experimental psychologists have known for a century or more, since Pavlov, that food is a ‘reinforcer’, the presence of which can increase the probability of a response, whether the response be salivation (classical conditioning) or bar pressing (operant conditioning). The key notion here is the ability of food to drive a response and reinforce that response. There is the subtle, unrecognised reality, that the process of ingestion is generally a positive one. It is only recently that this positive experience of eating food has been dimensionalised by researchers.

The key to MG and emotions is the ability to link emotions to specific messages, an ability that provides new direction for the current focus on dairy research, and indeed research in human experience. Most of the work involving emotions deals with the connection of emotions to facial expressions (Ekman et al. 1972), or even emotions in activities. The ability to parse compound stimuli by experimental design, and attach to each aspect of the compound stimulus a gradation of linkages to several emotions, as done here, provides another methodological advance for dairy science on the one hand, and psychological and sociological science on the other.

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## References

Bodyfelt, F.W., Drake, M.A., and Rankin, S.A. (2008). Developments in dairy foods sensory science and education: from student contests to impact on product quality. *International Dairy Journal* 18 (7): 729–734. <https://doi.org/10.1016/j.idairyj.2008.03.011>.

- Box, G., Hunter, S., and Hunter, W. (2005). *Statistics for Experimenters: Design, Innovation, and Discovery*, 2e. Hoboken, New Jersey, NY: Wiley.
- Clark, S., Costello, M., Drake, M., and Bodyfelt, F. (2009). *The Sensory Evaluation of Dairy Products*, 2e. New York, NY: Springer <https://doi.org/10.1007/978-0-387-77408-4>.
- 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 Quality and Preference* 15 (4): 383–392. [https://doi.org/10.1016/S0950-3293\(03\)00085-5](https://doi.org/10.1016/S0950-3293(03)00085-5).
- Desmet, P.M.A. and Schifferstein, H.N.J. (2008). Sources of positive and negative emotions in food experience. *Appetite* 50 (2): 290–301. <https://doi.org/10.1016/j.appet.2007.08.003>.
- Drake, M. (2004). ADSA Foundation Scholar Award: Defining dairy flavors. *Journal of Dairy Science* 87 (4): 777–784. [https://doi.org/10.3168/jds.S0022-0302\(04\)73221-X](https://doi.org/10.3168/jds.S0022-0302(04)73221-X).
- Drake, M. (2007). Invited review: Sensory analysis of dairy foods. *Journal of Dairy Science* 90 (11): 4925–4937. <https://doi.org/10.3168/jds.2007-0332>.
- Dubes, R. and Jain, A.K. (1980). Clustering methodologies in exploratory data analysis. *Advances in Computers* 19: 113–228. [https://doi.org/10.1016/S0065-2458\(08\)60034-0](https://doi.org/10.1016/S0065-2458(08)60034-0).
- Ekman, P., Friesen, W.V., and Ellsworth, P. (1972). Chapter X – Sampling emotions. In: *Emotion in the Human Face*, 1e (ed. P. Ekman, W.V. Friesen and P. Ellsworth). New York, NY: Pergamon Press Inc. <https://doi.org/10.1016/B978-0-08-016643-8.50019-7>.
- Esmerino, E.A., Castura, J.C., Ferraz, J.P. et al. (2017a). Dynamic profiling of different ready-to-drink fermented dairy products: a comparative study using Temporal Check-All-That-Apply (TCATA), Temporal Dominance of Sensations (TDS) and Progressive Profile (PP). *Food Research International* 101: 249–258. <https://doi.org/10.1016/j.foodres.2017.09.012>.
- Esmerino, E.A., Tavares Filho, E.R., Thomas Carr, B. et al. (2017b). Consumer-based product characterization using Pivot Profile, Projective Mapping and Check-all-that-apply (CATA): a comparative case with Greek yogurt samples. *Food Research International* 99 (May): 375–384. <https://doi.org/10.1016/j.foodres.2017.06.001>.
- Fernández-Vázquez, R., Stinco, C.M., Hernanz Vila, D. et al. (2018). Internal preference mapping of milk–fruit beverages: influence of color and appearance on its acceptability. *Food Science and Nutrition* 6 (1): 27–35. <https://doi.org/10.1002/fsn3.494>.
- Gere, A., Szabó, Z., Pásztor-Huszár, K. et al. (2017). Use of JAR-based analysis for improvement of product acceptance: a case study on flavored kefirs. *Journal of Food Science* 82 (5): 1200–1207. <https://doi.org/10.1111/1750-3841.13701>.
- Gofman, A. and Moskowitz, H. (2010). Isomorphic permuted experimental designs and their application in conjoint analysis. *Journal of Sensory Studies* 25 (1): 127–145. <https://doi.org/10.1111/j.1745-459X.2009.00258.x>.
- Green, P.E. and Rao, V.R. (1971). Conjoint measurement – for quantifying judgmental data. *Journal of Marketing Research* 8 (3): 355–363. <https://doi.org/10.1177/002224377100800312>.
- Green, P.E. and Srinivasan, V. (1990). Conjoint analysis in marketing: new developments with implications for research and practice. *Journal of Marketing* 54 (4): 3–19. <https://doi.org/10.1177/002224299005400402>.
- Hastie, T., Tibshirani, R., and Friedman, J. (2001). *The Elements of Statistical Learning*, 1e. New York, NY: Springer <https://doi.org/10.1007/978-0-387-84858-7>.
- Hekmat, S. and Reid, G. (2006). Sensory properties of probiotic yogurt is comparable to standard yogurt. *Nutrition Research* 26 (4): 163–166. <https://doi.org/10.1016/j.nutres.2006.04.004>.
- Jervis, S.M., Lopetcharat, K., and Drake, M.A. (2012). Application of ethnography and conjoint analysis to determine key consumer attributes for latte-style coffee beverages. *Journal of Sensory Studies* 27 (1): 48–58. <https://doi.org/10.1111/j.1745-459X.2011.00366.x>.
- Kemp, S.E., Hollowood, T., and Hort, J. (2009). *Sensory Evaluation – A Practical Handbook*, 1e. Chichester, West Sussex: Wiley.

- Luce, R.D. and Tukey, J.W. (1964). Simultaneous conjoint measurement: a new type of fundamental measurement. *Journal of Mathematical Psychology* 1 (1): 1–27. [https://doi.org/10.1016/0022-2496\(64\)90015-X](https://doi.org/10.1016/0022-2496(64)90015-X).
- Murphy, M., Cowan, C., Meehan, H., and O'Reilly, S. (2004). A conjoint analysis of Irish consumer preferences for farmhouse cheese. *British Food Journal* 106 (4): 288–300. <https://doi.org/10.1108/00070700410529555>.
- Meals, S.E., Schiano, A.N., and Drake, M.A. (2020). Drivers of liking for Cheddar cheese shreds. *Journal of Dairy Science* 103 (3): 2167–2185. <https://doi.org/10.3168/jds.2019-16911>.
- Moskowitz, H. (2012). 'Mind genomics': the experimental, inductive science of the ordinary, and its application to aspects of food and feeding. *Physiology & Behavior* 107 (4): 606–613. <https://doi.org/10.1016/j.physbeh.2012.04.009>.
- Moskowitz, H.R. and Gofman, A. (2007). *Selling Blue Elephants: How to Make Great Products that People Want Before they Even Know they Want Them*, 1e. New York, NY: Pearson Prentice Hall.
- Moskowitz, H.R. and Martin, D.C. (1993). How computer aided design and presentation of concepts speeds up the product development process. *ESOMAR Congress 1993: The Many Faces of Quality Now And In Future*.
- Pinto, V.R.A., Teixeira, C.G., Lima, T.S. et al. (2020). Health beliefs towards kefir correlate with emotion and attitude: a study using an emoji scale in Brazil. *Food Research International* 129: 108833. <https://doi.org/10.1016/j.foodres.2019.108833>.
- Pohjanheimo, T. and Sandell, M. (2009). Explaining the liking for drinking yoghurt: the role of sensory quality, food choice motives, health concern and product information. *International Dairy Journal* 19 (8): 459–466. <https://doi.org/10.1016/j.idairyj.2009.03.004>.
- Rousset, S., Deiss, V., Juillard, E. et al. (2005). Emotions generated by meat and other food products in women. *British Journal of Nutrition* 94 (4): 609–619. <https://doi.org/10.1079/BJN20051538>.
- Schouteten, J.J., De Steur, H., De Pelsmaeker, S. et al. (2015). Impact of health labels on flavor perception and emotional profiling: a consumer study on cheese. *Nutrients* 7 (12): 10251–10268. <https://doi.org/10.3390/nu7125533>.
- Tietje, C. and Brouder, A. (2009). *Handbook of Transnational Economic Governance Regimes*, 1e. Leiden, The Netherlands: BRILL.
- Torben, H. (2005). Understanding consumer perception of food quality: the cases of shrimps and cheese. *British Food Journal* 107 (7): 500–525. <https://doi.org/10.1108/00070700510606909>.