Categorizing genetically modified food products: Effects of labelling on information processing

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Categorizing genetically modified food products

Categorizing GM food products

Effects of labelling on information processing

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305

Abstract

Purpose – The purpose of this paper is to provide insight into whether GM-labelling leads to different processing behaviour of food stimuli compared to when products are not labelled.

Design/methodology/approach – A task was designed to investigate people's categorization behaviour as a function of information provided. In two studies each participant was randomly allocated to either the experimental "GM-labelled condition", or the control "non-labelled condition".

Findings – Different processing strategies and different characteristics are used to judge products that are labelled as genetically modified or not. GM labelling of foods is interpreted to induce analytical processing of information and therefore the products are classified relatively more often on the basis of verifiable categorization criteria compared to when they were not labelled as GM. When products are not labelled as GM, information is more likely to be automatically processed and non-verifiable categorization criteria are used.

Originality/value – This is the first study to examine the processes that labelling as GM brings about.

Keywords Genetic modification, Food products, Labelling

Paper type Research paper

Since the 18 April 2004, food products in the European Union that contain genetically modified (GM) ingredients must be labelled as such. Advocates claim that labelling will ensure that consumers have more complete information, enabling them to make more informed choices (Conko, 2003). An important question is whether providing information about a certain product characteristic (e.g. labelling that the product is GM) affects people's perception of the food products. And if labelling does have an effect, does it lead to more reasoned choices? Our perception of the world around us depends on the interpretative concepts that we use in perceiving. Kunda (1999, p. 17) uses the terms schema, concept and mental representation interchangeably. We will use the term "concept". When we encounter people, behaviours or objects, we classify them as instances of certain categories. For example, we do not see a round red object with a stalk, but we see an apple. Likewise, we do not see a man with a stethoscope, we see a doctor. Classification enables us to use our knowledge about categories and to make sense of individual members of the categories. For example, with the help of our knowledge about the concept "doctor" we can better understand the behaviour of the

man with the stethoscope (Kunda, 1999). This identification of an object belonging to a certain category leads to a process of inference; we know more about the object than we actually see.

Network

To understand how perception works, it is important to understand the way cognitive concepts are applied to stimuli and on what basis stimuli are distinguished (i.e. are categorized). Concepts are connected to each other in a network. According to modern cognitive theory (Sternberg, 1996), innumerable concepts are interconnected to each other (e.g. the concept “fruit” is connected to “apple”). Connections between concepts differ in strength (e.g. the concept “fruit” has a stronger connection to “apple” than to “avocado”). Concepts become activated by being confronted with them or by actively thinking about them. Depending on the strength of different connections, activation of one concept will spread to other concepts. This is called the process of “spreading activation”. A stronger connection facilitates information processing (e.g. that an apple is a kind of fruit). Because of the stronger connection between “fruit” and “apple” as compared to “fruit” and “avocado”, it is more probable that “apple” will come to mind when one has to give an example of some kind of fruit (Sternberg, 1996). The probability that a concept comes to mind depends on characteristics of the semantic network but also of temporary factors such as recency of use.

Based on the original spreading activation models, other semantic network theories and connectionist models of cognition have been developed (Niemann *et al.*, 1990; Janiszewski and van Osselaer, 2000).

Hierarchies

Within a network, concepts are hierarchically organized (see Figure 1). The most concrete concepts are at the bottom, and more abstract concepts are at higher levels. For example, the concept “fruit” is at a high, superordinate level. At a lower level different categories of fruits are present, for example “tropical fruits” and “temperate fruits” and at the lowest, subordinate level exemplars are represented (respectively avocado and apple) (Kunda, 1999; Rosch *et al.*, 1976).

Whatever is known about items at a higher level can be inferred to all items at lower levels in the hierarchy (this is called heritance, Daelemans *et al.*, 1992). Thus, when you believe that fruit is healthy, an apple and a kiwi must also be healthy because they both are fruits. However, one cannot make inferences about higher order categories on the basis of characteristics of concrete lower order categories: if you believe that all apples have cores, it does not mean that all fruits have cores.

Figure 1.
Hierarchy of fruit

Automatic and analytical processes

The inference of information is an automatic process. This is a non-analytical, relatively unconscious process (Garcia-Marques and Mackie, 2001). In automatic processing more abstract and general knowledge and evaluations can be inferred and can be used to judge objects (Grunert *et al.*, 2003). Before information can be inferred automatically, the higher order knowledge has to be inductively constructed: information has to be generalized analytically from exemplars. When you have analyzed that an apple is healthy, that a banana is healthy and a pear is healthy, this information can be generalized into the idea that all fruits are healthy. This higher-level information can then be used when you encounter other types of fruit. When an object is subsequently categorized as a fruit, it can be inferred that it is healthy. Analytic processing involves careful attention to the specifics of the situation or the object and is a relatively conscious process (Grunert *et al.*, 2003).

Labelling a new category

People activate different aspects of their mental representation depending on which aspects are relevant (Sia *et al.*, 1999). For example, when people have to mention characteristics of an avocado, people automatically activate the concept fruit and consequently all categories of fruit (for example “tropical fruits” and “temperate fruits”) get slightly activated too, due to spreading activation. When the avocado is classified as an exemplar of the category “tropical fruit”, this category gets activated temporarily above threshold and the needed information can be inferred (e.g. grows in warm countries). When the avocado was (falsely) classified as belonging to the category “temperate fruit” other information would be inferred instead. Apparently, whether a concept is labelled as belonging to a certain category or another has consequences for what information gets inferred and consequently how it is perceived.

As mentioned before, higher levels in the hierarchy contain abstract concepts. We believe that these abstract general judgments are inferred to categorize non-labelled, familiar products. These abstract general judgments contain beliefs that cannot be verified or tasted by the consumer (e.g. I believe that this product is healthy, safe or natural). These abstract, non-verifiable, general judgments are called credence attributes (Steenkamp, 1989). We assume that people initially infer a credence attribute automatically when categorizing non-labelled products and will then apply this criterion to the stimulus products in order to categorize them.

Garcia-Marques and Mackie (2001) showed that when situations are new, analytic strategies are triggered. When people have little experience with an object, they have not yet made generalizations at a higher level. So, when confronted with that new object it is hard to make inferences about the object. In this case people will have to search actively for information. GM foods are relatively new products and consumer knowledge of GM is limited (Eurobarometer, 2000).

We suggest that people in general do not know how to categorize GM products, because a category that represents these products is not readily available. Consequently, they cannot infer information automatically and have to search analytically for information in order to generalize information from the exemplars. Therefore we argue that people will use an analytic processing strategy when confronted with GM products and will search at the concrete level in the hierarchy for

categorization criteria. We assume that the generalized information from the exemplars are concrete judgments. In contrast with non-verifiable categorization criteria, concrete judgments can be verified by the consumer and therefore we will refer to these criteria as verifiable criteria. Verifiable categorization criteria are empirical observable observations of the physical characteristics of a stimulus or one's own reactions towards the stimulus (e.g. "These product are vegetable products", "These are processed products", "These products are products that I regularly consume", "These products are products that I am willing to accept"). Besides this, the criteria used will give insight into which characteristics of the products are most associated (most temporary accessible) with GM labelling.

Consistent with these ideas, several investigations have shown that differences in perception account for differences in GM acceptance. Tenbült *et al.* (2006) showed that acceptance of GM products differs between processed and non-processed products and Frewer *et al.* (1998) showed that people accept GM more when it involved plants and less when it involved animals. We suggest that people will analytically search for these verifiable criteria when categorizing GM products.

We want to investigate whether different categorization criteria are used and, hence, different characteristics are used to judge GM-labelled products and non-labelled products.

We will also examine whether different processes (analytic versus automatic) can account for these differences. We hypothesize that in general automatic processes are prevalent when categorizing conventional food products, resulting in relatively more non-verifiable categorization criteria. Besides this, we hypothesize that in general analytic processing takes place when products are labelled as GM, resulting in relatively more verifiable categorization criteria.

Study 1

Method

Sample. A total of 74 inhabitants of Maastricht (43 women, 31 men) participated in this study. The mean age of participants was 40.04 years (SD = 12.91, range 18 to 69). Participants responded to an advertisement in a local newspaper, which asked for people to participate in a study about food preferences in return for a small payment.

Food products. In a pilot study, ten participants were asked to list some products that have a non-processed and a processed form (e.g. tomato and ketchup). From the most frequently mentioned products, we chose nine products that spread over different dimensions other than on the basis of non-processed versus processed (e.g. healthy versus unhealthy products, natural versus unnatural products, vegetable versus animal products). We chose: tomato, chips, eggs, apple, steak, ketchup, potato, beef and baby food.

Procedure. The present experiment was part of a larger series of unrelated experiments. The participants had to classify the list of products into two groups. The participants were free to categorize the products as they liked as long as they described why they classified them this way. The participants received a form on which two frames were printed. The participants were asked to write the two groups of products into the two frames depending on the categorization they had made. They were asked to write beneath the two frames the criterion on which they had categorized the

products. The participants were randomly assigned to one of two conditions. In the first condition, the participants were instructed to imagine that the products were genetically modified. In the second (control) condition this was not mentioned. At the end, the participants were thanked and received a payment of 10 euros (including travel compensation).

Results

The categorization criteria on the basis of which the participants classified the products into two groups were scored. Six different criteria were mentioned by the participants (whether they ate it or not, whether it was healthy or not, whether the products were vegetable or animal, whether it was natural or not, whether it was a processed product or not and whether it they accepted it or not). We regrouped the criteria in two major groups, namely the “verifiable categorizations” (containing the criteria whether the products were “vegetable or animal”, whether the product was “processed or not” and whether they “accepted it or not” or “ate it or not”) and the “non-verifiable” categorizations containing the credence criteria (whether it was “healthy or not” and whether it was “natural or not”).

We performed a Chi-square test to compare the percentages of verifiable and non-verifiable categorization criteria on which the participants classified the non-labelled and GM-labelled products. The results showed that people tend to use more verifiable classification criteria when it concerned GM products and tend to use relatively more non-verifiable categorization criteria when it concerned non-labelled products $\chi^2(1) = 4.33, p < 0.05$ (for percentages see Table I). This result was present for every verifiable and non-verifiable categorization criteria separately.

Discussion

In study 1 we investigated whether GM labelling of food products has consequences for how information is processed: people tend to use verifiable categorization criteria which we take as an indication of analytical, and when not labelled as GM they use non-verifiable distinctions due to inferential, automatic processes. Besides this we investigated whether different categorization criteria are used to judge GM-labelled food products compared to non-labelled food products. Our data showed that when people classify non-labelled products, they tend to categorize these products according to non-verifiable categorization criteria (credence attributes like healthiness and naturalness). When the products are labelled as GM, people tend to classify products according to verifiable categorization criteria (like processed or animal origin). We assume that non-labelled products are evaluated with the use of non-verifiable information that are inferred from higher order levels in the hierarchy. We therefore believe that this is an automatic process. On the other hand, we assume that in general people will use analytical processing strategies when confronted with GM-labelled

	Non-labelled	GM-labelled	Percentages of mentioned criteria in the non-labelled and GM-labelled products, study 1
Verifiable categorizations	44.4	68.4	
Non-verifiable categorizations	55.6	31.6	
Total	100	100	

Table I.

products. Because people have little knowledge about GM, and therefore no inferences can be made, they will search for categorization criteria at the concrete level for, i.e. verifiable categorization criteria. Because people tend to use more verifiable classification criteria when it concerned GM products and tend to use relatively more non-verifiable categorization criteria when it concerned non-labelled products, we conclude that the type of categorization criteria that is used depends in general on whether the product is labelled or not.

The criteria used give insight into which characteristics of the products are most associated with GM labelling. Participants categorize products on the basis of whether the products were vegetable or animal, whether it was a processed product or not and whether they accepted it or not. Therefore, we believe that these are the important dimensions on which people perceive GM products.

Study 2

Study 1 showed that GM labelling leads to the use of different categorization criteria of products as compared to when foods are not labelled as such. We suggest that products become differently categorized on the basis of different processing strategies (automatic versus analytic).

Analytical processing requires attention and therefore occurs when someone is both willing and able to perform the task at hand (Kunda, 1999). Conversely, in situations where cognitive ability is inhibited, it is harder for a person to process information analytically. In this case, information has to be processed automatically. If our results are associated with a distinction in information processing strategies (analytical versus automatic), inhibiting people's processing capacity will lead to relatively more use of non-verifiable classifications, because of more frequent automatic processing behaviour.

Method

Design and participants. Our experiment used a 2 (product label: GM label versus no label) by 2 (cognitive load: load versus no load) full factorial design. A total of 166 students (140 women, 26 men) of University Maastricht were randomly assigned to one of four conditions of our experiment. The mean age of the participants was 20.77 years (SD = 4.05, range 18 to 46). The participants received a payment of 3 euros in return.

(1) *Materials:*

- *Food products.* We chose the same nine products as in study 1 and we added yoghurt. We made sure that there were food products that can be classified into multiple categorizations. For example, baby food can be classified both as an animal product and as a vegetable product, beef can be seen as a non-processed product but also as a processed product. We added yoghurt because it can be classified as natural and as unnatural depending on the perceiver.
- *Cognitive load.* In order to prevent people paying attention to the products we chose to let participants count backwards from 100 to 1 (e.g. 100, 99, 98, etcetera.). A cassette recorder recorded this in order to check that the participants performed the cognitive load task.

Procedure

Instructions stated that the participants had to divide a list of products into two groups. Again, the participants were free to divide the products as they liked as long as they described the basis for their categorization. This study consisted of four conditions. The first two conditions were the same as in study 1. In the first condition, the participants were instructed to imagine that the products were genetically modified. In the second condition no such information was provided. The third and the fourth, cognitive load, conditions were similar to respectively the first and the second conditions, with the addition that participants were asked to count backward from 100 to 1, while they executed the categorization task. This was audio-taped. After the participants had finished the categorization task, they were allowed to stop counting, irrelevant of how far they had advanced and were asked to push the stop button on the cassette recorder. As manipulation checks, participants in the third and fourth condition were also asked about whether they tried to count backwards ("I tried counting backwards as good as possible") and whether they perceived counting backwards to impede the execution of the division task ("counting backwards inhibited my performance on the task"). These two questions were rated on a Likert scale, ranging from 1 (not at all) to 5 (definitely yes). At the end, all participants were thanked and rewarded with a three-euro reward in cash.

Results

Manipulation check. The manipulation checks showed that for both the GM-labelled condition and the non-labelled condition the cognitive load was equally perceived as highly difficult and was perceived as affecting performance to the same extent (for means see Table II).

Categorizations. The categorization criteria of the four conditions were classified in the same two major groups as in study 1, namely "verifiable categorizations" (containing criteria whether the products were "vegetable or animal", "processed or not" and whether they "accepted it or not" or "ate it or not") and the "non-verifiable categorizations" containing the credence criteria (whether it was "healthy or not" and whether it was "natural or not").

For the analysis of the data we used the hierarchical log-linear (G^2) procedure in SPSS12. To preserve statistical power, all two-way expected frequencies were greater than 1 and not more than 20 percent were less than 5. The hierarchical log linear analysis showed no significant three-way interaction effect of product label, cognitive load and the tendency to use verifiable versus non-verifiable categorization categories. The analysis did show an interaction effect of product label on the tendency to use verifiable versus non-verifiable categorization categories ($G^2(1) = 18.38, p < 0.001$) and an interaction effect of cognitive load on the tendency to use verifiable versus

Table II.
Questions about
cognitive load for
non-labelled and GM
products (five-point
Likert scale)

	Non-labelled		GM-labelled	
	M	SD	M	SD
I tried to count backwards	4.39	0.86	4.38	0.84
The counting inhibited my task performance	4.30	0.55	4.40	0.55

non-verifiable categorization categories ($G^2(1) = 14.27, p < 0.001$). We did not find a significant interaction effect between label and cognitive load.

We performed Chi-square tests to compare the percentages of verifiable and non-verifiable categorizations depending on whether the products were labelled or not (for both the non-cognitive load condition and cognitive load condition) and whether cognitive load was present (for both the non-labelled and GM-labelled products). Data showed that people tend to use non-verifiable categorization criteria when it concerned non-labelled products and tend to use relatively more verifiable categorization criteria when it concerned GM-labelled products ($\chi^2(1) = 17.98, p < 0.001$; for percentages see Table III). Data also showed that people tend to use verifiable categorization criteria when no cognitive load was present and tend to use non-verifiable categorization criteria when cognitive load was present ($\chi^2(1) = 14.03, p < 0.001$; see Table III). This result was present for every verifiable and non-verifiable categorization criterion separately.

When people’s processing capacity was inhibited due to cognitive load, the same pattern of more verifiable categorization criteria in the labelled condition and more non-verifiable categorization criteria in the non-labelled condition is present. However, under conditions of load the dominance of the use of non-verifiable categories was much stronger. In the GM-labelled condition, load seems to attenuate the dominance of verifiable categorization criteria (see Table III). This result was present for every verifiable and non-verifiable categorization criteria separately.

Discussion

In study 2 we tried to replicate the findings of study 1 and we examined experimentally whether the results are indeed the effect of differences in processing strategies (analytic versus automatic). Study 2 showed the same pattern in relative differences as in study 1 and showed that people tend to use non-verifiable categorization criteria when it concerned not-labelled products and tend to use verifiable categorization criteria when it concerned labelled products. Above this, study 2 showed that people tend to use verifiable categorization criteria when no cognitive load is present and tend to use non-verifiable categorization criteria when cognitive load is present. We did not find an interaction effect between labelling and cognitive load. Inhibiting people’s processing capacity leads to relatively more use of non-verifiable categorization criteria irrespective of whether the products were labelled or not. Cognitive load appears to increase more automatic processing behaviour and therefore we tentatively conclude that the results of study 1 are due to automatic versus analytic processing. When products are not labelled as GM or when people have less processing capacity due to cognitive load, people generally apply abstract non-verifiable categorization criteria from a higher hierarchical level to subordinate exemplar products. Labelling a product

Table III.
Percentages of mentioned
criteria for non-labelled
and GM-labelled
products, with and
without cognitive load,
study 2

	Non-labelled		GM-labelled	
	No load	Load	No load	Load
Verifiable	50	11.8	77,5	54.3
Non-verifiable	50	88.2	22.5	45.7
Total	100	100	100	100

as belonging to a relatively new and unfamiliar category of products (e.g. GM) will lead to more use of verifiable categorization criteria due to analytical processing. Additionally, the reported verifiable categorization criteria of GM-labelled products give us insight into which information is analytically searched for and are important dimensions on which people perceive GM products.

The studies reported here are subject to certain limitations. In our studies, participants were told to imagine a product was GM, and were not actually exposed to product labelling in terms of applying physical attributes (e.g. stickers). A study of Epstein and Pacini (2001) showed that visualized experience is similar to real experience. Besides this, we believe that telling people to imagine that a product is GM is labelling because it conveys information about a certain product characteristic. A further limitation of this study concerns sample characteristics. Study 1 has a wide age range; age differences could affect expertise with GM and non-GM products. However, in study 2 we used a much smaller age range and found similar results. Besides this, study 2 has an overrepresentation of female participants in the sample, but showed similar results as study 1 (which has a better distribution between males and females).

Further research could focus on whether age differences and gender differences affect the usage of processing strategies and whether labelling of other types of new food production technologies (e.g. functional production) replicate our findings.

The present study provides insight into the processes that labelling as GM brings about. It can be concluded that labelling of a product as belonging to a certain category or another has consequences for what information gets inferred and consequently how it is perceived.

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Further reading

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