Creating a Mind Genomics Wiki for Non-Meat Analogs

Attila Gere 1,*, Ariola Harizi 2, Nick Bellissimo 3, Derek Roberts 4 and Howard Moskowitz 5

1 Sensory Laboratory, Faculty of Food Science, Szent István University, Villányi út 29-43., 1118 Budapest, Hungary
2 Slovak University of Agriculture, 949 76 Nitra, Slovakia; ariolaharizi@hotmail.com
3 School of Nutrition, Faculty of Community Services, Ryerson University, 350 Victoria Street, Toronto, ON M5B 2K3, Canada; nick.bellissimo@ryerson.ca
4 QEP Marketing Clinic, Chicago, IL 60661, USA; derek@qepmarketingclinic.com
5 Mind Cart AI, White Plains, NY 10605, USA; mjihrm@gmail.com

* Correspondence: gereattilaphd@gmail.com

Received: 26 May 2020; Accepted: 27 June 2020; Published: 2 July 2020

Abstract: In the past few decades, several negative aspects of excess meat consumption have been identified, ranging broadly from health to environment to consumer rejections of meat analogs. At the same time, however, several new meat alternatives have emerged such as algae, insects, and cultured meat, which all present a sustainable option to reduce meat consumption. The paper assesses the psychology of the “everyday” for meat-free products, focusing on how consumers in two specific markets in the USA (California, New York) respond to messages about four specific topics involving meat-free products. These four are sensory characteristics, possible usage in products, health aspects, and environmental aspects, respectively. Each study with 100 or more respondents used experimental design of messages (Mind Genomics) to understand the degree to which the respondents reacted positively or negatively to the 16 messages in each of the four studies. The data suggest that focusing on the Total Panel or on geography, gender, or age will not reveal the dramatically different mind-sets existing in each of the four topics. We introduce the notion of the PVI, personal viewpoint identifier, to help the researcher uncover these mind-sets, and help communicate effectively with each mind-set about meat analogs or help recruit these individuals to participate in further studies.

Keywords: Mind Genomics; mind-sets; cultured meat; meat alternatives; sustainable food production

1. Introduction

Meat consumption is considered to be part of a healthy diet. However, excess meat consumption raises several issues ranging from health problems [1] through animal welfare issues [2] to adverse environmental effects of meat production [3]. Due to these unwanted effects of meat consumption, several attempts are made to reduce the consumed amount of meat [4,5] or to substitute meat with a presumably more healthy, more sustainable protein source [6,7]. Different research groups have focused on a wide range of meat alternatives starting from the application of plant-based diets [8], algae [9], insects [10], cultured meat [11], or even using meat by-products and 3D printing [12].

Plant-based diets are well-known and are popular among vegetarians and vegans. Yet, a completely meat-free diet might not be universally acceptable. A possible strategy to promote the transition from meat-based diets to a more sustainable plant-based one blends plant-based ingredients into traditional meat-based foods. One study using a mushroom-meat blend-based product revealed that consumers would consume such a product mainly for its health benefits, and of interest to the food industry, would most strongly accept a mushroom-meat blend-based burger [13]. In turn, algae offer a viable, cost-effective option with which to create protein-rich products. Consumers from Germany, France, and the Netherlands preferred a blend of algae with eggs, peas, and milk, respectively. Since eggs and
milk have animal origin, as well as being implicated in food-allergies, the study suggested that algae and peas might achieve the necessary acceptance as protein sources for non-vegetarians. Additionally, it has been shown that consumers value the organic and local nature of meat substitutes [14]. At the other end of the spectrum, almost opposite to the desire for vegetable analogs, lies the potential use of insect protein. Consumer acceptance of insects as food is mainly limited by food neophobia (fear from new, unfamiliar food products) as well as food safety issues associated with insects [15]. However, product tests reveal that insect-enriched products are accepted, respectively, in pastas [16], breads [17], and biscuits [18].

Although cultured meat has been introduced in the past decade and continues to attract attention for its novelty and possibilities, the emerging studies suggest that proper messaging to enhance consumer awareness, understanding and acceptance needs to be discovered. When cultured meat is then featured, one needs a deeper understanding of how to convince consumers of the naturalness and thus perceived safety of products containing cultured meat [19]. Data has emerged which suggest that cultured meat has inferior sensory quality, questionable food safety, societal concerns, and is incorrectly priced, either too low or too high, but just “not right.” [20,21]. The conclusions from these studies stress that the foregoing issues may be addressed and probably solved by providing appropriate information to the consumers regarding the benefits of cultured meat products, stressing the triumvirate of health, environment, and food safety [22–24]. Add to the benefit of familiarizing the consumer with the nature of cultured meat, and there may be an opportunity for an entirely new class of products [20].

Measuring consumer acceptance of meat-alternatives presents some difficulties. In many cases, real products are not available or difficult to produce. A promising method to address these issues comes from the emerging science of Mind Genomics® [25], a method using experimental design to construct test vignettes or concepts, present these to the consumer respondent for evaluation, and then deconstruct the response into the contribution of the different elements. In practice, Mind Genomics works in a Socratic fashion, defining the topic, creating four questions which “tell a story,” creating four answers to each question, with these answers being in the form of a phrase. The respondent evaluates different concepts, systematically created combinations of these answers. The question never appears. The question is only used to “motivate” the answer.

In practice, therefore, the respondent evaluates mixtures of messages, each respondent evaluating a unique set of 24 such mixtures, incorporating 2–4 answers into a single vignette, and each vignette presented a unique stimulus to be evaluated in and of itself, on a rating scale provided by the researcher. The analysis, usually by OLS, ordinary least-squares, reveals the part-worth contribution of each element or answer to the rating. When applied to the topic of meat analogs, Mind Genomics immediately reveals the contribution of each element, viz., answer, providing a fountain of knowledge about how people respond to these different messages about food analogs. The combination of elements makes it impossible to “game” the system. The respondent is presented with a set of test concepts, the mixtures of elements, rating and rating these concepts (aka vignettes) in about 3–5 seconds each. The responses are thus provided not so much by intellectualized, considered judgment as they are by intuitive judgment, responses to a “blooming, buzzing confusion” of different messages, with only a few seconds to decide.

Mind Genomics® was created in the early 1990s, based upon work from the late 1970s and 1980s in the practical world of product marketing [25]. The science was then expanded to address problems in food product design [26,27]. The science has found wide application because of ongoing efforts to create a simple, fast, inexpensive system (do it yourself research), to address complex problems from food product development [26], to specific almost esoteric problems such as consumer concerns about indoor plant toxicity [28], and on to applications such as criteria involved in agriculture such as peach variety selection [29].

A recent study evaluated consumer’s willingness to purchase different meat alternatives versus traditional meat products. The study was conducted in four countries. The authors reported that consumers attributed higher importance to meat characteristics such as healthiness, safety,
and nutritional content, and/or higher sustainability, taste, and lower price as compared to their own standard buying decisions or their own neophobia, fear of new things, when they compared meat alternatives to traditional meat products. Additionally, the study reports that “... a one unit increase in the healthiness, safety and nutritional content of plant-based products might be associated with a 68.7% increase in the probability of willingness to purchase plant-based proteins in Spain. A one-unit stronger belief in the cultured meat healthiness, safety and nutritional content may be associated with an 86.8% increase in the probability of willingness to purchase cultured meat in Brazil. A one-unit stronger belief in the perception of the insect-based characteristics of healthiness, safety and nutritional content might be associated with a 68.7% increase in the probability of willingness to purchase insect-based products in the United Kingdom, a 72.1% in Brazil and a 58.6% in the Dominican Republic” [6].

This paper focuses on the topic of the mind of the consumers related to meat alternatives. The paper expands the hitherto limited single-focus studies of Mind Genomics, exploring the possibility of creating a bank of knowledge through easily and inexpensively executed sets of related studies, a Wiki approach to the consumer mind. The four topics for this first “Wiki” are sensory expectations, food product development, health, and then environment.

2. Materials and Methods

2.1. Participants

A set of four parallel studies were done using the method of Mind Genomics and covering a range of alternative issues in the daily experience of a consumer faced with the evolving world of meat analogs. These were possible uses in different foods, sensory acceptance, health and wellness, and environmental impact, respectively. The four studies were run using the BimiLeap program, the DIY (do it yourself) version of Mind Genomics. A world-wide panel provider, Luc.id, Inc., was contracted to provide more than 50 respondents from California and more than 50 respondents from New York, generating more than 100 respondents for each study. This sample size is in accordance with the suggested number (100–300) of respondents [30]. The breakdown was specified to be half male, half female, between the ages of 16 and 53. The only information collected about the respondent was market, gender, age, and a question about attitude toward the meat analogues—that question was particularized to each study. Demographic data regarding the participants appear in presented in Table 1.

| Table 1. Gender and age of participants completed the four studies. Genders are presented in percentages (%), whereas age is presented as mean ± st.dev. |
|---|---|---|
| Different foods | Male | Female | Age |
| CA | 54 | 46 | 29.9 ± 2.3 |
| NY | 42 | 58 | 28.1 ± 2.4 |
| Sensory acceptance | CA | 48 | 52 | 29.5 ± 2.4 |
| NY | 50 | 50 | 30.6 ± 2.3 |
| Health & wellness | CA | 46 | 54 | 27.8 ± 2.0 |
| NY | 48 | 52 | 27.8 ± 2.5 |
| Environmental impact | CA | 44 | 56 | 27.2 ± 5.1 |
| NY | 50 | 50 | 28.0 ± 5.1 |

CA: California, NY: New York.

No significant difference was found among the eight studies \[ F(7,392) = 0.971, p = 0.452 \]. Similarly, there was no significant association among genders and the studies \[ \chi^2 (7, N = 400) = 2.63, p = 0.92 \].
2.2. BimiLeap®

BimiLeap® [31], is the DIY software instantiation of Mind Genomics [25,27]. BimiLeap® is a freely available browser-based software which makes it straightforward to create, run, and automatically analyze small-scale studies in the Mind Genomics family. Mind Genomics itself is an offshoot of conjoint measurement [27], except that each respondent evaluates a unique set of 24 combinations or “vignettes” (space-filling, analogous to the way the MRI works) and the unique set of 24 combinations comprises a stand-alone experimental design.

BimiLeap® is based upon a Socratic method for exploring a topic. The researcher specifies the topic, formulates four questions which, in sequence, “tell a story,” and provides four answers to each question, or a set of 16 answers. The answers are in the form of a declarative statement which should paint a “word picture.” The BimiLeap® program allows the researcher to type the topic, the questions, and the answers directly into the program, formulate a rating question, a set of classification questions, and an open-ended question. Once the researcher finishes, it is a matter of “publishing” the study, paying for respondents through Luc.id (or sourcing the respondents in another, more indirect fashion.) The process is rapid, with set-up times to type in the materials and launching requiring about 1 hour, actual field work with Luc.id about 2–3 hours, and the completely analyzed results including a presentation ready report about an additional 1–2 minutes. The report and database are emailed virtually immediately. BimiLeap® uses rapidly presented ideas, therefore there is a limited time to think about the answers. These rapid, “gut” answers ensure the possible influence of any external factors, such as social expectations. Many scientific fields deal with the ever-changing opinion of consumers. It cannot be expected that the same respondent will have exactly the same opinion after repeated exposures. However, there are some techniques available to handle it. One is a sample number which was set to 200 in the presented study (100 from California and 100 from New York). When dealing with average results, the differences among the opinions of the respondents fade away. If the same 200 respondents would be interviewed again, their average results are not expected to be changed significantly since the individual differences would compensate each other. One thing, however, cannot be changed and these are the significant environmental effects; for example, media-hype of the analyzed topic or the effect of season when dealing with seasonal food products. When the study was run, there were no such external factors since there was no media-hype around meat alternatives and meat alternatives do not seem to have any seasonality. Four studies were created following the above-described process. Each of the four studies was run twice, once in New York, once in California. The topics, the questions, and the answer appear in Table 2.

BimiLeap® combines the answers into small vignettes, little “stories” about the given topic. The vignettes are created by a systematic design, permuted, so that each respondent sees a different permutation of the design. This creates different vignettes for each respondent. Each respondent evaluates the same formal set of 24 vignettes (structure is the same) but the specific combinations vary. All vignettes contain only one element from a silo, but not necessarily all silos are used. This means that a vignette can list one to four elements. This is required in order to provide the equal presentation of all the elements. So, with 50 people, the system creates 50 × 24 or 1200 different vignettes. The structure of the vignettes (e.g., the presence and absence of each of the 16 answers for each vignette) is stored in a binary table which is available to download once the study is closed [31].

The respondent reads the vignette, and rates the entire vignette on an anchored scale, with anchors 1 and 9, respectively. A rating of 1 denotes the fact the respondent does not agree with the specific combination of the statements in the vignette. A rating of 9 denotes the fact the respondent agrees completely with the specific combination of statements in the vignette. Respondents were instructed on the surface of the questionnaire about how to answer the questions.
Table 2. Study design of the four topics. The silos and the elements were created by the research team after a careful and thorough analysis of the scientific literature of the topic based on Scopus and Web of Knowledge searches.

| Study Name: Food Types | Study Name: Sensory |
|------------------------|---------------------|
| **Question A: Type**   | **Question A: Appearance** |
| A1 Processed meat product (sausage, meat patty, etc.) | Looks exactly like real meat |
| A2 Sliced meat (steak-like) | Minor differences to meat in appearance |
| A3 Pasta (spaghetti pasta, noodle, etc.) | Visible meat like chunks |
| A4 Pastry (bread, meat pie etc.) | Looks processed and synthetic |
| **Question B: Meat type** | **Question B: Smell** |
| B1 Contains cultured-meat | Aroma of any normal meat |
| B2 Contains plant-based meat | Slight but mostly neutral aroma |
| B3 Contains insect-based protein | Strong but not unpleasant aroma |
| B4 Contains algae | No apparent aroma |
| **Question C: Where to consume** | **Question C: Texture** |
| C1 As fast food | Similar texture to ground meat |
| C2 Consumed home with family | Similar texture to traditional sliced meat |
| C3 Consumed in a fancy restaurant | Soft, juicy and succulent texture |
| C4 Consumed on a business lunch | Firmer and drier texture |
| **Question D: Price** | **Question D: Taste** |
| D1 Slightly higher price compared to traditional meat | Exact flavor as any meat |
| D2 Slightly lower price compared to traditional meat | Similar flavor but obvious differences to meat |
| D3 Same price as traditional meat | Major but not unpleasant flavor differences to meat |
| D4 Lower price compared to traditional meat | Contains vegetable flavors |

| Study Name: Health aspects | Study Name: Environmental aspects |
|-----------------------------|----------------------------------|
| **Question A: Lower rates of diseases** | **Question A: Climate change** |
| A1 A meat-free diet reduces the risk of cardiovascular diseases | Meat substitutes help to decrease greenhouse gas emissions |
| A2 Meat-free diet provides more energy | Meat production is one of the leading causes of climate change |
| A3 Meat-free diet reduces the risk of type-II diabetes | Meat production has little or no effect on climate change |
| A4 Children should not follow a 100% meat-free diet | Although meat production contributes to climate change, it is not the main cause |
| **Question B: Weight loss** | **Question B: Local benefits** |
| B1 Meat-free diet helps in losing weight | Meat substitutes can be produced by local farmers also |
| B2 It is easier to exercise when not consuming meat | By eating meat-free, the local environment will be saved |
| B3 Lower fat intake helps in diet | Locally produced meat is better than meat substitutes |
| B4 High calorie meat substitutes hinder weight loss | Local meat producers lose their living if we substitute meat |
| **Question C: Healthier life** | **Question C: Land/energy** |
| C1 Meat-free diet is part of a healthier lifestyle | Meat substitutes require less land, therefore reducing deforestation |
| C2 Consuming no meat fits in with regular exercise | When eating meat substitutes, no animals are harmed |
| C3 Non-meat eaters are healthier than meat-eaters | The increased meat demand contributes to significant biodiversity loss |
| C4 Non-meat eaters show no difference in their lifestyles than meat-eaters | With proper regulations, meat production would have no effect on our environment |
| **Question D: Nutrients** | **Question D: Values** |
| D1 Meat-free diet increases fiber intake; hence your stomach becomes healthier | Meat substitutes are not cruel to animals |
| D2 Meat substitutes are rich in vitamins and minerals | Meat substitutes are less harmful to the planet |
| D3 Eggs and milks should not be discarded completely | Consuming no meat is better for my conscience |
| D4 Meat-free diet lacks essential nutrients, such as iron and calcium | Humans are carnivores, our body needs meat to work properly |

2.3. Data Analysis

The Mind Genomics program BimiLeap® runs straightforward ordinary least squares regression (OLS) of the type found in most statistical analysis packages. In the first step, the rating scale is transformed into a binary scale, e.g., low/weak feeling and high/strong feeling. For the 9-point scale used here, ratings of 1–6 on the scale transformed to 0 (i.e., low/weak feeling), while ratings of 7–9 on the scale transformed to 100 (e.g., high/strong feeling). This transformation follows the conventions of consumer market research where the focus is on yes/no, even though the information collected is metric, from a Likert scale. After the transformation, a small random number between 0.01 and 0.1 is added to each binary rating to make the data immune to “crashing” in the OLS regression in the
event that the respondent rates all vignettes 1–6, or 7–9, respectively, and thus generates data with no variation. That lack of variation would cause the OLS to crash.

The binary table of the present/absent value (codes as 0 for absent, 1 for present) constitutes the set of independent variables. The transformed rating scale is used as a dependent variable. OLS is run on an individual level, e.g., on the 24 vignettes the participants evaluated. For these studies the regression models were estimated without the presence of an additive constant in the model, viz., “forced through the origin.” The 16 regression coefficients for each respondent were used as the data for the respondent. The respondents were then clustered using k-means cluster, with the measure of distance between pairs of respondents defined as the quantity (1-R), where R is the Pearson correlation, computed by using the 16 correlation coefficients of each respondent. The respondents were clustered into two groups, and then into three groups, these groups called “mind-sets” because they represent different patterns of thinking about the same topic [31].

Once each respondent was defined by age and gender (self-definition in the classification portion of the Mind Genomics experiment) and assigned to one of three mind-sets (clusters) by the above-mentioned procedures, the entire array of data was reanalyzed by OLS regression (through the origin) for all respondents (total), all respondents from California versus all from New York, all males, all females, all younger, all older, and then those respondents falling into Mind-Set1 (Cluster 1), Mind-Set2 (Cluster 2), and Mind-Set3 (Cluster 3). The foregoing analysis was done separately for each of the four studies. Data analysis was done using R project (version R-3.6.0) and lm.beta package [32].

3. Results and Discussion

3.1. Food Types

The results from the total panel shows that respondents accepted the idea of meat alternatives (Table 3). The coefficients are high, especially for elements such as “Contains plant-based meat” and “Contains cultured-meat.” Based on the coefficients, the most accepted meat-alternative would be:

- **A processed meat product (sausage, meat patty, etc.)**
- **Containing plant-based meat**
- **Consumed home with family**
- **Having lightly lower price compared to traditional meat**

| Code | Elements                                      | Total | Male | Female | MS1 | MS2 | MS3 |
|------|-----------------------------------------------|-------|------|--------|-----|-----|-----|
| A1   | Processed meat product (sausage, meat patty, etc.) | 18    | 19   | 16     | 22  | 27  | 3   |
| A2   | Sliced meat (steak-like)                      | 15    | 16   | 15     | 25  | 18  | 1   |
| A3   | Pasta (spaghetti pasta, noodle, etc.)         | 14    | 16   | 11     | 22  | 31  | -14 |
| A4   | Pastry (bread, meat pie, etc.)                | 16    | 20   | 12     | 23  | 21  | 1   |
| B1   | Contains cultured meat                        | 18    | 20   | 16     | 30  | 5   | 16  |
| B2   | Contains plant-based meat                     | 21    | 24   | 19     | 38  | 2   | 18  |
| B3   | Contains insect-based protein                 | 14    | 18   | 11     | 33  | -3  | 6   |
| B4   | Contains algae                                | 14    | 13   | 14     | 33  | -3  | 10  |
| C1   | As fast food                                  | 13    | 18   | 8      | 5   | 3   | 31  |
| C2   | Consumed home with family                     | 13    | 17   | 10     | 5   | 0   | 38  |
| C3   | Consumed in a fancy restaurant                | 13    | 20   | 6      | 17  | -6  | 25  |
| C4   | Consumed on a business lunch                  | 12    | 20   | 4      | 14  | -14 | 34  |
| D1   | Slightly higher price compared to traditional meat | 6    | 4    | 8      | -10 | 29  | 4   |
| D2   | Slightly lower price compared to traditional meat | 8    | 4    | 12     | -11 | 22  | 19  |
| D3   | Same price as traditional meat                | 6    | 4    | 7      | -10 | 28  | 4   |
| D4   | Lower price compared to traditional meat      | 5    | 1    | 9      | -16 | 23  | 15  |

When comparing males and females, the most obvious differences arise in the case of the location of consumption. Men proved to be more open to the different locations and gave the highest ratings to...
fancy restaurant, while women were less open and would consume meat alternatives during a family event. The other significant difference was price. Women show more price sensitivity; they would accept a slightly lower price of meat alternatives, while men showed generally low interest in prices.

The emergent mind-sets showed three distinct groups (Table 2). Mind-Set 1 appears to be more open to alternatives, Mind-Set 2 appears to focus on the price, whereas Mind-Set 3 appears to focus on the consumption venue. The three mind-sets showed completely different picture about their expectations of meat-free food products:

**Mind-set 1 (Foodies):**
- Sliced meat (steak-like) product
- Made of plant-based meat
- Consumed on a business lunch
- Same price as traditional meat

**Mind-set 2 (Price sensitives):**
- Pasta (spaghetti pasta, noodle, etc.) product
- Made of cultured meat
- Consumed as fast food
- Slightly higher price compared to traditional meat

**Mind-set 3 (Diners):**
- A processed meat product (sausage, meat patty, etc)
- Made of plant-based meat
- Consumed home with family
- Lower price compared to traditional meat

3.2. Sensory Aspects

Sensory aspects of meat-free products resulted in three distinct clusters. Table 4 presents the regression coefficients for total panel, genders, and mind-sets, respectively. The coefficients from the Total Panel suggest that respondents would buy meat-free products having similar sensory aspects as traditional meat. If we construct the product features greatest for each sensory input, we would emerge with this product:

- Looks exactly like real meat (element A1);
- Has strong but not unpleasant aroma (element B3);
- Has soft, juicy, and succulent texture (element C3) and Has exact flavor as any meat (D1).

When gender differences are considered, the data suggest that males place more emphasis on appearance since their highest coefficient occur for the element “Looks exactly like real meat.” In contrast, women agree most with the element “Similar flavor but obvious differences to meat” the most.

The generally higher coefficients of men, a higher willingness to buy, are in accordance with the literature. For example, in the case of cultured meat, men proved to be more accepting compared to women in the US [33]. Along with this, female participants showed significantly higher willingness to change their meat consumption patterns compared to the expressed willingness of men, respectively [4].

As the total panel and gender results suggest, participants expect meat alternatives having similar characteristics to the mean products with which they are familiar. The three emergent mind-sets tell a different story, however, or more appropriately, tell three different stories. The created clusters show characteristic differences and completely different patterns of highly rated elements.
Table 4. Mean regression coefficients of total panel, males, females, and the three mind-sets. Bold represents significant difference among clusters based on the given element. The highest four coefficients of each mind-set (MS) are colored as gray.

| Code | Elements                             | Total | Male | Female | MS1 | MS2 | MS3 |
|------|--------------------------------------|-------|------|--------|-----|-----|-----|
| A1   | Looks exactly like real meat         | 16    | 24   | 9      | −5  | 19  | 34  |
| A2   | Minor differences to meat in appearance | 11   | 11   | 11     | −7  | 13  | 26  |
| A3   | Visible meat like chunks             | 11    | 15   | 7      | −8  | 15  | 25  |
| A4   | Looks processed and synthetic         | 13    | 18   | 9      | −10 | 19  | 30  |
| B1   | Aroma of any normal meat             | 14    | 14   | 14     | 28  | 20  | −6  |
| B2   | Slight but mostly neutral aroma       | 13    | 13   | 13     | 19  | 22  | −1  |
| B3   | Strong but not unpleasant aroma       | 19    | 19   | 19     | 27  | 28  | 1   |
| B4   | No apparent aroma                    | 15    | 17   | 14     | 14  | 34  | −1  |
| C1   | Similar texture to ground meat       | 10    | 9    | 10     | 5   | 28  | −4  |
| C2   | Similar texture to traditional sliced meat | 4    | 7    | 1      | −1  | 15  | −2  |
| C3   | Soft, juicy and succulent texture     | 11    | 14   | 7      | 5   | 17  | 10  |
| C4   | Firmer and drier texture              | 9     | 11   | 7      | 0   | 27  | −1  |
| D1   | Exact flavor as any meat             | 18    | 19   | 16     | 37  | −3  | 18  |
| D2   | Similar flavor but obvious differences to meat | 14   | 9    | 19     | 39  | −13 | 17  |
| D3   | Major but not unpleasant flavor differences to meat | 14   | 14   | 15     | 34  | −21 | 30  |
| D4   | Contains vegetable flavors            | 15    | 17   | 13     | 30  | −9  | 23  |

Mind-Set 1 is the “Flavor-oriented” cluster, since they would buy meat alternatives which have positive flavor notes, whether or not these notes show similarity or difference compared to traditional meat products. Consequently, Mind-Set 1 places a great emphasis on aroma notes. They would buy a meat alternative which has:

- Aroma of any normal meat
- Similar flavor but obvious differences to meat.

Mind-Set 2 focuses on aroma and texture attributes since these elements received the highest ratings, therefore have the highest positive coefficients. Mind-Set 2 can be labelled Texture-Oriented. They want:

- No apparent aroma
- Similar texture to ground meat.

Mind-Set 3 is more responsive to appearance and flavor attributes, and so can be labelled “Appearance-Oriented.” They want a meat alternative which

- Looks exactly like real meat
- Has major but not unpleasant flavor differences to meat.

Based on the pattern of the answers, cultured meat should be introduced to Mind-Set 1 since cultured meat has the most similar sensory attributes to traditional meats. On the other hand, plant-based proteins should meet the requirements of Mind-Set 2 since they have no apparent aroma and can be formed to have similar texture to ground meat [13]. Insect-based proteins could be a good alternative for Mind-Set 3 since insects have major but not unpleasant flavor differences to meat and they can also be formed to look like real meat [33].

3.3. Health Aspects

Total panel analysis of health aspects of consumption of meat-free products (Table 5) revealed a number of noteworthy patterns. Among the total panel, the highest coefficient is “Meat-Free Diet Helps in Losing Weight” (element B1), which suggests that meat-free diets are associated with weight loss. Yet, respondents do not consider a meat-free lifestyle and meat-free diets as a healthier life style, since they agree with the element “Eggs and milks should not be discarded completely” (D3). Furthermore, elements in Question C (meat-free lifestyle) received the lowest agreement ratings. These patterns accord with the literature. It has been shown that regardless of being semi-vegetarian or omnivore,
The leading motive to eat less meat was “my health” [34]. In the Netherlands, it has been shown that vegetarians reported two key reasons of not eating meat: they do not like it at all and they think animal welfare is important [35]. Another study from the United States found that flexitarians turn into full vegetarians due to social identity aspects of meat avoidance [36].

For genders, men agree more with statements related to weight loss and benefits during exercises compared. In contrast, women are more open to messages about health benefits such as lower risks of diseases, and messages about better nutrient intake of meat-free diets. These results were also supported by a recent study from the United States examining gender differences in vegetarian identity. Major differences between vegetarian identities of men and women were found as dietary motivation and dietary adherence. Women were reported as more motivated and willing to keep their diet stricter [37].

Our total panel and gender results are well supported by other, different authors and different, other methods from the literature. The most interesting results emerge from clustering into “mind-sets” based upon the patterns of coefficients of the individual respondent.

Table 5. Mean regression coefficients of total panel, males, females, and the three mind-sets. Bold represents significant difference among clusters based on the given element. The highest four coefficients of each mind-set (MS) are colored as gray.

| Code | Elements | Total | Male | Female | MS1 | MS2 | MS3 |
|------|----------|-------|------|--------|-----|-----|-----|
| A1   | A meat-free diet reduces the risk of cardiovascular diseases | 8 | 5 | 9 | −20 | 32 | 12 |
| A2   | A meat-free diet provides more energy | 10 | 8 | 13 | −8 | 30 | 11 |
| A3   | A meat-free diet reduces the risk of type-II diabetes | 13 | 12 | 13 | −10 | 40 | 11 |
| A4   | Children should not follow a 100% meat-free diet | 5 | −2 | 11 | −25 | 33 | 9 |
| B1   | Meat-free diet helps in losing weight | 21 | 33 | 10 | 31 | 10 | 21 |
| B2   | It is easier to exercise when not consuming meat | 13 | 18 | 9 | 18 | 4 | 16 |
| B3   | Lower fat intake helps in diet | 14 | 18 | 10 | 25 | −5 | 17 |
| B4   | High-calorie meat substitutes hinder weight loss | 13 | 14 | 11 | 22 | 0 | 15 |
| C1   | Meat-free diet is part of a healthier lifestyle | 10 | 11 | 9 | 14 | −3 | 18 |
| C2   | Consuming no meat fits in with regular exercise | 8 | 11 | 5 | 12 | −8 | 17 |
| C3   | Non-meat eaters are healthier than meat-eaters | 10 | 14 | 6 | 14 | −12 | 25 |
| C4   | Non meat-eaters show no difference in their lifestyles than meat-eaters | 8 | 9 | 7 | 8 | −3 | 17 |
| D1   | A meat-free diet increases fiber intake; hence your stomach becomes healthier | 13 | 8 | 17 | 35 | 19 | −14 |
| D2   | Meat substitutes are rich in vitamins and minerals | 9 | 4 | 14 | 37 | 12 | −20 |
| D3   | Eggs and milks should not be discarded completely | 13 | 7 | 19 | 38 | 21 | −18 |
| D4   | A meat-free diet lacks essential nutrients, such as iron and calcium | 11 | 6 | 16 | 33 | 22 | −20 |

Mind-Set 1, which we label nutrition-minded group, showed coefficients for elements highlighting the nutrient intake benefits of meat-free diets. They agree with the statements of eggs should not be discarded and that a meat-free diet lacks some essential nutrients, such as iron and calcium. Perhaps paradoxically, Mind-Set 1 has strong negative coefficients for elements in silo A which are about the lower risks of diseases.

Mind-Set 2, which we label disease-avoiders, agree with all the elements of Question A, meaning that they see the lower risks of diseases as the major health benefit of a meat-free diet.

Mind-Set 3, which we label sports enthusiasts, see the benefits of a meat-free diet in helping them losing weight and getting into better shape.

3.4. Environmental Aspects

Total panel results presented by Table 6 highlight the most important elements regarding environmental aspects of meat-free products. The highest coefficients, viz. those driving the greatest agreement by the respondent to the proposition embedded in the element, are fear of biodiversity loss (element C3), positive effects on conscience (D3) and animal welfare (C2), as well as the general agreement that people need meat to maintain our normal functions (D4). Previously published data suggest that respondents agree that a meat-free diet exerts positive effects on the environment and on animal welfare, respectively [34,35].
Table 6. Regression coefficients of total panel, males, females, and the three mind-sets. Bold represents significant difference among clusters based on the given element. The highest four coefficients of each mind-set (MS) are shaded in gray.

| Code | Elements                                                                 | Total | Male | Female | MS1 | MS2 | MS3 |
|------|--------------------------------------------------------------------------|-------|------|--------|-----|-----|-----|
| A1   | Meat substitutes help to decrease greenhouse gas emissions               | 11    | 11   | 8      | 25  | 15  | -20 |
| A2   | Meat production is one of the leading causes of climate change           | 9     | 13   | 8      | 20  | 20  | -12 |
| A3   | Meat production has little or no effect on climate change, it is not the main cause | 10    | 12   | 11     | 26  | 26  | -25 |
| A4   | Although meat production contributes to climate change                   | 7     | 3    | 4      | 14  | 20  | -31 |
| B1   | Meat substitutes can be produced by local farmers also                   | 10    | 17   | 8      | 32  | -8  | 16  |
| B2   | By eating meat-free, the local environment will be saved                 | 10    | 16   | 6      | 29  | -8  | 18  |
| B3   | Locally produced meat is better than meat substitutes                     | 12    | 8    | 15     | 29  | -11 | 23  |
| B4   | Local meat producers lose their living if we substitute meat             | 12    | 11   | 11     | 16  | 3   | 15  |
| C1   | Meat substitutes require less land, therefore reducing deforestation     | 13    | 9    | 16     | -11 | 25  | 20  |
| C2   | When eating meat substitutes, no animals are harmed                       | 13    | 8    | 16     | -23 | 28  | 30  |
| C3   | The increased meat demand contributes to significant biodiversity loss    | 13    | 5    | 20     | -13 | 25  | 23  |
| C4   | With proper regulations, meat production would have no effect on our environment | 11    | 7    | 19     | -12 | 24  | 24  |
| D1   | Meat substitutes are not cruel to animals                                | 11    | 7    | 9      | 17  | -3  | 13  |
| D2   | Meat substitutes are less harmful to the planet                          | 12    | 14   | 16     | 23  | 2   | 22  |
| D3   | Consuming no meat is better for my conscience                           | 13    | 15   | 15     | 28  | -2  | 23  |
| D4   | Humans are carnivores, our body needs meat to work properly             | 13    | 19   | 14     | 23  | 9   | 22  |

Patterns of response by gender show some interpretable patterns. Whereas men uprated elements about climate change higher, women uprated elements dealing with local production and land/energy aspects. Women gave their highest rating to element “The increased meat demand contributes to significant biodiversity loss.” Additionally, compared to men, women agree more with the proposition about the positive effects of meat-free diets on animal welfare.

Men gave the highest coefficient of both genders for “Humans are carnivores, our body needs meat to work properly” (D4), possibly hinting that men might be less willing to follow a meat-free diet. These results are in accordance with those found in the literature; compared to men, women express a greater support for animal rights and environmental benefits of meat-free diets [37].

The emergent mind-sets suggest three clearly different ways of thinking, a result which characterizes clusters created on the basis of responses to specifics (relevant messages), rather than clusters created on the basis of a person is, or how a person thinks in general about a topic. Mind-Set 1 suggests local patriots who value local products and support the production of meat and meat substitutes by local farmers. Additionally, they consider eating meat as good for their consciousness and their local environment. They may be similar to the emerging group called “locavores.” Mind-Set 2 suggests environmentalists, who decry the fact that meat production contributes to deforestation, animal abuse, and the loss of biodiversity. Mind-Set 3 appears to be practicals, who care about both local values and land/energy aspects of meat production. They are not idealists, who blame climate change on the activities involved with meat product.

4. Conclusions

The four integrated studies with comparable coefficients and interrelated elements reveal the possibility of creating a Wiki of a topic area in a short time (1–2 weeks), with the studies conducted among the desired target population, and with the cost and time parameters so low and fast that one can do several iterations. Our goal here is to explore the topic of the new meat analogs or replacements, showing what can be created in terms both of experimentation and about data-based hypothesis generation to guide subsequent explorations of the topic.

The importance of the studies is their integration into a database, the aforementioned “wiki,” as well as the importance of emergent mind-sets, with these mind-sets relevant to the particulars of the topic. Researches know that data from the “many,” from total panels, might give overgeneralized, and seeming irrelevant, “bland” results which do not teach or advance science, and simply “do not work in practice.” Some improvement could be achieved by splitting the participants based on gender and/or age; however, these can result in misleading results, too.
Besides the speed, low cost, and sheer interactivity of Mind Genomics experiments, the contribution of Mind Genomics may be most important in terms of its ability to reveal specific, granular mind-sets, groups of individuals emerging from the pattern of responses to a particular localized topic. It is the granularity of knowledge, and the ability to test specific, concrete suggestions of what to say and what to do, that allows Mind Genomics to contribute both to science and to practice.

The mind-sets created in these studies did not show any significant differences neither by gender nor by age groups, meaning that the mind-sets may be explained and described better by categorized “thinking styles” that crosswise the different demographic variables. This confirms the 30–40-year science of Mind Genomics as a powerful discovery and application tool for sensory and consumer scientists. The presented results enable food companies and policy makers to get a clearer overview of US participants’ attitudes toward meat-free products and some related aspects. Future studies are needed to uncover how to classify newly recruited participants into the defined mind-sets by developing a fast, simple, powerful, and cost-effective method to classify. A good analogy is color science. Mind Genomics provides the “theory of colors” in a day or two for any defined or even hypothesized set of topics and questions. The next step is to create a “personal viewpoint identifier” to assign new people to the just-uncovered mind-sets, a discovery that may have taken simply one morning or one afternoon to make.

**Author Contributions:** Conceptualization: A.G., A.H., N.B., D.R., and H.M.; Methodology: A.G., H.M.; Software: A.G., H.M.; Validation: A.G., A.H., N.B., D.R., and H.M.; Formal analysis: A.G., H.M.; Writing—Original draft preparation: A.G., A.H.; Writing—Review and editing: N.B., D.R., H.M.; Funding acquisition: A.G., H.M. All authors have read and agreed to the published version of the manuscript.

**Funding:** This research received no external funding.

**Acknowledgments:** Attila Gere thanks the support of the Premium Postdoctoral Researcher Program of the Hungarian Academy of Sciences and National Research, Development and Innovation Office of Hungary (OTKA, contracts No. K119269). The Project is supported by the European Union and co-financed by the European Social Fund (grant agreement no. EFOP-3.6.3-VEKOP-16-2017-00005).

**Conflicts of Interest:** The authors declare no conflicts of interest.

**References**

1. Wang, X.; Lin, X.; Ouyang, Y.Y.; Liu, J.; Zhao, G.; Pan, A.; Hu, F.B. Red and processed meat consumption and mortality: Dose-response meta-analysis of prospective cohort studies. *Public Health Nutr.* **2016**, *19*, 893–905. [CrossRef] [PubMed]

2. De Backer, C.J.S.; Hudders, L. Meat morals: Relationship between meat consumption consumer attitudes towards human and animal welfare and moral behavior. *Meat Sci.* **2015**, *99*, 68–74. [CrossRef]

3. Lynch, J. Availability of disaggregated greenhouse gas emissions from beef cattle production: A systematic review. *Environ. Impact Assess. Rev.* **2019**, *76*, 69–78. [CrossRef]

4. Malek, L.; Umberger, W.J.; Goddard, E. Committed vs. uncommitted meat eaters: Understanding willingness to change protein consumption. *Appetite* **2019**, *138*, 115–126. [CrossRef] [PubMed]

5. Bonnet, C.; Bouamra-Mechemache, Z.; Réquillart, V.; Treich, N. Viewpoint: Regulating meat consumption to improve health, the environment and animal welfare. *Food Policy* **2020**, *101847*. [CrossRef]

6. Gómez-Luciano, C.A.; de Aguiar, L.K.; Vrieseekoop, F.; Urbano, B. Consumers’ willingness to purchase three choices to meat proteins in the United Kingdom, Spain, Brazil and the Dominican Republic. *Food Qual. Prefer.* **2019**, *78*, 103732. [CrossRef]

7. van der Weele, C.; Feindt, P.; Jan van der Goot, A.; van Mierlo, B.; van Boekel, M. Meat alternatives: An integrative comparison. *Trends Food Sci. Technol.* **2019**, *88*, 505–512. [CrossRef]

8. Graça, J.; Godinho, C.A.; Truninger, M. Reducing meat consumption and following plant-based diets: Current evidence and future directions to inform integrated transitions. *Trends Food Sci. Technol.* **2019**, *91*, 380–390. [CrossRef]

9. Grahl, S.; Palanisamy, M.; Strack, M.; Meier-Dinkel, L.; Toepfl, S.; Mörlein, D. Towards more sustainable meat alternatives: How technical parameters affect the sensory properties of extrusion products derived from soy and algae. *J. Clean. Prod.* **2018**, *198*, 962–971. [CrossRef]
10. Gere, A.; Radványi, D.; Héberger, K. Which insect species can best be proposed for human consumption? *Innov. Food Sci. Emerg. Technol.* **2019**, *52*, 358–367. [CrossRef]

11. Zhang, G.; Zhao, X.; Li, X.; Du, G.; Zhou, J.; Chen, J. Challenges and possibilities for bio-manufacturing cultured meat. *Trends Food Sci. Technol.* **2020**, *97*, 443–450. [CrossRef]

12. Dick, A.; Bhandari, B.; Prakash, S. 3D printing of meat. *Meat Sci.* **2019**, *153*, 35–44. [CrossRef]

13. Lang, M. Consumer acceptance of blending plant-based ingredients into traditional meat-based foods: Evidence from the meat-mushroom blend. *Food Qual. Prefer.* **2020**, *79*, 103758. [CrossRef]

14. Weinrich, R.; Elshewy, O. Preference and willingness to pay for meat substitutes based on micro-algae. *Appetite* **2019**, *142*, 104353. [CrossRef] [PubMed]

15. Mancini, S.; Moruzzo, R.; Riccioli, F.; Paci, G. European consumers’ readiness to adopt insects as food. A review. *Food Res. Int.* **2019**, *122*, 661–678. [CrossRef]

16. Biró, B.; Fodor, R.; Szedlajk, I.; Pásztor-Huszár, K.; Gere, A. Buckwheat-pasta enriched with silkworm powder: Technological analysis and sensory evaluation. *LWT* **2019**, *116*, 108542. [CrossRef]

17. Haber, M.; Mishyna, M.; Martinez, J.J.I.; Benjamin, O. The influence of grasshopper (Schistocerca gregaria) powder enrichment on bread nutritional and sensorial properties. *LWT* **2019**, *115*, 108395. [CrossRef]

18. Akande, A.O.; Jolayemi, O.S.; Adelugba, V.A.; Akande, S.T. Silkworm pupae (Bombyx mori) and locusts as alternative protein sources for high-energy biscuits. *J. Asia. Pac. Entomol.* **2020**, *23*, 234–241. [CrossRef]

19. Bryant, C.; Barnett, J. Consumer acceptance of cultured meat: A systematic review. *Meat Sci.* **2018**, *143*, 8–17. [CrossRef]

20. Verbeke, W.; Marcu, A.; Rutsaert, P.; Gaspar, R.; Seibt, B.; Fletcher, D.; Barnett, J. “Would you eat cultured meat?”: Consumers’ reactions and attitude formation in Belgium, Portugal and the United Kingdom. *Meat Sci.* **2015**, *102*, 49–58. [CrossRef]

21. Laura, O.; Carly, M.; Clair, G.; Sarah, M.; Alice, B.-L. Consumer responses to a future UK food system. *Br. Food J.* **2016**, *118*, 412–428. [CrossRef]

22. Bekker, G.A.; Tobi, H.; Fischer, A.R.H. Meet meat: An explorative study on meat and cultured meat as seen by Chinese, Ethiopians and Dutch. *Appetite* **2017**, *114*, 82–92. [CrossRef]

23. Mancini, M.C.; Antonioli, F. Exploring consumers’ attitude towards cultured meat in Italy. *Meat Sci.* **2019**, *150*, 101–110. [CrossRef]

24. Weinrich, R.; Strack, M.; Neugebauer, F. Consumer acceptance of cultured meat in Germany. *Meat Sci.* **2020**, *162*, 107924. [CrossRef] [PubMed]

25. Moskowitz, H. “Mind genomics”: The experimental, inductive science of the ordinary, and its application to aspects of food and feeding. *Physiol. Behav.* **2012**, *107*, 606–613. [CrossRef] [PubMed]

26. Moskowitz, H.; Rappaport, S.; Moskowitz, D.; Porretta, S.; Velema, B.; Rossi, L.; Atwater, M. Chapter 14–Product design for bread through mind genomics and cognitive economics. In *Developing New Functional Food and Nutraceutical Products*; Bagchi, D., Nair, S., Eds.; Academic Press: San Diego, CA, USA, 2017; pp. 249–278. ISBN 978-0-12-802780-6.

27. Porretta, S.; Gere, A.; Radványi, D.; Moskowitz, H. Mind Genomics (Conjoint Analysis): The new concept research in the analysis of consumer behaviour and choice. *Trends Food Sci. Technol.* **2019**, *84*, 29–33. [CrossRef]

28. Keene, S.A.; Kalk, T.N.; Clark, D.G.; Colquhoun, T.A.; Moskowitz, H.R. Indoor plant toxicity concerns some consumers. *Acta Hortic.* **2018**, *1212*, 361–365. [CrossRef]

29. Olmstead, M.A.; Gilbert, J.L.; Colquhoun, T.A.; Clark, D.G.; Kluson, R.; Moskowitz, H.R. In pursuit of the perfect peach: Consumer-assisted selection of peach fruit traits. *HortScience* **2015**, *50*, 1202–1212. [CrossRef]

30. Cattin, P.; Wittink, D.R. Commercial Use of Conjoint Analysis: A Survey. *J. Mark.* **1982**, *46*, 44–53. [CrossRef]

31. Gere, A.; Zemel, R.; Papajorgij, P.; Radványi, D.; Moskowitz, H. Chapter 3–Public driven and public perceptible innovation of environmental sector. In *Innovation Strategies in Environmental Science*; Galanakis, C.M., Ed.; Elsevier: Amsterdam, The Netherlands, 2019; pp. 69–106. ISBN 978-0-12-817382-4.

32. R Core Team R: A Language and Environment for Statistical Computing; R Core Team: Vienna, Austria, 2019.

33. Wilks, M.; Phillips, C.J.C. Attitudes to in vitro meat: A survey of potential consumers in the United States. *PLoS ONE* **2017**, *12*, 1–14. [CrossRef]

34. Smetana, S.; Ashhtari Larki, N.; Pernutz, C.; Franke, K.; Bindrich, U.; Toepfl, S.; Heinz, V. Structure design of insect-based meat analogs with high-moisture extrusion. *J. Food Eng.* **2018**, *229*, 83–85. [CrossRef]
35. Mullee, A.; Vermeire, L.; Vanaelst, B.; Mullie, P.; Deriemaeker, P.; Leenaert, T.; De Henauw, S.; Dunne, A.; Gunter, M.J.; Clarys, P.; et al. Vegetarianism and meat consumption: A comparison of attitudes and beliefs between vegetarian, semi-vegetarian, and omnivorous subjects in Belgium. *Appetite* 2017, 114, 299–305. [CrossRef] [PubMed]

36. de Boer, J.; Schösler, H.; Aiking, H. Towards a reduced meat diet: Mindset and motivation of young vegetarians, low, medium and high meat-eaters. *Appetite* 2017, 113, 387–397. [CrossRef] [PubMed]

37. Rosenfeld, D.L.; Rothgerber, H.; Tomiyama, A.J. From Mostly Vegetarian to Fully Vegetarian: Meat Avoidance and the Expression of Social Identity. *Food Qual. Prefer.* 2020, 103963, in press. [CrossRef]