

Perceptions of food naturalness and the influence of ingredient statements, colors, and flavors

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## **Abstract**

Food selection and consumer behavior are popular topics of study due to the benefits to both academics and food producers. A less studied area, however, is consumer perceptions of naturalness. Neither the U.S. Food and Drug Administration nor the U.S. Department of Agriculture have an official definition for what constitutes as a natural food, although both organizations have general guidelines. This, combined with a lack of consumer understanding of the term, make natural food a complex and important topic to study. Work has been done to study the consumer definition of natural and perceptions of natural food, but no work has studied how food ingredient statements affect consumer perceptions of product naturalness. The objectives of this study were (1) to understand how food ingredient statements influences perceptions of naturalness, (2) to understand how ingredient statement length impacts perceptions of naturalness, (3) to understand how artificial and natural colors and flavors influence perceptions of naturalness, and (4) to understand how product identity and ingredient statements affect naturalness perceptions of whole, non-processed foods. An online survey was launched in the United States, United Kingdom, and Australia, recruiting 1000 consumers in each country. The results of the survey found that consumers use several cues to determine the naturalness of a food product. Product identity has a large impact, but naturalness perceptions can be influenced by the presence of an ingredient statement. Both artificial colors and artificial flavors are perceived as less natural by consumers, but other ingredients also have an effect. Products with ingredient statements that contain a high volume of ingredients with unfamiliar, chemical sounding names lower perceptions of naturalness. Additionally, products with longer ingredient statements are perceived to be less natural than products with short ingredient statements. The location of certain ingredients within the statement also influence naturalness

perceptions. When the colorant was located at the end of the ingredient statement, the product was perceived as less natural than when the colorant was located in the middle. Products that come from plants and products that are physically processed are seen as more natural than products with unhealthy ingredients and products that are highly processed. In general, males, Millennials, and consumers with more education and higher income perceived the presented food products as more natural than others in their respective demographic groups. There were also no large differences in perception between US, UK, and Australian respondents. The results from this research project help to form a more complete picture of consumers' perceptions of natural food and help to understand the importance of ingredient statements in forming these perceptions.

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# Chapter 1 - Literature Review

## Ambiguous Definition of “Natural”

“Natural” is a claim that can be seen on many food items in all sections of the grocery store. This claim, however, is controversial because there is no established definition informing consumers what “Natural” really means. In the United States, three government organizations are responsible for various aspects of the “Natural” label claim: the FDA, the USDA, and the FTC (Parasidis, 2015). The FDA and USDA are responsible for “Natural” label claims on foods and beverages with the USDA in charge of meat, poultry, and egg products and the FDA responsible for all other foods and beverages. The FTC is responsible for advertising of foods and beverages (Parasidis, 2015). In 1993, the FDA ruled not to define the term “Natural”, but stated that they would not restrict its use with the exception of products containing “added color, synthetic substances, and flavors” (Department of Health and Human Services, 2015). As of 2015, the USDA guidelines state that “Natural” products cannot contain artificial ingredients or added colors and must be minimally processed, meaning that the food cannot be fundamentally altered. Additionally, in order to make the “Natural” claim, the USDA requires that manufacturers reveal why the food is considered “Natural” (for example, a callout stating “no artificial ingredients; minimally processed”) (FSIS, 2015). Though the USDA has guidelines regarding “Natural” label claims, no current definition exists to help consumers when making food selections. In fact, many American consumers do not know the difference between natural foods and Organic foods. Authors K.M. Abrams and C.A. Meyers presented their findings from focus group studies conducted to gather consumer thoughts and opinions about natural foods. They found that some consumers do not know the difference between organic foods and natural foods. They also discovered that some consumers are suspicious of the “Natural” claim and believe that it is just a

24 marketing tactic to increase sales (Abrams, 2010). Canadian consumers are more comfortable  
25 with organic products because of the clear definitions in place (Mintel, 2018). The lack of a  
26 formal definition does not help consumers who are unsure what “Natural” means and if it is even  
27 a real claim. According to proprietary research conducted by FONA in 2017 and published in  
28 2018, 40% of respondents to their consumer survey do not trust the “Natural” claim. They also  
29 found that 45% of respondents reported that they read ingredient statements to determine if the  
30 products are in line with their personal definitions of “Natural” (FONA, 2018).

31       Even without an official definition, however, natural foods are sought after by  
32 consumers. Nielsen found that between 2012 and 2014, sale of natural products has increased by  
33 24% (Nielsen, 2015). According to their 2016 Global Ingredient and Out-Of-Home Dining  
34 Trends Report, Nielsen found that sales of salty snacks with a “Natural” claim grew by 5.7%  
35 between 2015 and 2016, compared to just 2.6% growth for the salty snack category as a whole  
36 (Nielsen, 2016). Market research company Mintel reports that “Natural” claims have decreased  
37 by 62% in Canada in the past 10 years. Canadian food and beverage companies have started to  
38 replace “All Natural” claims with less vague claims like “GMO-Free” and “Preservative-Free”  
39 (Mintel, 2018). Regardless of the number of claims, including “Natural” or “All-Natural” on  
40 food and beverage labels appears to increase sales. According to Consumer Report’s Natural  
41 Food Labels Survey from 2015, 62% of U.S. consumers purchase food labeled “Natural” and  
42 87% are willing to pay more for food labeled “Natural” (Consumer Reports, 2015). Mintel also  
43 found that though the number of “Natural” claims is falling, 29% of Canadian consumers report  
44 buying more natural foods and beverages in 2018 than in they did in 2017 (Mintel, 2018).  
45 Nielsen reports that 58% of global respondents want more all-natural products in the market  
46 (Nielsen, 2016). When making purchases, 43% of global respondents, 29% of North American

47 respondents, 42% of European respondents, and 64% of Latin American respondents reported  
48 that “All-Natural” was an important feature of foods and beverages (Nielsen, 2015).  
49 Additionally, among those that believe “All-Natural” foods are at least slightly important to  
50 them, 39% of global consumers and 24% of North American consumers are willing to pay more  
51 for foods with this label claim (Nielsen, 2015). S.R. Dominick found that 48-57% of respondents  
52 were likely to purchase various food products with “All-Natural” label claims (Dominick, 2018).  
53 On a global level, it is clear that consumers are interested in about “All-Natural” foods and  
54 beverages. In 2016, the FDA, in response to increasing interest and questions from consumers,  
55 asked the public for information and comments regarding the “Natural” label claim. Though the  
56 comment period has ended, they still state that they have not “engaged in rulemaking to establish  
57 a formal definition for the term ‘natural’”, though they do provide their “longstanding policy” on  
58 the subject (Center for Food Safety and Applied Nutrition, 2018).

59         A large part of the FDA’s policy on the “Natural” label claim centers around the word  
60 “no”, as in nothing artificial/synthetic (Center for Food Safety and Applied Nutrition, 2018).  
61 Many authors have gathered data on how consumers define the term “Natural” and reached  
62 similar conclusions that the definition revolves around the word “no”. In their focus groups, K.  
63 M. Abrams and C. A. Meyers found that the consumer definition of “Natural” includes no  
64 additives, no preservatives, no hormones, and no chemicals (Abrams, 2010). In a review of 72  
65 articles about the importance of naturalness to consumers, Author Sergio Román found that  
66 consumers think “Natural” foods should have no artificial colors, no additives, no human  
67 intervention, etc. (Román, 2017). More specifically, Paul Rozin found that the absence of  
68 human intervention was important to consumers and their definition of “Natural” includes no  
69 processing, no alterations, no contact with humans, and no industrial intervention (Rozin, 2012).

## So, what is a “Natural” Food?

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In addition to all the “no’s”, consumers also consider some positive aspects associated with the “Natural” label. These positive features include minimally processed, organically grown, increased animal handling and welfare, improved nutritional value, improved food safety, improved taste, etc. (Abrams, 2010; Román, 2017; Dominick, 2018). In an online survey, author S. R. Dominick found that 63% of respondents believe foods labeled as “Natural” are more nutritious and safer, 60% believe natural foods are better for animal well-being, and 56% believe natural foods taste better than their conventional counterparts (Dominick, 2018).

Paul Rozin found that consumers believe that physical changes (like freezing and thawing) are more natural processes than chemical changes (like fat reduction) (Rozin, 2005). This conclusion was supported by findings from a questionnaire-based study by Evans et al conducted in Australia (Evans, 2010). Rozin also concluded that “process is more important than content” when respondents reported that genetic engineering is less natural than domestication even though genetic engineering (specifically, the insertion of a single gene) involves less human intervention than domestication, which can take generations (Rozin, 2005). He supported the process over content results with follow-up study that found that a food product that was “doubly-transformed” (tomato paste with sucrose removed, then added back in) was less natural than a once transformed product even if the twice transformed product was chemically identical to the original product (Rozin, 2006). Evans et al. found contrary results in their questionnaire-based study. Respondents rated products made with vegetable powder to be significantly less natural than products made with fruit powder and products made with fruit powder were rated significantly less natural than products made with fruit pulp. He concludes that both process and content impact the perception of naturalness, but ultimately, content is more important (Evans,

93 2010). This study by Evans et al. explored additional food qualities than impact the consumer  
94 perception of naturalness. As more additives are added to a product, the less natural a food is  
95 considered. Only a small amount of additives added to a food product (as little as 2%) can  
96 decrease naturalness ratings, but beyond a certain threshold (between 4 and 6%), the score does  
97 not continue to decrease. This threshold, however, was not seen with processing. Evans states  
98 that a linear relationship exists in which the more processing a food product receives, the less  
99 natural it is perceived to be. He also found that products made with 'like' additives are  
100 considered by respondents to be more natural than products made with dissimilar additives. For  
101 example, a carrot soup made with black carrot concentrate was considered more natural than a  
102 tomato sauce made with black carrot concentrate. Food products that were made with fruit  
103 powder and black carrot were rated as more natural than the same products made with starch and  
104 gums even though the former two ingredients are likely to be more novel to consumers (Evans,  
105 2010). Though fruit powder and black carrot may be novel to consumer, it is likely the name of  
106 the ingredient that affects perceptions of naturalness. Evans et al. found that the presence of an  
107 E-number on an ingredient label was perceived as less natural than the same label with a  
108 chemical name or common name instead. The presentation of ingredient names on food labels  
109 has been found by other authors to impact consumers' perceptions of naturalness. Michael  
110 Siegrist and Bernadette Sütterlin found that including the E-number on a label instead of a  
111 chemical or common name significantly decreased the perception of naturalness (Siegrist, 2017).

112 Chambers V et al. found that inclusion of an ingredient's chemical name also influences  
113 perceived naturalness, as Sodium Bicarbonate was rated as less natural than baking soda. They  
114 note this as a good example of familiarity bias where consumers perceive foods or ingredients  
115 they are more aware of as more natural than novel foods or ingredients. Additionally, wheat flour

116 was perceived as more natural than sorghum flour, though both are flours made from cereal  
117 grains. Along with familiarity, Chambers V found that insect powder was perceived as natural  
118 only by a small percentage of respondents, suggesting that neophobia may also play a role in  
119 naturalness perceptions. In the same online survey, the team found that none of the ingredients  
120 were considered natural by 100% of the respondents and corn was considered natural by the  
121 largest percentage of consumers, still only at 69%. They note that two of the ingredients  
122 considered to be natural by the most respondents, corn and soybeans, are some of the most  
123 commonly genetically modified foods in the market. Both of these ingredients, however, are  
124 considered healthy by many consumers, which may have affected perceptions of naturalness  
125 (Chambers, 2018). Rozin et al. found that respondents to their questionnaire believe that natural  
126 foods are considered healthier than their conventional counterparts (Rozin, 2004).

127        Besides food or ingredient cues, packaging cues also influence perceptions of  
128 naturalness. Anne-Sophie Binnering found that the perceived naturalness of product packaging  
129 could give an indication of the naturalness the product inside. The more natural the packaging is  
130 perceived to be, the more credible and attractive the product is to consumers. Consumers also  
131 believe that “Natural” packaging is associated with higher quality products and increases their  
132 intent to purchase (Binnering, 2017).

133        Many studies have noted that consumers perceive positive qualities and characteristics  
134 with natural food products (Rozin, 2004; Rozin, 2012; Dominick, 2018). Thus, Apaolaza et al.  
135 studied this possible halo effect associated with the “Natural” claim. When exposed to the claim  
136 “Perfumes made of 100% natural ingredients” participants’ overall acceptance scores and  
137 intention to purchase increased. Additionally, ratings of the perfume’s naturalness as well as  
138 ratings of affective terms, like pleasantness and joy, increased compared to a control group not

139 exposed to the claim. They conclude that there is strong evidence of a halo effect with the term  
140 “Natural” and this could be influencing liking and purchase intent with these products (Apaolaza,  
141 2014).

142

### 143 **More about “Natural” Consumers**

144 In addition to assumptions about natural foods, consumers form assumptions about  
145 natural food consumers. The team of Taylor and Stevenson hypothesized that people think more  
146 highly of consumers of natural foods. Through both online and in-person studies, they found that  
147 natural food consumers are considered more virtuous and healthier than “unnatural” food  
148 consumers are (Taylor, 2018). They state some possible explanations for these associations.  
149 Someone who consumes natural foods must possess those positive characteristics associated with  
150 natural foods. If consumers may associate natural foods with moral attributes like healthiness,  
151 then someone who consumes natural foods must also be healthy. If “unnatural” foods are  
152 associated with being less eco-friendly and worse for animal welfare, than consumers of natural  
153 foods must not support these ideals and, therefore, have higher moral character (Taylor, 2018).  
154 Along with these morality characteristics, Taylor and Stevenson found that people associate  
155 natural food consumers with being more feminine, more educated, wealthier, and older (Taylor,  
156 2018). In their review of related studies, Román et al. found that gender and age were the most  
157 studied demographics in studies focusing on naturalness. They also determined that female and  
158 older consumers are more receptive to natural foods in those two demographics (Román, 2017).  
159 Bäckstrom et al. and Dominick et al. support the finding that female consumers are more  
160 receptive to natural foods than male consumers (Bäckstrom, 2004; Dominick, 2018). Bäckstrom  
161 et al. also found that naturalness is more important to consumers living in rural areas than those

162 living in urban areas (Bäckstrom, 2004). In a study of U.S. consumers, market research  
163 companies IRI and SPINS found two segments that comprise just under half of all natural and  
164 organic food sales. The first, called “True Believers”, consists of consumers with a medium  
165 income of \$65,000, an average age of 40, attended college, and are interested in trying new  
166 things and staying healthy. These consumers also believe that natural and organic products have  
167 benefits for the consumer. The second segment, called “Enlightened Environmentalists”, average  
168 at 63 years old, attended graduate school, have a medium income of \$57,000, and are passionate  
169 about the environment. This group is also likely to shop at stores that specifically carry natural  
170 and organic food products (Business Wire, 2013). Though gender and age are the most studied  
171 demographics, interest in the traits and attitudes of natural consumers is valuable to food  
172 manufacturers who wish to tailor their marketing strategies to increase sales of their natural  
173 products. Based on these studies, consumers with the most interest in natural foods tend to be  
174 female and older. They are also likely to have a college degree, value a healthy lifestyle, and be  
175 more trustworthy, though these results were found in fewer studies.

176

## 177 **Natural and Artificial Colors and Flavors**

178 Much work has been done on natural foods in general. Fewer studies have looked  
179 specifically at two groups of ingredients that play a big role in the natural food movement: colors  
180 and flavors. For years, artificial colors and flavors have been used to attract consumers, to make  
181 up for processing losses, and to create exciting and unique sensory profiles in foods and  
182 beverages. The main benefit of artificial over natural is cost. Artificial colors and flavors are  
183 cheaper than their natural counterparts are because they have been synthesized in a lab as  
184 opposed to being extracted from natural sources (Gebhardt, 2015). Along with cost, natural



185 colors and flavors need to be used in larger amounts in food formulations to get the same effect  
186 as artificial. Sources of natural color, for example, may contain 2% or less of the desired pigment  
187 whereas artificial colors are 90% pigment (Gebhardt, 2015). Natural colors are derived from  
188 minerals, plants, animals and microorganisms (Sigurdson, 2017). Natural flavors are more  
189 commonly derived from plants. Spices and essential oils from various plant sources are  
190 commonly used to increase the flavor and aromatic profiles of foods and beverages (Attokaran,  
191 2017). In their review on food additives, Carocho states that the use of colors and flavor  
192 additives differ by country with European countries tending to have stricter allowances of  
193 additives in food and beverage products. One of the main reasons for the shift from artificial to  
194 natural additives involves concerns about the influence of artificial additives and unwanted  
195 health problems (Carocho, 2014; Carocho, 2015; Martins, 2016). Bearth found that respondents  
196 to a mail survey perceived risk with the consumption of artificial colors, specifically (Bearth,  
197 2014). Though natural colors and flavors are thought to be safer, some drawbacks include  
198 instability from pH and temperature, oxidation losses, higher usage rates, and higher  
199 manufacturing costs (Carocho, 2014; Martins, 2016).

200 In general, natural food additives are significantly more acceptable to consumers than  
201 artificial additives (Siegrist, 2017). There was no difference to consumers whether an additive  
202 was synthetic or nature-identical (synthetic additives that imitate natural ones); additives made  
203 by humans have greater perceived risk than natural additives (Siegrist, 2017; Carocho, 2014).  
204 Globally, Nielsen found that artificial flavors and artificial colors are the first and second most  
205 avoided ingredients by consumers (62% and 61%, respectively). Both are in the top five most  
206 avoided ingredients in Asia-Pacific, Europe, Africa/Middle East, and Latin America, but not in  
207 the top five in North America (Nielsen, 2016). Among those (globally) who avoid certain

208 ingredients in foods, 84% state that they avoid artificial colors and flavors because they believe  
209 these ingredient are harmful to their health (Nielsen, 2016). 75% of global respondents indicated  
210 that they are worried that artificial ingredients may have long-term impacts on their health and  
211 69% of global respondents reported that foods without artificial ingredients are better for health.  
212 Additionally, 45% and 43% of global respondents want more products in the market with no  
213 artificial colors and no artificial flavors, respectively (Nielsen, 2016). 42%, 41%, and 36% of  
214 global respondents consider no artificial colors, no artificial flavors, and presence of natural  
215 flavors (respectively) to be very important when making purchase decisions (Nielsen, 2015).

216

## 217 **Research Objectives**

218 The source of colors and flavors is important to consumers all around the globe. It is  
219 evident that the presence of artificial colors and flavors on food labels influences perceptions of  
220 naturalness, but it is not as clear if differences in perceptions exist between various demographic  
221 groups. Few studies have made comparisons cross cultures and not much work has been done to  
222 determine reasons beyond health-related ones that consumers avoid artificial colors and flavors.  
223 Based on the review literature, it is hypothesized that the presence of artificial colors or flavors  
224 on an ingredient statement will reduce consumers' willingness to purchase as well as their ratings  
225 of product naturalness. Additionally, it is not clear how much consumers know about the sources  
226 of natural colors and flavors and if all sources of natural colors and flavors considered equally  
227 natural. Carmine is a color pigment derived from the *Dactylopius coccus* insect species and the  
228 carotenoid astaxanthin is derived from the bacterium *Paracoccus carotinifaciens* (Sigurdson,  
229 2017). If neophobia impacts perceptions of naturalness, it is hypothesized that these sources of  
230 color will be perceived as less natural than other color sources. More research is needed to

231 understand the effect that colors and flavors, specifically, have on consumer perceptions of  
232 naturalness. The objectives of this study are: (1) to determine the affect natural and artificial  
233 colors and flavors have on perceptions of naturalness and willingness to pay, (2) to understand  
234 how consumer demographics influence perceptions of naturalness, (3) to determine if the length  
235 of an ingredient statement impacts perceptions of naturalness and willingness to pay, and (4) to  
236 determine how the ingredient statement impact the perceptions of naturalness of whole food  
237 items like bananas.

238

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341 **Chapter 2 - Impact of Statement Length and Ingredient Location on**  
342 **Perceptions and Behaviors**

343 **Abstract**

344 Research has shown that food labeling can influence perceptions of food and beverage  
345 products, yet little work has been done on the ingredient statement, specifically. The objectives  
346 of this research were to understand how ingredient statement length and the presence of artificial  
347 or natural colorants impact purchase behavior and perceptions of naturalness. An online survey  
348 was launched in the United States, United Kingdom, and Australia, targeting 1000 consumers in  
349 each region. Results showed that the length of the statement and the location of ingredients  
350 within the statement impact likelihood of purchase and perceptions of naturalness. Short  
351 statements with the colorant listed in the middle were the most likely to be purchased and  
352 considered the most natural whereas the long statements were considered the least natural and  
353 thought to have unhealthy ingredients. The location of the colorant in a statement is believed to  
354 draw attention to color additives, affecting consumer perceptions. A long ingredient statement  
355 with natural colors, though perceived to be more natural, is less likely to be purchased due to the  
356 high volume of ingredients with chemical sounding names. Males and younger participants were  
357 generally more willing to purchase and gave higher naturalness scores. Long ingredient  
358 statements are also associated with being more unhealthy than shorter ingredient statements.

359

360 **Introduction**

361 The ingredient statement is one of the components found on almost every processed food  
362 and beverage sold in many countries around the globe. In the United States (US), two agencies



363 are responsible for ingredient statement labels: US Department of Agriculture (USDA) and Food  
364 and Drug Administration (FDA). Many countries have similar regulatory bodies although they  
365 may be called by different names and have somewhat different responsibilities.

366 For the US, USDA is responsible for ingredient statements on meat, poultry, and egg  
367 products and FDA is responsible for ingredient statements on all other foods and beverages  
368 (FSIS, 2007; Center for Food Safety and Applied Nutrition, 2013). Both agencies require that all  
369 ingredients be listed on the statement in descending order based on the weight of the ingredients  
370 in the formulation (FSIS, 2007; 21CFR101, 2018). Ingredients that make up the smallest  
371 proportion in the formula follow a statement that declares “Contains \_\_\_ percent or less of” or  
372 “Less than \_\_\_percent of”. This threshold is commonly 2%, but can also be 1.5, 1.0, or 0.5%,  
373 depending on the formulation (FSIS, 2007; 21CFR101, 2018). Sub-ingredients, or ingredients  
374 that are part of an ingredient used in the formulation, are listed in parenthesis following the name  
375 of the main ingredient (Center for Food Safety and Applied Nutrition, 2013). The common name  
376 of ingredients are listed on the statement (Sugar or Baking Soda, for example), but different rules  
377 apply for colors and flavors. Certified colors are listed by their specific names (FD&C Yellow  
378 No. 5 or Yellow 5) and non-certified colors are listed by their common name (Caramel Coloring,  
379 Vegetable Juice for Color) or as “artificial color” and/or “natural color”. Flavors are declared as  
380 “artificial flavor” and/or “natural flavor” (Center for Food Safety and Applied Nutrition, 2013).

381 Previous work has been done to study various aspects of food labeling and the effects  
382 they have on consumers from various countries. Research has been done on label use (generally  
383 and with specific demographics), nutrition label use, consumer beliefs about nutrition labels,  
384 understanding of nutrition labels, and areas of nutrition labels most used by consumers (Campos,  
385 2011). Additionally, research has been conducted to study the impact of product name and

386 descriptions on perception, impact of nutrition labeling on consumer expectations and sensory  
387 perceptions, impact of label and ingredient claims on expectations of liking and actual liking,  
388 impact of pictures and photographs on expectations and sensory perceptions, and the impact of  
389 organic certification logos on willingness to pay and preference (Piqueras-Fiszman, 2015;  
390 Schouteten, 2015; Janssen, 2012).

391 Not much work has been done to study the effect of ingredient statement length on  
392 consumer perceptions. However, Nielsen reports that 52% of respondents from Asia-Pacific,  
393 50% from Europe, 53% from Africa/Middle East, 46% from Latin America, and 61% of North  
394 American respondents strongly or somewhat agree that shorter ingredient statements correlate  
395 with healthier food and beverage products (Nielsen, 2016). In addition, not much research has  
396 been conducted to study the association between the ingredient statement and perceptions of  
397 naturalness.

398 The term “Natural” has not been officially defined by the FDA in the United States  
399 (Department of Health and Human Services, 2015). The FDA and USDA, however, do have  
400 “guidelines” for what foods constitute as “Natural” (Department of Health and Human Services,  
401 2015; FSIS, 2015). Both organizations state that “Natural” foods must not contain  
402 artificial/synthetic ingredients and the USDA specifies that “Natural” foods must be minimally  
403 processed (not fundamentally altered) (Center for Food Safety and Applied Nutrition, 2018;  
404 FSIS, 2015). To make up for the lack of an official definition, research has been conducted to  
405 understand what “Natural” means to consumers. Similar to the government organizations,  
406 consumers believe the definition of “Natural” includes no additives, no preservatives, no  
407 hormones, no processing, no alterations, and no human intervention (Abrams, 2010; Román,  
408 2017; Rozin, 2012). No artificial colors in the formulation was explicitly mentioned by

409 consumers (Román, 2017). Consumers also believe “Natural” foods should be organically  
410 grown, better for animal welfare, better nutritionally, safer to consumers, and better tasting  
411 (Abrams, 2010; Román, 2017; Dominick, 2018).

412 Chambers et al. studied consumer perceptions of naturalness for various food ingredients.  
413 Of the selected ingredients, none were found to be natural by 100% of the 630 American  
414 consumers. They reported that Corn, Wheat Flour, and Black Beans were perceived as the most  
415 natural and Maltodextrins, Butylated Hydroxyanisole (BHA), and Sodium Acid Pyrophosphate  
416 (SAPP) were perceived as the least natural (Chambers, 2018). Novel ingredients, such as Insect  
417 Powder and Pea Flour, were perceived as natural by a relatively small percentage of respondents,  
418 indicating that neophobia may affect perceptions of naturalness. Additionally, respondents were  
419 more likely to report familiar ingredients, like wheat flour, as natural compared to less familiar  
420 ingredients, like sorghum flour, though both are flours derived from cereal grains. Finally, they  
421 found that the ingredient name impacts naturalness, as Baking Soda was reported as natural by  
422 more participants than Sodium Bicarbonate, the same product identified by its chemical name  
423 (Chambers, 2018).

424 Although the relation between specific ingredients and perceptions of naturalness has  
425 been studied, no work has been done to understand the relationship between ingredient statement  
426 length and consumer perceptions of naturalness. This study was conducted to fill this gap in  
427 knowledge. The objectives of this study were (1) to understand the differences in perceptions of  
428 naturalness of long, intermediate, and short ingredient statements, (2) to understand how  
429 ingredient statement length impacts likelihood of purchase, (3) to understand how the presence  
430 of artificial and natural colors impacts perceptions of naturalness in ingredient statements of

431 varying lengths, and (4) to understand consumer knowledge about the sources of color in  
432 ingredient statements.

433

## 434 **Materials & Methods**

435 A survey using a standardized questionnaire was used by consumers in three  
436 countries: United States of America (USA), the United Kingdom (UK), and Australia (AUS) to  
437 gather data for this research.

438

### 439 **Questionnaire**

440 Participants were shown eight ingredient statements followed by four questions  
441 (questionnaire available in the Appendix). Of the eight statements, two were long (more than 15  
442 ingredients), two were intermediate (between 6 and 15 ingredients), and four were short (no  
443 more than 5 ingredients). One of the long and intermediate ingredient statements and two of the  
444 short ingredient statements contained artificial colors and the remaining statements contained  
445 natural colors. The locations of the colorants were varied in the short ingredient statements. One  
446 of the short statements with natural/artificial colors had the color additive at the end of the  
447 statement and the other had the additive in the middle of the statement. Ingredient statements of  
448 varying lengths were chosen to understand the affect that statement length has on perceptions of  
449 naturalness and purchase intent.

450 The ingredient statements were selected from existing products in the US and then  
451 modified as needed for the research. They were presented blind, without product names, as they  
452 appeared on the product label in most cases. Any potential biasing information was removed  
453 from the ingredients statement to obscure the product identity from the respondents. For

454 example, “Flamin’ Hot Seasoning” was removed from the ingredient statement and replaced  
455 with a nondescript statement so that participants would not associate the label with Flamin’ Hot  
456 Cheetos®. Ingredient statements used in the survey can be found in the appendix.

457         Following each ingredient statement, participants were asked to rate their likelihood to  
458 purchase (9-point fully labeled scale from ‘Extremely unlikely’ to ‘Extremely likely’) and their  
459 perceptions of naturalness (9-point scale labeled at the ends with ‘Not At All Natural – 1’ to  
460 ‘Extremely Natural – 9’). Next, participants were shown a Check All That Apply (CATA)  
461 question and asked to select which items from the list of statements they believe apply to the  
462 ingredient label. Finally, the participants were shown a CATA list of all the ingredients present  
463 in the statement and were asked to select all the items they believed were sources of color in that  
464 food. Compound ingredients were kept together as a single item. For example, a leavening  
465 system was shown as “Leavening (Baking Soda, Sodium Acid Pyrophosphate)”.

466         Along with ingredient statement questions, participants were asked various demographic  
467 questions including gender, age, race/ethnicity (using race demographics commonly used in each  
468 country/region), education level, income (using income brackets commonly used in each  
469 country/region), and number of children. Additionally, participants were asked how often they  
470 read ingredient statements, how often they pay attention to the source of coloring/flavors on  
471 labels, importance of color/flavor on the label, and likelihood to purchase based on the presence  
472 of artificial colors/artificial flavors. Participants were also asked how often they consume various  
473 foods from a list of foods that contain color additives, in CATA format. Items from the Health  
474 and Taste Attitudes Scale were included to further segment participants.

475

476

477 **Consumers**

478           The online survey was launched in the United States, the United Kingdom, and Australia  
479 using Qualtrics Survey Software (Provo, UT, USA), recruiting 1,000 participants from each  
480 country/region. These countries/regions were chosen because English was spoken as the native  
481 language and so comparisons could be made across cultures within a common language, with  
482 slight variation in spelling and wording. Three quotas were employed to recruit potential  
483 participants: gender (50% males, 50% females), age (20-25% for 18-23, 24-41, 42-52, and 53-  
484 73; 10% or less for 74 years or older), and estimate of household grocery shopping. Participants  
485 were not included if they were under 18 years of age or if they did less than 40% of the grocery  
486 shopping for their household. Rather than using traditional age demographic brackets,  
487 generational groups were used. In order of appearance, from youngest to oldest, these generation  
488 groupings were Centennials/Gen Z, Millennials/Gen Y, Gen X, Baby Boomers, and Silent  
489 Generation. Rather than financial compensation, Qualtrics uses a reward system to compensate  
490 respondents for their participation.

**Table 2-1.** Demographic percentages\*

<b>Demographic Characteristics</b>	<b>Categories</b>	<b>US</b>	<b>UK</b>	<b>AUS</b>	
Gender	Male	48%	50%	48%	
	Female	52%	50%	52%	
Age	Centennials/Gen Z	25%	15%	14%	
	Millennials/Gen Y	18%	23%	24%	
	Gen X	26%	26%	26%	
	Baby Boomers	20%	26%	26%	
	Silent Generation	11%	10%	10%	
Race/Ethnicity	American Indian/Alaska Native	1%			
	Asian	4%	5%	12%	
	Black/African/Caribbean	10%	3%	1%	
	Hispanic/Latino	6%	0%	1%	
	Caucasian/White	77%	90%	82%	
	Aboriginal/Torres Strait			1%	
	Pacific Islander	0%		1%	
	Other	1%	<1%	1%	
	Prefer Not to Answer	1%	2%	1%	
Education	High School or Less	25%	34%	33%	
	Associate Degree/Some College	32%	18%	25%	
	College Degree	27%	33%	27%	
	Post Graduate	16%	13%	15%	
		Prefer Not to Answer	1%	2%	1%
	Number of Children	No Children	66%	64%	63%
One Child		14%	16%	16%	
Two Children		16%	14%	15%	
Three Children		3%	5%	4%	
Four or More Children		2%	1%	2%	

\* Percentages were based on 932, 959, and 969 respondents from the US, UK, and AUS, respectively.

491

492

493

494 **Table 2-2.** Income demographic percentages\*

495	<b>Demographic Characteristics</b>	<b>Categories</b>	<b>US</b>	<b>UK</b>	<b>AUS</b>
496		Less than \$52,000	27%		
497		\$52-103,999	25%		
498		\$104-155,999	17%		
499		\$156-207,999	12%		
500		\$208-259,999	10%		
501		\$260,000 or more	6%		
502		Less than £20,000		33%	
503		£20,000 - £39,999		33%	
504		£40,000 - £59,999		16%	
505	Income	£60,000 - £79,999		5%	
506		£80,000 - £99,999		4%	
507		£100,000 or more		3%	
508		Less than \$52,000			39%
509		\$52-103,999			32%
510		\$104-155,999			15%
511		\$156-207,999			5%
512		\$208-259,999			1%
513		\$260,000 or more			1%
514		Prefer Not to	3%	6%	7%
515		Answer			

516 \* Percentages were based on 932, 959, and 969 respondents from the US, UK, and AUS, respectively.

510 **Analysis**

511 Excel (Microsoft Office Pro ver. 2013) was used to calculate means and percentages, for  
 512 descriptive statistics, and for chi-square tests for significance (p-values less than 5% were  
 513 considered significant). For the analysis, the 9-point point scales were converted into 3-point  
 514 scales (Unlikely or Unnatural, Neither nor, Likely or Natural) to more easily report any existing  
 515 trends in behavior/perception. XLSTAT (Addinsoft, New York, NY, USA) was used for  
 516 Analysis of Variance and Correspondence Analysis for CATA data. Participants with incomplete



517 responses were excluded from the analysis. Because some respondents are inattentive and may  
518 answer questions without really thinking or simply checking boxes without reading the question  
519 (Baker and Le Guin, 2007; Allen, 1966) a fake or “cheater” question (e.g. Yang et al., 2015) was  
520 included in the survey. Participants were excluded from the analysis if they reported consuming  
521 ‘Live worms’ or ‘Pickled chicken’ in the past week. After exclusion, 969 respondents from  
522 Australia, 959 respondents from the UK, and 932 respondents from the US were included in the  
523 analysis.

524

## 525 **Results and Discussion**

### 526 **United States**

527 The length of the ingredient statement had a great effect on purchase behavior and  
528 naturalness perceptions. The products represented by the short statements were the most likely to  
529 be purchased and were perceived as the most natural (Figures 2-1 and 2-2). American  
530 respondents were slightly less likely to purchase these products than they were to report them as  
531 natural. The products with long statements were the least likely to be purchased and were  
532 perceived as the least natural. Respondents were slightly more likely to purchase the products  
533 with the long statements than they were to report them as natural. There was a significant  
534 difference in both likelihood to purchase and perceived naturalness between both of the products  
535 with long statements and all of the products with short statements. The products with  
536 intermediate statements were split, however, and were not significantly different from either the  
537 products with long statements or the products with short statements.

538 The presence of artificial or natural colors also had an effect on purchase behavior and  
539 naturalness perceptions (Figures 2-1 and 2-2). The naturally colored products with short and

540 intermediate statements were more likely to be purchased and perceived as more natural than  
541 their artificially colored counterparts. The products with short statements were more likely to be  
542 purchased and perceived as more natural than the products with intermediate statements. The  
543 products with short statements and the colorant listed in the middle of the statement were more  
544 likely to be purchased and perceived as more natural than when the colorant was listed at the  
545 end, although this difference was not significant. American respondents perceived the naturally  
546 colored product with an intermediate statement to be significantly more similar to the products  
547 with short statements than to those with long statements. This same trend is present with  
548 likelihood to purchase, though it was not significant. The naturally colored product with the long  
549 statement was the least likely to be purchased. It was also perceived as significantly less natural  
550 than all of the other products.

551         For every statement, regardless of statement length or colorant, males were more likely to  
552 purchase and females were less likely to purchase. All of these differences were significant  
553 except for the naturally colored product with an intermediate statement and the product with a  
554 short statement and natural color listed in the middle. A similar trend can be seen with  
555 perceptions of naturalness. Males perceived all products, regardless of statement length or  
556 colorant, as more natural than females. There were no significant gender differences in natural  
557 perceptions for the naturally colored products with short statements. Younger generations were  
558 significantly more likely to purchase and older generations were significantly less likely to  
559 purchase the products with long and intermediate statements and the product with a short  
560 statement and artificial color in the middle. Millennials and Generation X were more likely to  
561 purchase the naturally colored products with short statements and the product with a short  
562 statement and artificial color at the end, although this difference was not significant for the

563 product with a short statement and natural color in the middle. Centennials and the Silent  
564 Generation were less likely to purchase these products. Overall, the Millennials were the most  
565 likely to purchase and the Silent Generation was the least likely. Millennials also perceived the  
566 products as more natural. Younger generations gave higher naturalness scores to the products  
567 with long and intermediate statements and older generations gave lower naturalness scores to  
568 these products. Of the products represented by short statements, the product with artificial color  
569 at the end was the only one with significant generational differences. Millennials and Gen X  
570 perceived this product as more natural and Centennials and the Silent Generation perceived this  
571 product as less natural. In general, respondents with higher levels of education and higher annual  
572 income were more likely to purchase and had higher perceptions of naturalness. Parents were  
573 more likely to purchase and perceived products as more natural. However, differences by  
574 education level, income, and number of kids were not always significant. Respondents who  
575 always read ingredient statements and who pay more attention to the source of color/flavor on  
576 labels gave higher naturalness scores. There were significant differences for these demographics  
577 for the products with long and intermediate statements, but not for the products with short  
578 statements. Race/Ethnicity was not a good predictor of likelihood to purchase and perceptions of  
579 naturalness.

580 American respondents who frequently consumed Toaster Pastries, Hard Candy, Cookies,  
581 Ice Cream, Popsicles, Flavored Gelatin, Chewing Gum, Breath Mints, Breakfast Cereal,  
582 Flavored Crackers, Fruit Yogurt, Fruit Juice, Soda, Energy Drinks, and Sports Drinks were more  
583 likely to purchase. Many of these differences were significant, but there were very few  
584 significant differences for the naturally colored products with short statements. This same trend  
585 was present for perceptions of naturalness, except there were few significant differences for all

586 of the products with short statements. There were no significant differences for likelihood to  
587 purchase and perceptions of naturalness for frequent consumption of salad dressing.

588         Respondents who agree that artificially colored and flavored foods are not harmful for  
589 health are significantly more likely to purchase and have significantly higher perceptions of  
590 naturalness for all products. This difference was not significant, however, for the product with a  
591 short statement and natural colors in the middle. Respondents who disagree that artificially  
592 colored (48%) and flavored foods (48%) are not harmful for health are significantly less likely to  
593 purchase and have significantly lower perceptions of naturalness for all products. Respondents  
594 that agreed that they try to eat foods that do not contain additives and agreed that they would like  
595 to eat only organic vegetables were more likely to purchase the naturally colored products and  
596 perceived the long, intermediate, and naturally colored products with short statements as more  
597 natural. Respondents who agreed that they look for only non-GMO ingredients in the food they  
598 eat and always look for natural ingredients in the snack foods that they eat were generally more  
599 likely to purchase and perceived products as more natural.

600         The item “Has natural colors”, selected for the product with a short statement and natural  
601 colors at the end, was the only item chosen by over 50% of American respondents. The products  
602 with long statements were associated with “Too long”, “Has chemical names”, “Contains  
603 unnatural ingredients”, “Has unhealthy ingredients”, and “Don’t recognize ingredients”. The  
604 artificially colored product with a long statement was also associated with “Extra flavor added”  
605 and “Ingredients made in a lab”. All four artificially colored products were associated with “Has  
606 artificial colors” and “Extra color added”. The artificially colored products with long and  
607 intermediate statements were also associated with “Has unhealthy ingredients” and the  
608 intermediate statement product was associated with “Food sounds tasty”. The artificially colored

609 products with short statements were associated with “Has healthy ingredients”, but only the  
610 product with the colorant in the middle was associated with “Ingredients come from nature”.  
611 There were no common associations for all of the naturally colored products. However, the  
612 products with intermediate and short statements were associated with “Has natural colors”,  
613 “Ingredients come from nature”, and “Has healthy ingredients”. No more than 18% of American  
614 respondents selected “Too short”, “Food sounds gross”, and “Not appropriate for kids”. No more  
615 than 9% chose “I believe I am sensitive to one or more of these ingredients”, “Ingredients cause  
616 cancer”, “Ingredients cause ADD/ADHD”, and “I have a diagnosed allergy to one or more of the  
617 ingredients”.

618

## 619 **United Kingdom**

620 The length of the ingredient statement had the greatest effect on UK respondents  
621 purchase behavior and perceptions of naturalness (Figures 2-1 and 2-2). The products  
622 represented by short ingredient statements were significantly more likely to be purchased and  
623 perceived as significantly more natural than the products with intermediate and long statements.  
624 UK respondents gave higher naturalness scores than likelihood to purchase scores to the products  
625 with short statements. The products represented by long ingredient statements were the least  
626 likely to be purchased and perceived as the least natural. These products received slightly higher  
627 scores for likelihood to purchase compared to ratings of naturalness. Purchase behavior and  
628 naturalness perceptions of the products with intermediate statements was more similar to the  
629 products with long statements than to the products with short statements.

630 The naturally colored products with short or intermediate statements were more likely to  
631 be purchased than their artificially colored counterparts were (Figures 2-1 and 2-2). These

632 products were also perceived as significantly more natural. Conversely, the product with a long  
633 statement and artificial colors was more likely to be purchased and perceived as significantly  
634 more natural than the naturally colored product. The location of the colorant in the statement  
635 affected purchase behavior and naturalness perceptions of the short statements. When the  
636 colorant was listed in the middle of the statement, the product received higher scores, although  
637 these differences were not significant. The naturally colored product with an intermediate length  
638 statement was perceived as significantly more natural than its artificially colored counterpart  
639 was. Similarly, the artificially colored product with a long statement was perceived as  
640 significantly more natural than its naturally colored counterpart was. There were, however, no  
641 significant difference in likelihood to purchase between the naturally and artificially colored  
642 products with intermediate and the naturally and artificially colored products with long  
643 statements.

644         Demographics were not great predictors of purchase intent or perceptions of naturalness  
645 for UK respondents. There were no significant gender differences for all products except for the  
646 naturally colored product with a long statement and the artificially colored product with an  
647 intermediate statement. Males were more likely to purchase the product with the long statement  
648 and females were both more and less likely to purchase the product with the intermediate  
649 statement. For both statements, males rated the products as more natural and females rated the  
650 products as less natural. There were significant generational differences for likelihood of  
651 purchase for all products except for the naturally colored products with short statements and the  
652 product with a short statement and artificial color in the middle. Younger generations,  
653 specifically the Millennials, were more likely to purchase and older generations, specifically the  
654 Silent Generation, were less likely to purchase. Fewer generational differences were seen for

655 perceptions of naturalness. The products with long statements and the artificially colored product  
656 with an intermediate statement were the only products with significant differences by age group.  
657 Millennials perceived these products to be more natural than the rest of the generational brackets.  
658 In general, respondents with higher levels of education and higher annual income were more  
659 likely to purchase and rated products as more natural, regardless of statement length and source  
660 of color. Not all of these differences were significant, however. Parents were also more likely to  
661 purchase, regardless of statement length or colorant source, although the differences were not  
662 always significant. Race/ethnicity was not a good predictor of purchase intent or perceptions of  
663 naturalness. Frequency of statement use, importance of color/flavor source, and purchase habits  
664 based on artificial colors/flavors were also not strong predictors of likelihood of purchase or  
665 perceived naturalness.

666 UK respondents who frequently consume Toaster Pastries, Hard Candy, Cookies, Ice  
667 Cream, Popsicles, Flavored Gelatin, Chewing Gum, Breath Mints, Flavored Crackers, Salad  
668 Dressing, Fruit Yogurt, Fruit Juice, Soda, Energy Drinks, and Sports drinks were more likely to  
669 purchase and had higher perceptions of naturalness. Many of these differences were significant,  
670 but there were few significant differences for likelihood to purchase for the product with a short  
671 statement and natural color in the middle and few significant differences for perceptions of  
672 naturalness for the naturally colored product with an intermediate statement and the products  
673 with short statements. There were no significant differences in purchase behavior with  
674 consumption of breakfast cereal and no significant differences in perceptions of naturalness for  
675 all products but the artificially colored product with a long statement for consumption of  
676 breakfast cereal.

677           Forty-six percent of UK respondents believe that artificial colors are harmful for health  
678 and 45% believe that artificial flavors are harmful for health. Respondents who agree that  
679 artificially colored and flavored foods are *not* harmful for health had significantly higher  
680 perceptions of naturalness for all products except for the naturally colored product with an  
681 intermediate statement, the product with a short statement and artificial color in the middle (only  
682 for flavor), the product with a short statement and natural color in the middle, and the product  
683 with a short statement and natural color at the end (only for color). They were also significantly  
684 more likely to purchase all products, but there was no significant difference for the product with  
685 a short statement and natural color listed in the middle. Those who agree that they try to eat  
686 foods that do not contain additives were more likely to purchase the naturally colored products,  
687 but there were no significant differences for perceptions of naturalness. Respondents who agreed  
688 that they would like to eat only organic vegetables were more likely to purchase all products and  
689 perceived all products, except for the artificially colored product with a short statement, as  
690 natural. Participants who agree that they only look for non-GMO ingredients in the foods they  
691 eat and always look for natural ingredients in the snack foods they eat are more likely to  
692 purchase the naturally colored products with short statements and the product with a short  
693 statement and artificial color at the end.

694           None of the CATA statements were selected by more than 49% of the UK respondents.  
695 The products with long statements were associated with “Too long”, “Has chemical names”,  
696 “Contains unnatural ingredients”, “Don’t recognize ingredients”, “Ingredients made in a lab”,  
697 “Extra flavor added” and “Has unhealthy ingredients”. The artificially colored product with a  
698 long statement was also associated with “Extra color added”. All of the artificially colored  
699 products were associated with “Has artificial colors”, and “Extra color added”. The artificially



700 colored products with long and intermediate statements were also associated with “Has  
701 unhealthy ingredients”. All four of the naturally colored products shared no common  
702 associations. However, the naturally colored products with intermediate and short statements  
703 were associated with “Has natural colors”, “Ingredients come from nature”, and “Has healthy  
704 ingredients”. No more than 18% of UK respondents selected “Food sounds tasty”, “Food sounds  
705 gross”, “Not appropriate for kids”, and “Too short”. No more than 7% of respondents selected  
706 “Ingredients cause ADD/ADHD”, “I believe I am sensitive to one or more of these ingredients”,  
707 “Ingredients cause cancer”, and “I have a diagnosed allergy to one or more of the ingredients”.

708

## 709 **Australia**

710 As with the US and UK respondents, ingredient statement length had the greatest  
711 impact on purchase behavior and perceptions of naturalness. Australian respondents were  
712 significantly more likely to purchase products represented by short ingredient statements than  
713 those represented by intermediate and long ingredient statements (Figures 2-1 and 2-2). They  
714 gave higher scores to perceived naturalness than they did to likelihood to purchase for these  
715 products. Similarly, they perceived these products as significantly more natural than the products  
716 with intermediate and long ingredient statements. The products with long ingredient statements  
717 were the least likely to be purchased and were perceived as the least natural. Australian  
718 respondents gave higher scores for likelihood to purchase than they did to perceived naturalness  
719 for the products represented by long statements. The products represented by intermediate  
720 statements were more similar in likelihood to purchase and perceived naturalness to the products  
721 with long statements than they were to the products with short ingredient statements.

722           Australians were more likely to purchase and had higher perceptions of naturalness for  
723 the naturally colored products with short and intermediate statements (Figures 2-1 and 2-2). They  
724 were slightly more likely to purchase the artificially colored product represented by the long  
725 statement and perceived this product to be significantly more natural than its naturally colored  
726 counterpart. The product with a short statement and the natural color listed in the middle was  
727 significantly more likely to be purchased and perceived as significantly more natural than the  
728 product with natural color listed at the end. There was no significant difference, however,  
729 between the two products with short statements and artificial colors. There was also no  
730 significant difference in purchase behavior between the products represented by short statements  
731 with natural color listed in the middle and artificial colors listed at the end. The naturally colored  
732 product with an intermediate statement and the artificially colored product with a long statement  
733 were perceived as significantly more natural than their counterparts were. There was no  
734 significant difference between the artificially and naturally colored products with intermediate  
735 and long statements for likelihood to purchase.

736           There were significant gender differences in likelihood to purchase and perceptions of  
737 naturalness for all products except for the naturally colored products with short statements and  
738 the naturally colored product with an intermediate statement. Male respondents were more likely  
739 to purchase and perceived the products as more natural compared to female respondents. There  
740 were significant generational differences for likelihood to purchase for all products except the  
741 natural colored intermediate product and naturally colored products with short statements. There  
742 were significant generational differences in naturalness perceptions for the products with long  
743 statements and the artificially colored product with an intermediate statement. Millennials and  
744 Centennials were more likely to purchase the products with long statements, artificially colored

745 product with an intermediate statement, and artificially colored products with short statements.  
746 The Baby Boomers and Silent Generation were the least likely to purchase these statements.  
747 Younger participants perceived the artificially colored product with a long statement as natural  
748 and older participants perceived this product as less natural. Younger participants and the Silent  
749 Generation perceived the naturally colored product with a long statement and the artificially  
750 colored intermediate statement to be more natural and Gen X and the Boomers perceived the  
751 naturally colored long statement as less natural. There were no significant generational  
752 differences in perceptions of naturalness for the four short statements and the naturally colored  
753 intermediate statement. In general, participants with more education were more likely to  
754 purchase and perceived the statements as more natural, although these differences were often not  
755 significant. Participants who reported that the source of color/flavor were important to them were  
756 less likely to purchase the long statements and the artificially colored statements and more likely  
757 to purchase the short and naturally colored statements, although not all these differences were  
758 significant. No trends were seen with perceptions of naturalness. Participants who were more  
759 likely not to purchase foods with artificially colors/flavors perceived the intermediate, short, and  
760 artificially colored long statements as more natural. Race, income, and number of children in the  
761 household were not good predictors of likelihood to purchase and perceptions of naturalness and  
762 not many significant differences existed between demographic groups. Frequency of reading  
763 ingredient statements was also not a good predictor and there were not many significant  
764 differences.

765 Australian respondents who frequently ate Toaster Pastries, Hard Candy, Cookies, Ice  
766 Cream, Popsicles, Flavored Gelatin, Chewing Gum, Breath Mints, Breakfast Cereal, Flavored  
767 Crackers, Salad Dressing, Fruit Yogurt, Fruit Juice, Soda, Energy Drinks, and Sports Drinks

768 were significantly more likely to purchase and perceived the products as more natural. There  
769 were few significant differences for the naturally colored short statements for purchase behavior  
770 and few significant differences for the naturally colored intermediate statement and all products  
771 with short statements for perceptions of naturalness.

772         Respondents who agree that artificial colors and flavors are not harmful for health were  
773 significantly more likely to purchase all statements. They also had significantly higher  
774 perceptions of naturalness. There were no significant differences in perceptions of naturalness  
775 for the naturally colored product with an intermediate statement (just for flavor) and the product  
776 with a short statement and natural color listed in the middle. However, 57% believe that artificial  
777 colors are harmful for health and 58% believe that artificial flavors are harmful for health. The  
778 statements “I try to eat foods that do not contain additives”, “I would like to eat only organically  
779 grown vegetables”, and “I always look for natural ingredients in the snack foods that I eat” were  
780 not a great predictors of purchase behavior and perceptions of naturalness. There were no  
781 significant differences for purchase behavior and perceptions of naturalness for the statement “I  
782 look for only non-GMO ingredients in the food I eat”.

783         Of the CATA items relating to each ingredient statement, only two of the options were  
784 selected by more than 50% of the Australian respondents. “Has artificial colors” was selected by  
785 more than 50% of respondents for the artificially colored products with long and intermediate  
786 statements and “Has natural colors” was selected by more than “50%” for the naturally colored  
787 products with short statements. The products with long statements were associated with “Too  
788 long”, “Has chemical names”, “Contains unnatural ingredients”, “Has unhealthy ingredients”,  
789 “Don’t recognize ingredients” and “Extra flavor added”. The artificially colored product with a  
790 long statement was also associated with “Ingredients made in a lab”. The artificially colored

791 products were associated with “Has artificial colors” and “Extra color added”. The artificially  
792 colored products with long and intermediate statements were associated with “Contains  
793 unnatural ingredients” and “Has unhealthy ingredients”. Between the artificially colored  
794 products with short statements, the product with the color in the middle was also associated with  
795 “Ingredients come from nature” and “Has healthy ingredients”. All four naturally colored  
796 products were associated with “Has natural colors”. The naturally colored products with  
797 intermediate and short statements were also associated with “Ingredients come from nature” and  
798 “Has healthy ingredients”. No more than 22% of Australian respondents chose “Food sounds  
799 tasty” and “Not appropriate for kids”. No more than 18% chose “Food sounds gross”, “Too  
800 short”, and “I believe I am sensitive to one or more of these ingredients”. Finally, no more than  
801 10% of respondents chose “Ingredients cause ADD/ADHD”, “Ingredients cause cancer” and “I  
802 have a diagnosed allergy to one or more of the ingredients”.

803

#### 804 **Cross Country Comparisons**

805       Between the three countries/regions, respondents from the United States were more likely  
806 to purchase the products represented by each statement. The products represented by short  
807 ingredient statements with natural color were the most likely to be purchased in every country.  
808 There were no significant differences between the two products with short ingredient statements  
809 and natural color, however. The products with long ingredient statements were the least likely to  
810 be purchased, although participants from the United States were more likely to purchase both of  
811 these products than UK or Australian respondents. Between the two, the naturally colored  
812 product with a long statement was the least likely to be purchased. Respondents from the UK and  
813 Australia were more likely to purchase the naturally colored product with an intermediate

814 statement than the product with a short statement and artificial color listed at the end. Likelihood  
815 of purchase was higher for the products short statements and color in the middle of the statement  
816 compared to when the colorant was listed at the end of the statement.

817           American participants gave higher average natural ratings for each product and  
818 the Australian participants gave lower average natural ratings for each product, though these  
819 differences were not always significant. Overall, the natural versions of each product received  
820 higher naturalness scores than their artificial counterparts. The products with short ingredient  
821 statements and natural color received the highest naturalness scores. The products with short  
822 ingredient statements and color in the middle were rated as more natural than the products with  
823 short ingredient statements and color at the end of the statement. All three countries gave higher  
824 naturalness scores to the product with an intermediate statement with natural color than the  
825 product with a short ingredient statement and artificial color located at the end of the statement.  
826 This difference in scores was significant for UK and Australian respondents, but not for  
827 Americans. All three countries rated the product with a long statement and artificial color as the  
828 least natural. Participants from the UK and Australia rated the product with a long ingredient  
829 statement and natural colors as slightly more natural than the artificially colored product with an  
830 intermediate statement, although this difference was not significant.

831           Between the three regions, Americans were more likely to purchase and perceived  
832 product as more natural than respondents from the UK and Australia. In addition, Australians  
833 gave the lowest naturalness scores. The long and intermediate statements were taken from  
834 products commonly found in the United States. Though these ingredient names were not shown,  
835 there is a possibility that American respondents were unconsciously more familiar with these  
836 ingredient statements and/or the format of the ingredient label. Some of the ingredient statements

837 used in this survey came from products that are sold in markets all over the world (Cheetos and  
838 M&M's®, for example). The differences in purchase behavior and perceptions of naturalness  
839 could also be due to skepticism of processed foods. Abrams and Meyers found that consumers  
840 were suspicious of the "Natural" claim on foods and though respondents were not exposed to this  
841 claim (with the exception of "Natural color"), this same wariness may still be involved (Abrams,  
842 2010). The lack of identifying information could also contribute to the skepticism. Binninger  
843 found that "Natural" packaging influence consumer perceptions of a product's naturalness  
844 (Binninger, 2017). Consumers from different countries may rely more heavily on external cues  
845 when making decisions about purchasing or the naturalness of a given food or beverage.  
846 Therefore, Australian and UK respondents may be less willing to purchase products without a  
847 product name or picture.

848 Perceptions of the statements were similar across the three regions. Between the three  
849 regions, generally, Australians had a higher frequency of selection of the various CATA items  
850 compared to the US and UK. Participants from all regions associated the long ingredient  
851 statements with being too long, having chemical names, containing unnatural ingredients,  
852 containing unhealthy ingredients, and they did not recognize some of the ingredients. These  
853 statements, more so than the others, had more ingredients with chemical names. They also  
854 contained more additives than the others, leading to perceptions about poor health and unnatural  
855 ingredients. Americans had relatively high frequencies for the statement "Has healthy  
856 ingredients", which could indicate that Americans associate health related benefits to more  
857 ingredients than UK or Australian consumers. The artificially colored statements had high  
858 associations with "Contains artificial colors" and the naturally colored statements had high  
859 associations with "Contains natural colors". Australian respondents were more sensitive to the

860 presence of artificial colors and selected this item for the artificially colored statements more  
861 frequently than respondents from the US or UK. They also had higher frequencies for “Extra  
862 color added” and “Extra flavor added” for most statements. This, combined with the lowest  
863 perceptions of naturalness, could indicate that Australian consumers are more particular about  
864 ingredient statements than consumers from the US or UK. All three countries had similar  
865 frequencies of selection for the sources of color in each statement. The intermediate and short  
866 naturally colored statements were thought to have healthy ingredients and ingredients that come  
867 from nature. These statements had less than five ingredients, all of which were commonly named  
868 as opposed to having chemical names. The long naturally colored statement had more in  
869 common with the artificially colored long and intermediate statement than it did with the  
870 intermediate and short naturally colored statements. This supports the conclusion that long  
871 ingredient statements can have a negative impact on consumer perceptions of a food or beverage.

872         When the source of color was clearly called out in the statement (for example, “Color”,  
873 “Artificial Colors”, “Natural Colors”, “Red 40”) respondents from all three regions had high  
874 frequency of selection. Ingredients from plants were also frequently selected, but not to the same  
875 degree. Ingredients such as Tomato Powder, Red and Green Bell Pepper Powder, Carrot Juice  
876 Concentrate, Sweet Potato Juice Concentrate, and Pear Juice Concentrate were frequently  
877 selected, but by not nearly as many people. Milk Chocolate, Cinnamon, and Cocoa were also  
878 selected as sources of color. All ingredients were selected by at least 25 people. Interestingly,  
879 ingredients like Water, Salt, and Baking Powder were selected as sources of color, though only  
880 by a small percentage of respondents. Australians selected these types of ingredients less  
881 frequently than respondents from the US or UK. American respondents selected cheese based



882 ingredients more frequently than respondents from the UK or Australia. Respondents from the  
 883 UK selected “Spices” more frequently than respondents from the US or Australia.

884

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**Table 2-3.** Likelihood to purchase and perceptions of naturalness of products represented by blind ingredient statements, of varying length, with either natural or artificial colors.

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887

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Statement	Country /Region	Likelihood to Purchase	Naturalness
Short, Natural, Middle	US	6.12 <sup>a</sup>	6.94 <sup>a</sup>
	UK	5.90 <sup>ab</sup>	6.72 <sup>ab</sup>
	AUS	6.10 <sup>a</sup>	6.63 <sup>abc</sup>
Short, Natural, End	US	6.02 <sup>a</sup>	6.72 <sup>ab</sup>
	UK	5.79 <sup>abc</sup>	6.58 <sup>bc</sup>
	AUS	5.78 <sup>abc</sup>	6.31 <sup>cd</sup>
Short, Artificial, Middle	US	5.81 <sup>abc</sup>	6.14 <sup>de</sup>
	UK	5.47 <sup>cde</sup>	5.84 <sup>ef</sup>
	AUS	5.57 <sup>bcd</sup>	5.77 <sup>f</sup>
Short, Artificial, End	US	5.55 <sup>bcd</sup>	5.81 <sup>ef</sup>
	UK	4.87 <sup>hij</sup>	5.36 <sup>gh</sup>
	AUS	4.98 <sup>ghi</sup>	5.23 <sup>h</sup>
Intermediate, Natural	US	5.50 <sup>cde</sup>	5.90 <sup>ef</sup>
	UK	5.27 <sup>defg</sup>	5.70 <sup>f</sup>
	AUS	5.36 <sup>def</sup>	5.68 <sup>fg</sup>
Intermediate, Artificial	US	5.39 <sup>def</sup>	4.79 <sup>i</sup>
	UK	4.80 <sup>hijk</sup>	4.37 <sup>kl</sup>
	AUS	4.94 <sup>ghij</sup>	4.34 <sup>kl</sup>
Long, Natural	US	5.02 <sup>fghi</sup>	4.57 <sup>ij</sup>
	UK	4.49 <sup>k</sup>	4.44 <sup>ijk</sup>
	AUS	4.61 <sup>jk</sup>	4.41 <sup>kl</sup>
Long , Artificial	US	5.15 <sup>efgh</sup>	4.19 <sup>klm</sup>
	UK	4.74 <sup>ijk</sup>	4.10 <sup>lm</sup>
	AUS	4.66 <sup>ijk</sup>	3.86 <sup>m</sup>

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\*Different letters indicated significant differences at p≤0.05

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**Table 2-4.** Associations of US, UK, and AUS respondents with products represented by long ingredient statements.

Statements	Long, Artificial Color			Long, Natural Color		
	USA	UK	AUS	USA	UK	AUS
Too Long	35%	33%	30%	31%	30%	26%
Has artificial colors	49%	47%	56%	18%	21%	23%
Too short	3%	1%	1%	3%	2%	2%
Has chemical names	42%	41%	46%	39%	38%	42%
I have a diagnosed allergy to one or more of the ingredients	3%	2%	5%	5%	2%	4%
Has natural colors	12%	8%	9%	23%	25%	26%
Food sounds gross	14%	16%	18%	14%	13%	16%
Food sounds tasty	18%	12%	16%	13%	8%	12%
Contains unnatural ingredients	37%	38%	45%	28%	30%	32%
Ingredients come from nature	13%	13%	11%	16%	18%	19%
Ingredients made in a lab	23%	23%	29%	22%	22%	24%
Has unhealthy ingredients	34%	35%	39%	27%	26%	29%
Ingredients cause cancer	9%	6%	10%	7%	6%	6%
Has healthy ingredients	19%	14%	15%	23%	17%	23%
Not appropriate for kids	12%	17%	22%	10%	9%	15%
Don't recognize ingredients	25%	30%	29%	33%	34%	36%
Extra color added	37%	39%	44%	16%	19%	20%
Extra flavor added	33%	37%	47%	23%	23%	27%
Ingredients cause Attention Deficit Disorder (ADD)/Attention Deficit Hyper Disorder (ADHD)	5%	7%	10%	5%	5%	6%
I believe I am sensitive to one or more of these ingredients	9%	6%	11%	6%	4%	7%

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**Table 2-5.** Associations of US, UK, and AUS respondents with products represented by intermediate ingredient statements.

Statements	Intermediate, Artificial Color			Intermediate, Natural Color		
	USA	UK	AUS	USA	UK	AUS
Too Long	8%	8%	7%	7%	8%	7%
Has artificial colors	44%	45%	53%	13%	11%	53%
Too short	5%	3%	2%	2%	2%	2%
Has chemical names	21%	25%	24%	13%	11%	24%
I have a diagnosed allergy to one or more of the ingredients	5%	2%	2%	3%	2%	2%
Has natural colors	11%	11%	9%	34%	40%	9%
Food sounds gross	7%	8%	7%	13%	7%	7%
Food sounds tasty	28%	18%	23%	22%	18%	23%
Contains unnatural ingredients	25%	25%	26%	13%	11%	26%
Ingredients come from nature	15%	11%	14%	34%	35%	14%
Ingredients made in a lab	14%	17%	21%	8%	6%	21%
Has unhealthy ingredients	25%	28%	31%	13%	10%	31%
Ingredients cause cancer	6%	3%	6%	3%	2%	6%
Has healthy ingredients	16%	8%	13%	37%	32%	13%
Not appropriate for kids	7%	12%	18%	5%	7%	18%
Don't recognize ingredients	14%	22%	21%	15%	15%	21%
Extra color added	39%	38%	44%	17%	20%	44%
Extra flavor added	21%	17%	24%	20%	16%	24%
Ingredients cause Attention Deficit Disorder (ADD)/Attention Deficit Hyper Disorder (ADHD)	6%	7%	8%	3%	4%	8%
I believe I am sensitive to one or more of these ingredients	5%	4%	5%	3%	3%	5%

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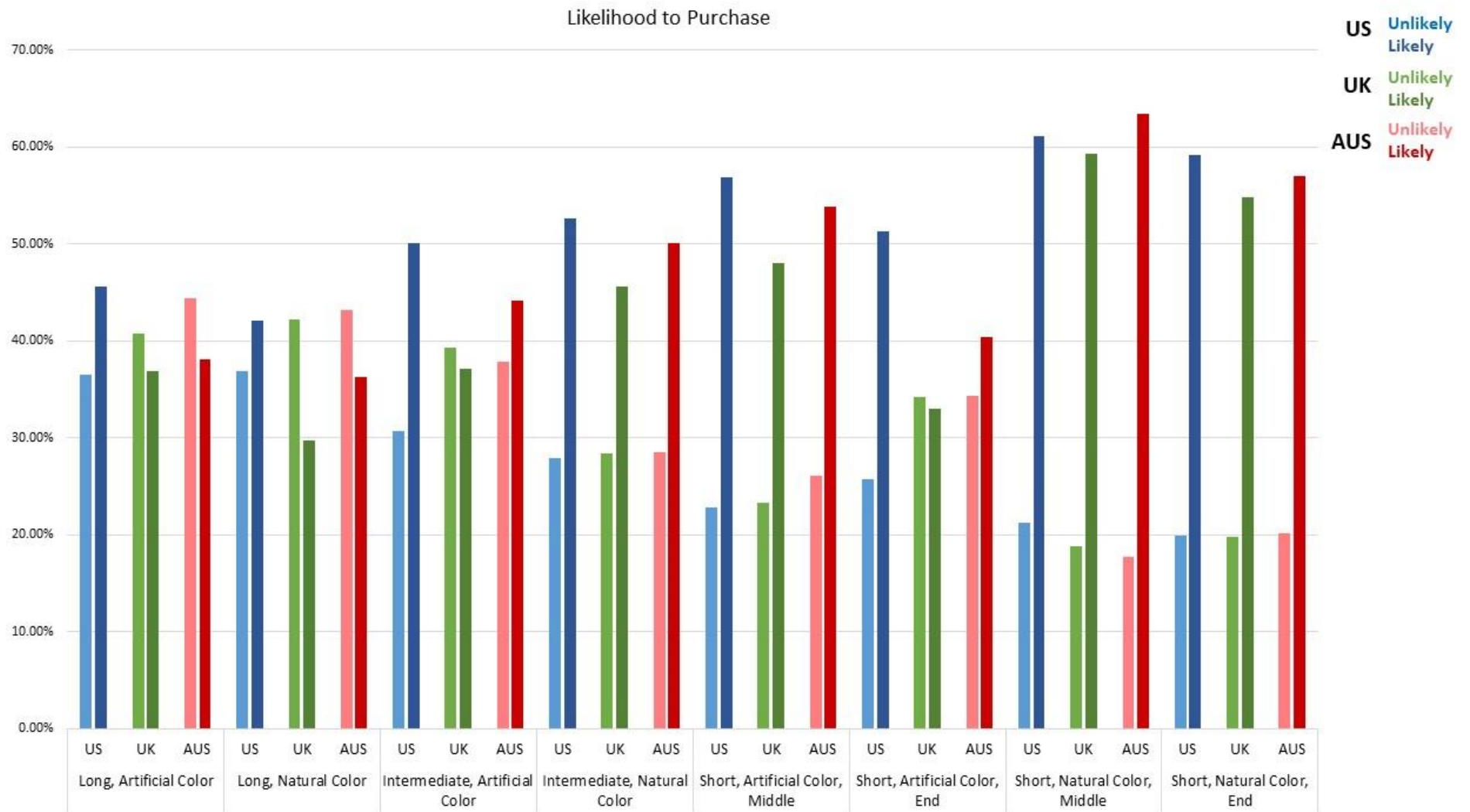
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**Table 2-6.** Associations of US, UK, and AUS respondents with products represented by short ingredient statements.

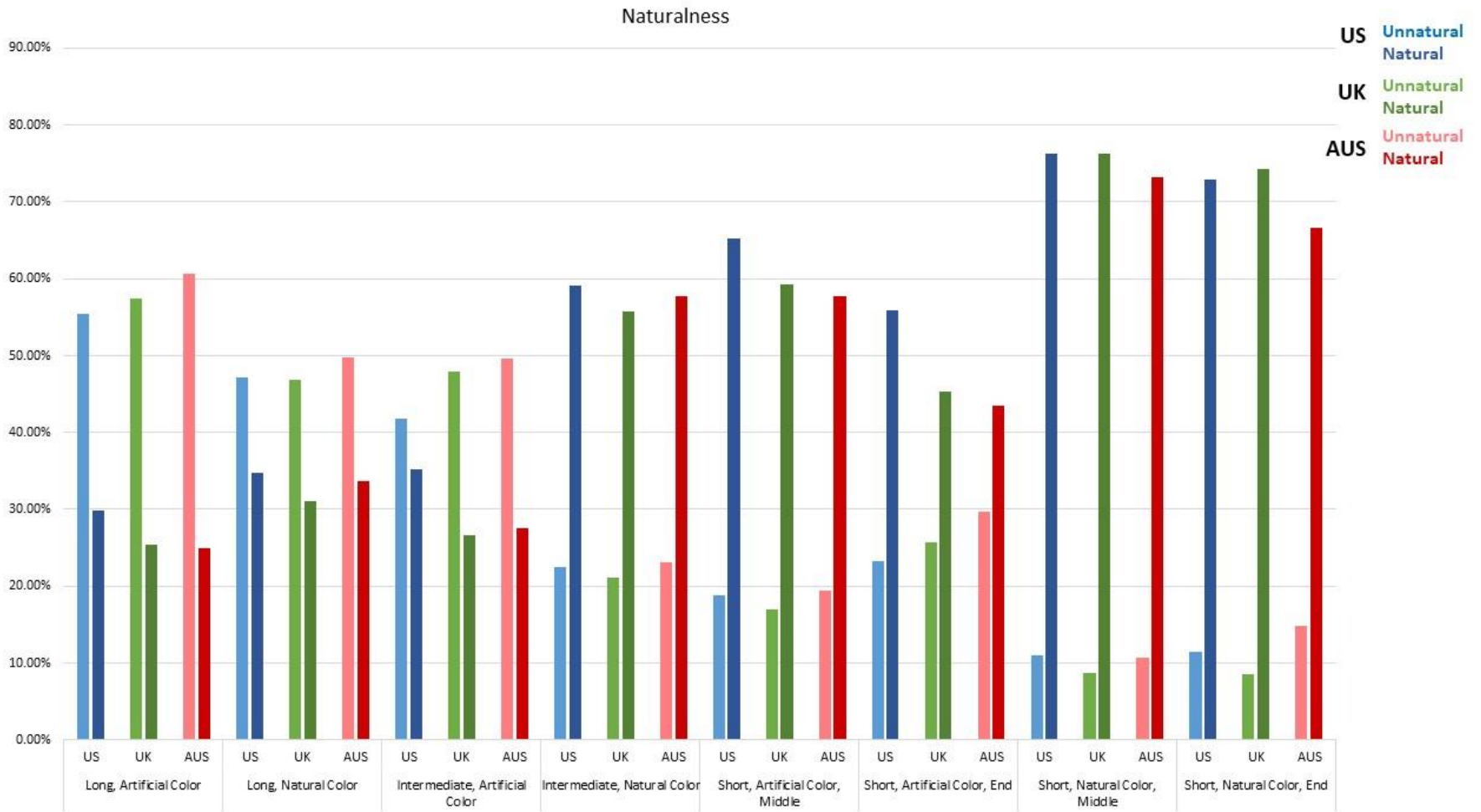
Statements	Short, Artificial Color, Middle			Short, Artificial Color, End			Short, Natural Color, Middle			Short, Natural Color, End		
	USA	UK	AUS	USA	UK	AUS	USA	UK	AUS	USA	UK	AUS
Too Long	2%	2%	2%	3%	2%	1%	3%	2%	2%	2%	2%	2%
Has artificial colors	33%	33%	36%	35%	36%	39%	6%	4%	5%	6%	6%	4%
Too short	15%	14%	11%	18%	16%	13%	12%	9%	11%	17%	12%	14%
Has chemical names	8%	7%	8%	7%	9%	10%	5%	2%	4%	6%	4%	4%
I have a diagnosed allergy to one or more of the ingredients	3%	2%	2%	2%	1%	1%	2%	2%	1%	2%	1%	1%
Has natural colors	14%	10%	13%	11%	8%	8%	49%	46%	52%	51%	49%	50%
Food sounds gross	7%	4%	5%	9%	7%	7%	12%	10%	9%	8%	6%	8%
Food sounds tasty	21%	13%	19%	15%	8%	8%	19%	13%	17%	18%	8%	11%
Contains unnatural ingredients	11%	11%	12%	11%	13%	16%	4%	4%	3%	6%	4%	5%
Ingredients come from nature	25%	25%	29%	23%	16%	21%	37%	38%	39%	33%	32%	33%
Ingredients made in a lab	8%	7%	8%	9%	9%	10%	4%	3%	4%	6%	4%	6%
Has unhealthy ingredients	11%	9%	13%	13%	11%	15%	4%	5%	4%	8%	8%	11%
Ingredients cause cancer	4%	2%	2%	4%	2%	3%	3%	2%	2%	3%	2%	2%
Has healthy ingredients	31%	26%	29%	25%	13%	20%	42%	37%	40%	29%	31%	26%
Not appropriate for kids	4%	4%	6%	6%	4%	8%	3%	4%	4%	4%	3%	5%
Don't recognize ingredients	5%	7%	7%	4%	13%	8%	4%	4%	4%	4%	3%	3%
Extra color added	32%	33%	35%	34%	35%	41%	9%	9%	9%	8%	10%	11%
Extra flavor added	8%	7%	9%	12%	9%	12%	9%	8%	7%	8%	6%	6%
Ingredients cause Attention Deficit Disorder (ADD)/Attention Deficit Hyper Disorder (ADHD)	5%	3%	4%	3%	3%	3%	3%	1%	2%	3%	2%	2%
I believe I am sensitive to one or more of these ingredients	4%	3%	4%	4%	2%	3%	3%	2%	2%	3%	2%	3%

972

973



974 **Figure 2-1.** Percentage of US, UK, and AUS participants who are likely or unlikely to purchase products represented by  
 975 ingredients statements of various lengths.



976

977 **Figure 2-2.** Percentage of US, UK, and AUS participants who rated products represented by ingredients statements of various lengths

978 as natural or unnatural.

979 **General Discussion**

980 Results from all three regions indicates that the length of an ingredient statement and the  
981 positioning of certain ingredients within the statement impact purchase behavior and perceptions  
982 of naturalness. Across the board, the short ingredient statement with natural color listed in the  
983 middle was the most likely to be purchase and was perceived as the most natural. Nielsen  
984 reported that 50% of respondents from Europe and 61% from North America believe that a  
985 shorter ingredient statement indicates a healthier product (Nielsen, 2016). The results from this  
986 study indicate that shorter ingredient statements also influence perceptions of naturalness. The  
987 ingredients contained within the statement also have an effect. Respondents from all three  
988 countries were less likely to purchase the naturally colored long statement than the artificially  
989 colored long statement. This is likely due to the presence of other ingredients in the former  
990 statement. The artificially colored statement had ingredients like cheese, natural and artificial  
991 flavors, spices, and vegetable derived ingredients (Maltodextrin from corn, tomato powder, red  
992 and green bell pepper powder), whereas the naturally colored statement had ingredients like  
993 bleached flour, oils with TBHQ, Calcium Stearoyl Lactylate, and Amylase Enzymes. Chambers  
994 et al. found that ingredients affect perceptions of naturalness and ingredients with chemical  
995 names were perceived to be the least natural (Chambers, 2018). In this case, the overall  
996 ingredient list had the greatest impact on purchase behavior. However, the same cannot be said  
997 for perceptions of naturalness. Respondents indicated that the artificially colored long statement  
998 was less natural than the naturally colored long statement. The presence of natural colors was  
999 more influential on perceptions naturalness than the rest of the ingredients in the statement.

1000 The location of ingredients within the statement also appears to have an impact on consumer  
1001 perceptions and buying behavior. An ingredient listed in the last position on an ingredient

1002 statement is the ingredient that makes up the smallest percentage of the formula. This may not be  
1003 common knowledge to consumers, however, and statements with a greater percentage of color  
1004 additives in the formulation were perceived to be more natural and were more likely to be  
1005 purchased. A reason for this could be related to consumers' attention. The statements with  
1006 natural or artificial colors listed at the end draw more attention to the source of color though it  
1007 makes up a smaller percentage of the formula. Thirty-nine percent of American respondents,  
1008 28% of UK respondents, and 36% of Australian respondents report that they always or most of  
1009 the time read ingredient statements. However, 49% of American respondents, 53% of UK  
1010 respondents, and 49% of Australian respondents report that they sometime or never pay attention  
1011 to the source of color on ingredient statements. With the percentage of those that read statements  
1012 relatively low and even lower for those that focus on the source of color, it is likely that  
1013 consumer attention is drawn to the source of color, influencing their perceptions of the product.

1014 Taylor and Stevenson found that people associated natural food consumers with being more  
1015 feminine, more educated wealthier, and older (Taylor, 2018). In their review, Román et al. also  
1016 found that female and older consumers were more receptive to natural foods and Bäckstrom  
1017 found that females are more receptive to natural foods (Roman, 2017; Backstrom 2004). This  
1018 study found that, generally, wealthier and more educated respondents had higher perceptions of  
1019 naturalness, supporting the conclusion made by Taylor and Stevenson. However, males and  
1020 younger respondents had higher perceptions of naturalness. This could be due to skepticism on  
1021 the part of female respondents and respondents from older generations. If they are indeed more  
1022 receptive to natural food products, they may be less willing to rate a product as natural without  
1023 additional product information. Males and those from younger generations may be more  
1024 comfortable making a decision with less information.



1025 **Limitations**

1026 There were some limitations with this study. Only eight ingredient statements were used,  
1027 with only two being used for the long and intermediate statements. The major difference between  
1028 the two was the source of color. More research could be done studying other differences such as  
1029 the impact of plant-based ingredients or novel ingredients on perceptions of naturalness when  
1030 only the ingredient statement is shown. Additionally, this study only looked at three, English-  
1031 speaking regions. Further research is needed to understand the influence of ingredient statement  
1032 length and presence of artificial/natural colors on Latin American, African, Asian, and other  
1033 European consumer perceptions of naturalness.

1034

1035 **Conclusion**

1036 Respondents from the United States, United Kingdom, and Australia were influenced by  
1037 both the length of ingredient statements and the location of specific ingredients within the  
1038 statement. Shorter ingredients statements were more likely to be purchased and were perceived  
1039 as more natural than longer ingredient statements. When color additives were located at the end  
1040 of the short statements, they were perceived as less natural and were less likely to be purchase  
1041 than when the colorant was listed in the middle of the statement. This is interesting considering  
1042 that the latter statements have a greater percentage of colorant in their formulation, yet were  
1043 perceived to be more natural. The long ingredient statement with natural color was less likely to  
1044 be purchased and perceived as less natural than the long ingredient statement with artificial  
1045 colors. This result may be due to the high volume of ingredients with chemical names in the  
1046 naturally colored statement. Americans were the most likely to purchase and gave higher average  
1047 naturalness scores and Australians gave lower average naturalness scores. Of the studied

1048 demographics, gender and age were the best predictors of buying behavior and natural  
1049 perceptions. Generally, males and younger generations (specifically the Millennials) were the  
1050 most likely to purchase and perceived the statements to be more natural than other groups in  
1051 those demographics. Respondents associated longer ingredient statements with containing  
1052 unnatural and unhealthy ingredients and the shorter, naturally colored statements with having  
1053 natural and healthy ingredients. Respondents also correctly identified sources of color in each  
1054 statement, especially if they were clearly labeled, and indicated that other plant based  
1055 ingredients, cheese based ingredients, and indulgent ingredients were sources of color. Further  
1056 research can be conducted with more ingredient statements to validate the conclusion from this  
1057 study and to understand perceptions in non-English speaking countries.

1058

1059

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## 1136 **Chapter 3 - The Influence of Colorants, Flavorants, and Product**

### 1137 **Identity on Perceptions of Naturalness**

#### 1138 **Abstract**

1139 Natural foods are important to consumers, yet frustrating to producers due to the lack of a  
1140 formal definition. Previous work has studied how consumers define naturalness and how they  
1141 rate the naturalness of various products, but there is a gap in knowledge relating to how color and  
1142 flavor additives are perceived. With this in mind, the objective of this study was to understand  
1143 how colorants and flavorants on ingredient statements affect perceptions of naturalness. An  
1144 online survey was launched in the United States, United Kingdom, and Australia to determine  
1145 how consumer perceive products with ingredient statement containing different combinations of  
1146 artificial and natural colors and flavors when shown with and without the product identity.  
1147 Results showed that consumers look at the whole product primarily to make decisions about  
1148 naturalness, but also consider other factors. Products derived from plants and products with  
1149 natural colors and flavors were found to be the most natural. Artificial flavors may be more  
1150 acceptable than artificial colors due to negative health perceptions and labeling rules associated  
1151 with colors. Additionally, factors like ingredient familiarity and processing likely influence  
1152 consumers when making decisions about product naturalness. There were not large differences  
1153 between the three regions. Males, Millennials, participants with more education, and participants  
1154 who do not believe artificial colors and flavors have negative health effects have higher  
1155 naturalness scores than other participants in their respective demographics. This information not  
1156 only supports prior conclusions made about naturalness, but also furthers understanding about  
1157 the topic, allowing academics and food producers to form a more complete picture about what  
1158 naturalness really means.

## Introduction

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As previously mentioned in Chapter 2, the U.S. Department of Agriculture and Food and Drug Administration are responsible for food labeling in the United States. The USDA is responsible for labeling on meat, poultry, and egg products, whereas the FDA is responsible for labeling on all other food and beverage products. Ingredients are listed on the statement in descending order by weight with the ingredients listed at the end comprising the smallest percentage of the total formula (CFR, 2018). For most ingredients, the common name is listed on the statement. Colors can be listed by their specific names, like FD&C Yellow No. 5 or just Yellow 5, if they are certified colors or listed by their common names, like Vegetable Juice for Color or natural color, if they are non-certified colors. Flavors are listed as “artificial flavor” and/or “natural flavor” on ingredient statements (Center for Food Safety and Applied Nutrition, 2013). Previous research has been conducted on consumer perceptions of food labels. This work include use of and beliefs about nutrition labels, effect of product name and descriptions on perception, influence of nutrition labeling on expectations and sensory perceptions, impact of label and ingredient claims on expectations of liking, effect of pictures and photographs on expectations and perceptions, and impact of organic certification logos on willingness to pay and preference (Campos, 2011; Piqueras-Fiszman, 2015; Schouteten, 2015; Janssen, 2012). Most of this work focuses on label claims and nutrition labels leaving the ingredient statement relatively unstudied.

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Color and flavor additives are important and controversial ingredients used in many processed food and beverage products in the United States. According to the FDA, artificial flavor is “any substance, the function of which is to impart flavor, which is not derived from a spice, fruit or fruit juice, vegetable or vegetable juice, edible yeast, herb, bark, bud, root, leaf or

1182 similar plant material, meat, fish, poultry, eggs, dairy products, or fermentation thereof” (CFR,  
1183 2018). They state that natural flavors come from essential oils, oleoresins, essences/extractives,  
1184 protein hydrolysates, distillates, or products of roasting, heating, or enzymolysis containing  
1185 flavor derived from the sources listed above in which artificial flavors cannot be derived (CFR,  
1186 2018). Colors, on the other hand, are only defined as color additives, which are dyes, pigments,  
1187 or other substances that impart color (CFR Part 70, 2018).

1188         There has been a large amount of work conducted on how food color influences  
1189 perceptions of food and beverages. In a study from 1980, Dubose et al. added congruent and  
1190 incongruent colors to fruit flavored beverages. They found that participants more frequently  
1191 misidentified the flavor of the beverage when the color was incongruent with the flavor of the  
1192 beverage. They also found that color intensity affected the flavor acceptance of colored  
1193 beverages and colored cakes (Dubose, 1980). Similarly, Zampini found that people correctly  
1194 identified the flavor of aqueous solutions more often when the color corresponded with their  
1195 expectations. The lime solution was correctly identified more frequently when the solution was  
1196 green or colorless, for example. Correct identification did not occur with strawberry, however.  
1197 This occurs because colors tend to be associated with specific flavors. Orange color was  
1198 associated with orange flavor, yellow with lemon flavor, and green with lime flavor.  
1199 Associations for the color red, however, were more complex and participants related red to  
1200 strawberry, raspberry, and cherry flavor (Zampini, 2007). Food color can also influence  
1201 expectations prior to tasting. Zellner and Durlach found that brown colored lemon and mint  
1202 beverages were expected to be less refreshing and clear beverages were expected to be more  
1203 refreshing. Brown colored lemon and mint beverages were found to be less refreshing than other  
1204 colors after tasting as well. The color of the beverage affected expectations of flavor intensity,



1205 though there were fewer significant differences after tasting. They also found that color affects  
1206 expectations of liking and actual liking (Zellner, 2003). Spence published a comprehensive  
1207 review of color perceptions studies discussing the influence of color on basic taste and flavor  
1208 perception, the influence of color on aroma perception, the influence of color on detection  
1209 thresholds, the influence of color on flavor identification, and influence of color on expectations  
1210 (Spence, 2010).

1211           Research has also been conducted to study the relationship between artificial colors and  
1212 health. When comparing artificial colors and sweeteners, participants perceived significantly  
1213 more risks with colors (Bearth, 2014). Wąsowicz found that Polish consumers believe that  
1214 unhealthy products contain artificial colors along with being high in fat and calories (Wąsowicz,  
1215 2015).

1216           Compared to color additives, little work has been done to study how flavor additives  
1217 affect perceptions. According to Nielsen, 62% and 61% of global respondents avoid artificial  
1218 flavors and artificial colors, respectively (Nielsen, 2016). They also report that a lack of artificial  
1219 colors and flavors and presence of natural flavors is important to global consumers when making  
1220 purchasing decisions (Nielsen, 2015). Additionally, FONA reports that 69% of American  
1221 consumers believe that products without artificial colors and flavors are more important than  
1222 “natural” products (FONA, 2018). It is clear that color and flavor additives are important to  
1223 consumers. Though there has been plenty of research studying how color affects perceptions,  
1224 there is a gap in knowledge related to how color and flavor additives affect perceptions of  
1225 product naturalness. Since there is no formal definition of natural, it is necessary for academics  
1226 and product developers to get a better understanding of this vague term and how products with  
1227 artificial and/or natural colors and flavors fit into the consumer definition. This research was

1228 conducted to address this gap in knowledge. The objectives of this study were (1) to understand  
1229 how products with artificial and/or natural colors and flavor additives affect consumer  
1230 perceptions of naturalness and (2) to understand what consumers believe are appropriate sources  
1231 of natural color and flavor additives.

1232

1233

## **Materials & Methods**

1234 A standardized online questionnaire was used by consumers in three countries: United  
1235 States of America (USA), the United Kingdom (UK), and Australia (AUS) to gather data for this  
1236 research.

1237

### **Questionnaire**

1239 An online survey was launched using Qualtrics Survey Software (Provo, UT, USA) and  
1240 participants were compensated using a reward system offered by Qualtrics. Participants were  
1241 shown eight statements from four food products, each being shown twice. The first time the  
1242 statement was shown, participants were only shown the ingredient statement with no other  
1243 information and were asked to rate the naturalness of the food. Naturalness was rated on a 9-  
1244 point scale anchored with “1 – Not At All Natural” and “9 – Extremely Natural”. After seeing all  
1245 four statements, they were shown the same statements, this time being informed of the identity of  
1246 the product. The four statement were chosen because they have different combinations of  
1247 artificial and natural colors and flavors. Product ingredient statements included Strawberry Puree  
1248 (Natural Color, Natural Flavor), Flamin’ Hot Cheetos® (Artificial Color, Natural Flavor),  
1249 Gummy Candy (Artificial Color, Artificial Flavor), and Blueberry Yogurt (Natural Color,  
1250 Artificial Flavor). In addition to these statements, participants were shown two check all that

1251 apply (CATA) lists and were asked to select all the sources they believe that natural colors and  
1252 natural flavors for food can come from. The questions included in the survey can be found in the  
1253 appendix.

1254 Respondents were also asked various demographic questions including gender, age,  
1255 race/ethnicity (using race demographics commonly used in each country/region), education level,  
1256 income (using income brackets commonly used in each country/region), and number of children.  
1257 They were also asked how often they read ingredient statements, how often they pay attention to  
1258 the source of coloring/flavors on labels, importance of color/flavor on the label, and likelihood to  
1259 purchase based on the presence of artificial colors/artificial flavors. Participants were also asked  
1260 how often they consume various foods from a list of foods that contain color additives, in CATA  
1261 format. Items from the Health and Taste Attitudes Scale were included to further segment  
1262 participants.

1263

## 1264 **Consumers**

1265 One thousand participants from the United States, the United Kingdom, and Australia  
1266 were recruited. Predominantly English speaking countries were chosen so that comparisons  
1267 could be made within a common language, with slight variations in spelling and wording.  
1268 Gender, age, and estimate of household grocery shopping were used to recruit participants. Three  
1269 quotas were employed to recruit potential participants: gender (50% males, 50% females), age  
1270 (20-25% for 18-23, 24-41, 42-52, and 53-73; 10% or less for 74 years or older), and estimate of  
1271 household grocery shopping. Participants were not included if they were under 18 years of age or  
1272 if they did less than 40% of the grocery shopping for their household. Age generations were used  
1273 instead of traditional age brackets to form more accurate conclusions about perceptual

1274 differences by age group. The generational groups, from youngest to oldest, were  
 1275 Centennials/Gen Z, Millennials/Gen Y, Gen X, Baby Boomers, and the Silent Generation.  
 1276

**Table 3-1.** Demographic percentages\*

<b>Demographic Characteristics</b>	<b>Categories</b>	<b>US</b>	<b>UK</b>	<b>AUS</b>
Gender	Male	48%	50%	48%
	Female	52%	50%	52%
Age	Centennials/Gen Z	25%	15%	14%
	Millennials/Gen Y	18%	23%	24%
	Gen X	26%	26%	26%
	Baby Boomers	20%	26%	26%
	Silent Generation	11%	10%	10%
Race/Ethnicity	American Indian/Alaska Native	1%		
	Asian	4%	5%	12%
	Black/African/Caribbean	10%	3%	1%
	Hispanic/Latino	6%	0%	1%
	Caucasian/White	77%	90%	82%
	Aboriginal/Torres Strait			1%
	Pacific Islander	0%		1%
	Other	1%	<1%	1%
Prefer Not to Answer	1%	2%	1%	
Education	High School or Less	25%	34%	33%
	Associate Degree/Some College	32%	18%	25%
	College Degree	27%	33%	27%
	Post Graduate	16%	13%	15%
	Prefer Not to Answer	1%	2%	1%
	Number of Children	No Children	66%	64%
One Child		14%	16%	16%
Two Children		16%	14%	15%
Three Children		3%	5%	4%
Four or More Children		2%	1%	2%

\* Percentages were based on 932, 959, and 969 respondents from the US, UK, and AUS, respectively.

**Table 3-2. Income demographic percentages\***

Demographic Characteristics	Categories	US	UK	AUS
	Less than \$52,000	27%		
	\$52-103,999	25%		
	\$104-155,999	17%		
	\$156-207,999	12%		
	\$208-259,999	10%		
	\$260,000 or more	6%		
	Less than £20,000		33%	
	£20,000 - £39,999		33%	
	£40,000 - £59,999		16%	
	£60,000 - £79,999		5%	
	£80,000 - £99,999		4%	
	£100,000 or more		3%	
	Less than \$52,000			39%
	\$52-103,999			32%
	\$104-155,999			15%
	\$156-207,999			5%
	\$208-259,999			1%
	\$260,000 or more			1%
	Prefer Not to Answer	3%	6%	7%

\* Percentages were based on 932, 959, and 969 respondents from the US, UK, and AUS, respectively.

### Analysis

Excel (Microsoft Office Pro ver. 2013) was used to calculate means and percentages, for descriptive statistics, and for chi-square tests for significance (p-values less than 5% were considered significant). XLSTAT (Addinsoft, New York, NY, USA) was used for Analysis of Variance and Correspondence Analysis for CATA data. Prior to analysis, 9-point scales were converted to 3-point scales to understand existing trends in perceptions. The scale was reduced to 1-Unnatural, Neither natural nor unnatural, and 3-Natural. Respondents with incomplete surveys were excluded before analysis. Some respondents are inattentive and may answer questions

1302 without thinking or simply check boxes without reading the question (Baker and Le Guin, 2007;  
1303 Allen, 1966). Because of this, a fake or “cheater” question (e.g. Yang et al., 2015) was included  
1304 in the survey. Participants who reported consuming ‘Live worms’ or ‘Pickled chicken’ in the  
1305 past week were also excluded from the analysis. After exclusion, 969 respondents from  
1306 Australia, 959 respondents from the UK, and 932 respondents from the US were included in the  
1307 analysis.

1308

## 1309 **Results & Discussion**

### 1310 **United States**

1311 Both of the fruit based products were perceived as the most natural and were considered  
1312 more natural when the product identity was revealed. Fifty-three percent of US respondents rated  
1313 the Blueberry yogurt (Natural Color, Artificial Flavor) as natural (Figure 3-1). This result was  
1314 not significantly different from the unidentified version of this statement, which was perceived as  
1315 natural by 49% of respondents. There was also no significant difference between the unidentified  
1316 Blueberry Yogurt and the identified Strawberry Puree (Natural Color, Natural Flavor), which  
1317 was perceived as natural by 45% of respondents. Participants perceived the Puree to be less  
1318 natural when unidentified and the percentage of natural ratings dropped to 38%. There was no  
1319 significant difference between the unidentified Flamin’ Hot Cheetos® (Artificial Color, Natural  
1320 Flavor) and the unidentified Gummy Candy (Artificial Color, Artificial Flavor), which were  
1321 perceived as natural by 30% and 25% of respondents, respectively. The unidentified Gummy  
1322 Candy were also not rated significantly different from the identified Flamin’ Hot Cheetos® and  
1323 the identified Gummy Candy, which were both perceived as natural by 24% of American  
1324 respondents.

1325 All statements, whether identified or unidentified, were perceived to be more natural by  
1326 males and less natural by females. Millennials also perceived all of the statements to be more  
1327 natural than any other generational group. These differences were significant for every statement  
1328 but the identified Blueberry Yogurt. Centennials, Silent Generation, and Baby Boomers  
1329 generally rated all statements as less natural. Respondents with college or post-graduate degrees  
1330 perceived the statements to more natural. These differences, however, were only significant for  
1331 the unidentified Strawberry Puree, unidentified Gummy Candy, identified Cheetos, and  
1332 identified Gummy Candy. Respondents with higher incomes also rated the statements as more  
1333 natural, though these differences were not significant for the unidentified and identified  
1334 Blueberry Yogurt statements. Parents perceived products as more natural than participants with  
1335 no children. There was no significant difference, however, for the identified Blueberry Yogurt  
1336 statement. Race was not a good predictor of naturalness perceptions and there were no  
1337 significant differences for any statement.

1338 American respondents who read ingredient statements more often when making  
1339 purchases perceived the products to be more natural. Additionally, respondents who reported that  
1340 they pay attention to the source of color and the source of flavor more often when making  
1341 purchases perceived the products to be more natural. There were, however, no significant  
1342 differences for the identified Yogurt for these three questions. Respondents who stated that the  
1343 source of color and the source of flavor in foods and beverages was important perceived the  
1344 products to be more natural. There were no significant difference for the unidentified Yogurt for  
1345 flavor (though it contains artificial flavors) and no significant differences for the identified  
1346 yogurt for color and flavor. Thirty-eight percent of respondents were likely not to purchase  
1347 products with artificial colors and 37% were likely not to purchase products with artificial colors.

1348 Despite this, these respondents perceived all of the products to be more natural than those whose  
1349 purchase decisions are not affected by artificial colors and flavors.

1350 Participants were also asked how frequently they consumed commonly colored and  
1351 flavored foods. These foods include Toaster Pastries, Hard Candy, Cookies, Ice Cream,  
1352 Popsicles, Flavored Gelatin, Chewing Gum, Breath Mints, Breakfast Cereal, Flavored Crackers,  
1353 Salad Dressing, Fruit Yogurt, Fruit Juice, Soda, Energy Drinks, and Sports Drinks. Generally,  
1354 participants who frequently consumed these products perceived the products as more natural.  
1355 There were significant differences for all of these foods/beverages for the unidentified Puree and  
1356 the identified and unidentified Gummy Candy. There were no significant differences for Salad  
1357 Dressing and Fruit Juice for the unidentified Cheetos; Ice Cream, Cereal, Dressing, and Soda for  
1358 the unidentified Yogurt; Dressing for the identified Puree; Dressing and Juice for the identified  
1359 Cheetos; and Ice Cream, Gum, Cereal, Dressing, Juice, and Soda for the identified Yogurt.  
1360 Frequency of Salad Dressing consumption was a poor predictor of naturalness ratings.  
1361 Respondents who agree that they are very particular about the healthiness of food perceived  
1362 products as more natural. There were no significant differences for the unidentified Cheetos,  
1363 identified Cheetos, and identified Yogurt statements. The former two were believed to be  
1364 unnatural by most of the participants and the latter was perceived to be natural by most of the  
1365 participants. Twenty-nine percent of respondents agree that artificially colored and artificially  
1366 flavored foods are not harmful for health and they perceived all products as more natural. Those  
1367 that believe that artificial colors and flavors are harmful for health perceived products to be less  
1368 natural. Participants that stated that they try to eat foods that do not contain additives perceived  
1369 products to be more natural. There were no significant differences, however, for the identified  
1370 and unidentified Yogurt. Respondents that stated that they would like to eat only organically



1371 grown vegetables, that they look for only Non-GMO ingredients in the foods they eat, and that  
1372 they always look for natural ingredients in the snack foods that they eat perceived all statements  
1373 to be more natural. There was no significant difference for the identified Yogurt for participants  
1374 who look for natural ingredients in snack foods.

1375

## 1376 **United Kingdom**

1377 The identified Strawberry Puree (Natural Color, Natural Flavor) and the identified  
1378 Blueberry Yogurt (Natural Color, Artificial Flavor) were perceived to be natural by the largest  
1379 percentage of UK respondents. The former was rated natural by 43% of respondents and the  
1380 latter by 42% of respondents (Figure 3-1). There was no significant difference between these two  
1381 and the unidentified Strawberry Puree, which was perceived as natural by 40% of respondents.  
1382 The unidentified puree was also not significantly different from the unidentified Blueberry  
1383 Yogurt statement (35% natural). There were no significant differences in naturalness perceptions  
1384 for the unidentified Flamin' Hot Cheetos® (Artificial Color, Natural Flavor), unidentified  
1385 Gummy Candy (Artificial Color, Artificial Flavor), and the identified Cheetos, which were  
1386 considered natural by 21%, 19%, and 18% of participants, respectively. There was also no  
1387 significant difference between the identified Cheetos and the identified Gummy Candy (17%  
1388 natural).

1389 In general, males gave higher naturalness ratings than females. These differences were  
1390 not significant, however, for the unidentified and identified Puree and the unidentified Yogurt.  
1391 Millennials perceived the products to be more natural, but there were no significant differences  
1392 for the identified Puree and identified Yogurt. Respondents with more education and more  
1393 income perceived the products to be more natural than other groups in these demographics.

1394 There were no significant differences for the unidentified Puree for income and for the identified  
1395 and unidentified Yogurt and the identified Puree for both demographics. Generally, parents  
1396 perceived products to be more natural than participants without kids, but there were no  
1397 significant differences for the identified and unidentified Puree and the identified and  
1398 unidentified Yogurt. These four statements had the least amount of significant differences for all  
1399 of these demographics. Race was not a good predictor of perceptions of naturalness.

1400 UK respondents who read ingredient statements more frequently when making purchases  
1401 perceived all products to be more natural. Similarly, respondents who pay attention to the source  
1402 of color and flavor more often were more likely to perceive the products as more natural. There  
1403 were no significant difference, however, for the identified and unidentified Yogurt and the  
1404 identified Puree for attention to source of color. Both of these products contain natural colors.  
1405 Respondents who reported that the source of color was important to them had higher perceptions  
1406 of naturalness, though there were no significant differences for the identified Cheetos (which  
1407 contain artificial colors) and the identified and unidentified Yogurt. For flavor source, the  
1408 identified gummy candy (which contains artificial flavors) was the only product with significant  
1409 differences and perceptions of naturalness were higher for respondents who report flavor source  
1410 as important. Thirty-three percent and 44% of UK respondents stated that they were likely not to  
1411 purchase products with artificial colors or artificial flavors, respectively. Those who were more  
1412 likely not to purchase artificially colored or flavored products, however, perceived most products  
1413 as more natural. There were no significant differences for the unidentified Puree for color and for  
1414 the identified and unidentified Yogurt for color and flavor.

1415 None of the products had significant differences in naturalness perceptions based on  
1416 consumption of the commonly colored foods used in the survey. Generally, UK respondents that

1417 frequently ate commonly colored/flavored foods perceived the statements to be more natural.  
1418 The identified Yogurt had the fewest significant differences. There were no significant difference  
1419 for consumption of Cereal and Soda for the unidentified Puree; Cookies and Cereal for the  
1420 unidentified Cheetos; Cereal, Fruit Juice, and Soda for the unidentified Gummy Candy; Cookies,  
1421 Cereal, and Soda for the unidentified Yogurt; Cereal for the identified Puree; Cookies, Cereal,  
1422 Fruit Juice, and Soda for the identified Cheetos; Cereal and Fruit Juice for the identified Gummy  
1423 Candy; and Hard Candy, Gum, Breath Mints, Cereal, Fruit Juice, Soda, Energy Drinks, and  
1424 Sports Drinks for the identified Yogurt. Breakfast Cereal, Soda, and Fruit Juice were poor  
1425 predictors of naturalness perceptions for UK respondents. Those who agree that they are very  
1426 particular about the healthiness of food perceived the unidentified and identified Puree and the  
1427 identified Cheetos to be more natural. Twenty-three percent of UK respondents believe that  
1428 artificially colored and artificially flavored foods are not harmful for health. These people  
1429 perceived all of the products to be more natural than those who believe that artificially colored  
1430 and flavored foods are harmful for health. Participants who state that they try to eat foods that do  
1431 not contain additives perceived the products to be more natural, but there were no significant  
1432 differences for the unidentified and identified Puree, and the identified Yogurt. Participants who  
1433 would like to eat only organically grown vegetables perceived all of the products to be more  
1434 natural. Those who look for only Non-GMO ingredients also perceived the products to be more  
1435 natural. There were no significant differences for the unidentified and identified Puree and the  
1436 identified Yogurt. Finally, participants who always look for natural ingredients in snack foods  
1437 perceived the products to be more natural, though there was no significant difference for the  
1438 unidentified Puree, unidentified Cheetos, and the identified Yogurt.  
1439

1440 **Australia**

1441 The fruit based products were perceived to be the most natural and there were no  
1442 significant differences between the identified and unidentified. The identified Blueberry Yogurt  
1443 (Natural Color, Artificial Flavor) was perceived as natural by 47% of Australian respondents and  
1444 the identified Strawberry Puree (Natural Color, Natural Flavor) was perceived as natural by 43%  
1445 of respondents (Figure 3-1). When unidentified, both the Yogurt and Puree were perceived to be  
1446 natural by 41% of respondents. There was no significant difference between the unidentified  
1447 Flamin' Hot Cheetos® (Artificial Color, Natural Flavor) and the unidentified Gummy Candy  
1448 (Artificial Color, Artificial Flavor), perceived natural by 25% and 19% of respondents,  
1449 respectively. There was also no significant difference between the unidentified Gummy Candy  
1450 and the identified Cheetos (20% natural) and the identified Gummy Candy (19% natural).

1451 Males perceived the products to be more natural and females perceived the products to be  
1452 less natural, but the difference was not significant for the unidentified Puree and the identified  
1453 Yogurt. Millennials and Centennials perceived products to be more natural than respondents in  
1454 the other generational groups. These differences were not significant for the identified and  
1455 unidentified Puree and the identified Yogurt. There were only significant Race/Ethnicity  
1456 differences for the identified and unidentified Cheetos and the identified and unidentified  
1457 Gummy Candy statements. White/Caucasian respondents perceived these products to be less  
1458 natural than other groups in this demographic. Respondents with more education perceived the  
1459 products to be more natural, though there were no significant differences for the identified Puree  
1460 and Yogurt statements. Income was not a good predictor of naturalness. There were only  
1461 significant differences for the identified and unidentified Cheetos and the unidentified Gummy

1462 Candy and respondents in the middle-income brackets perceived these statements to be more  
1463 natural. There were no significant differences for any products based on number of children.  
1464         There were no significant differences for frequency of reading ingredient statements for  
1465 any of the products. Similarly, the identified Gummy Candy was the only product with a  
1466 significant difference for attention to the source of color. Though this product contains artificial  
1467 color, participants who pay attention to color source most of the time perceived this product to be  
1468 more natural. Australian respondents who pay attention to the source of flavor more frequently  
1469 perceived the products to be more natural. There were no significant differences for the  
1470 identified Puree and the identified and unidentified Yogurt (which contains artificial flavor).  
1471 There were no significant differences for any of the products based on the importance of the  
1472 source of color or the source of flavor. Additionally, there were no significant differences for any  
1473 of the products based on the likelihood not to purchase artificially colored or artificially flavored  
1474 products.

1475         In general, Australian participants who eat commonly colored foods more frequently,  
1476 perceived the products to be more natural. There were no significant differences for Ice Cream,  
1477 Gum, Cereal, Yogurt, Fruit Juice, and Soda for the unidentified Puree; Mints, Cereal, Juice, and  
1478 Soda for the unidentified Cheetos; Cereal, Dressing, Yogurt, and Soda for unidentified Gummy  
1479 Candy; Hard Candy, Ice Cream, Gum, Cereal, Dressing, Yogurt, Juice, and Soda for unidentified  
1480 Yogurt; Soda for the identified Puree; Cereal and Soda for the identified Cheetos; Cereal and  
1481 Yogurt for the identified Gummy Candy; and Hard Candy, Popsicles, Gum, Juice, Soda, and  
1482 Sports Drinks for the identified Yogurt. Breakfast Cereal, Yogurt, Fruit Juice, and Soda  
1483 consumption were poor predictors of naturalness ratings for Australian participants. Those that  
1484 state that they are particular about the healthiness of food perceived the products to be more

1485 natural, but there were no significant differences for the identified Puree and identified Gummy  
1486 Candy. Twenty-one percent of Australian respondents believe that artificially colored and  
1487 artificially flavored foods are not harmful for health. These people perceived all of the statements  
1488 to be natural. There were no significant differences for the statement “I try to eat foods that do  
1489 not contain additives”. Participants who would like to eat only organically grown vegetables  
1490 perceived the unidentified Puree and unidentified Cheetos to be more natural. Those who look  
1491 for only Non-GMO ingredients perceived the identified Cheetos to be more natural. Australian  
1492 respondents who always look for natural ingredients in snacks perceived the unidentified Puree  
1493 to be more natural than those who do not.

1494

### 1495 **Cross Country Comparisons**

1496 Respondents from the US gave the highest mean naturalness scores for all products but  
1497 the unidentified Strawberry Puree. Of the three regions, US respondents gave the lowest mean  
1498 score to this product, though the difference was not significant. Overall, there was a significant  
1499 difference by region, with the US scoring significantly higher on average than respondents from  
1500 the UK and Australia. There was no significant difference between the latter two. Of the  
1501 products, the identified Puree and Yogurt received higher mean naturalness scores than the  
1502 unidentified for all three regions. Conversely, the identified Cheetos and Gummy Candy received  
1503 lower mean naturalness scores than the unidentified. There were two distinct groupings, with the  
1504 identified and unidentified Puree and Yogurt being significantly different from the identified and  
1505 unidentified Cheetos and Gummy Candy. The US and Australia gave higher mean scores to the  
1506 identified Yogurt and the UK gave about the same mean score to the Puree and Yogurt. In the  
1507 grouping with the lower mean scores, the US and Australia gave higher mean scores to the

1508 unidentified Cheetos statement and the UK gave higher mean scores to the unidentified Gummy  
1509 Candy statement. All three regions gave the lowest mean naturalness scores to the identified  
1510 Gummy Candy.

1511           When considering demographics, there were not large differences between the US, UK,  
1512 and Australia. It appears that Males, Millennials, and consumers with more education and higher  
1513 income are the most likely to give higher naturalness scores than others in their respective  
1514 demographic groups. This trend was seen in all three regions with the exception of income not  
1515 being a good predictor of naturalness scores in Australia. Race/Ethnicity was a poor predictor of  
1516 natural perceptions in all three regions. Additionally, it appears that frequent consumptions of  
1517 some commonly colored foods and beverages may be good predictors of natural perceptions, but  
1518 more so for Americans.

1519           Australian respondents made the most selections and Americans made the least amount  
1520 of selections when choosing which sources are appropriate sources of colors in foods and  
1521 beverages. Respondents from all three regions associated Fruit, Fruit Juice, Vegetables, and  
1522 Flowers with acceptable sources of food colors. Algae, Beans, Minerals, Roots, Food Dyes, and  
1523 Bark were also associated with acceptable sources of food colors, though they were chosen by  
1524 less than 50% of respondents from each country. Sea Weed was selected by all three regions, but  
1525 was more associated with UK and Australian respondents. Americans strongly associated  
1526 Extracts with being acceptable color sources. They were also more associated with Vitamins as a  
1527 color source. Less than 25% of US respondents selected insects as being an acceptable source of  
1528 food color. UK respondents, on the other hand, strongly associated insects with being an  
1529 acceptable color source. They were less likely, however, to select Grains. Australian respondents  
1530 associated Leaves as being an acceptable color source. Chemicals, Meat, Vitamins, Animal Skins

1531 or Bones, Clay, and Beneficial Microorganisms were selected by less than 25% of respondents  
1532 from all three regions, with Beneficial Microorganisms being the least selected option.

1533 Australian respondents also made the most selections for appropriate sources of flavor in  
1534 foods and beverages and Americans made the least amount of selections. All three regions  
1535 strongly associated Fruit, Fruit Juice, and Vegetables with being appropriate sources of food  
1536 flavors. They also associated Algae, Meat, Flowers, Beans, Extracts, Minerals, Roots, Grains,  
1537 Sea Weed, and Leaves with being acceptable. Respondents from the UK and Australia selected  
1538 Flowers and Sea Weed more frequently than American respondents. Americans were more  
1539 associated with Extracts and Vitamins and UK respondents were more associated Insects as  
1540 acceptable flavor sources. Australians were more associated with Beans, Leaves, Clay, and  
1541 Beneficial Microorganisms. Insects, Chemicals, Food Dyes, Clay, and Beneficial  
1542 Microorganisms were selected by less than 25% of respondents from all three regions with Clay  
1543 and Chemicals being the least selected options. Animal Skins and Bones were also selected by  
1544 less than 25% of Americans, Bark was selected by less than 25% of UK respondents, and  
1545 Vitamins were selected by less than 25% of UK and Australian respondents.

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1548 **Table 3-3.** ANOVA results of US, UK, and Australian participants' naturalness scores  
 1549 to identified and unidentified products with various combinations of artificial and  
 1550 natural colors and flavors.

	<b>Statement * Country</b>	<b>Response</b>
1551	Blueberry Yogurt (Nat color, Art flavor)*US	5.55 a
1552	Blind Yogurt (Nat color, Art flavor)*US	5.32 ab
	Blueberry yogurt (Nat color, Art flavor)*AUS	5.21 abc
1553	Strawberry Puree (Nat color, Nat flavor)*US	5.19 bcd
	Strawberry Puree (Nat color, Nat flavor)*AUS	5.06 bcde
1554	Strawberry Puree (Nat color, Nat flavor)*UK	5.04 bcde
	Blueberry Yogurt (Nat color, Art flavor) *UK	5.03 bcde
1555	Blind Puree (Nat color, Nat flavor) *AUS	4.97 bcde
1556	Blind Yogurt (Nat color, Art flavor) *AUS	4.94 cde
	Blind Puree (Nat color, Nat flavor) *UK	4.92 cde
1557	Blind Puree (Nat color, Nat flavor) *US	4.84 de
	Blind Yogurt (Nat color, Art flavor) *UK	4.75 e
1558	Blind Cheetos (Art color, Nat flavor) *US	4.31 f
	Blind Candy (Art color, Art flavor) *US	4.06 fg
1559	Blind Candy (Art color, Art flavor) *UK	3.98 fgh
	Blind Cheetos (Art color, Nat flavor) *AUS	3.98 fgh
1560	Flamin' Hot Cheetos (Art color, Nat flavor)*US	3.98 fgh
1561	Blind Cheetos (Art color, Nat flavor) *UK	3.94 gh
1562	Gummy Candy (Art color, Art flavor)*US	3.91 gh
	Blind Candy (Art color, Art flavor)*AUS	3.86 ghi
1563	Flamin' Hot Cheetos (Art color, Nat flavor)*UK	3.74 ghi
1564	Flamin' Hot Cheetos (Art color, Nat flavor)*AUS	3.68 hi
1565	Gummy Candy (Art color, Art flavor)*UK	3.65 hi
	Gummy Candy (Art color, Art flavor)*AUS	3.53 i
1566	Pr > F(Model)	< 0.0001
	Significant	Yes

\* Different letters denote a significant difference at  $p \leq 0.05$

**Table 3-4.** Percentages of US, UK, and AUS respondents rating various color sources as acceptable for natural foods and beverages.

<b>Color Sources</b>	<b>US</b>	<b>UK</b>	<b>AUS</b>
Fruit Juice	64%	63%	66%
Fruit	76%	78%	80%
Insects	17%	35%	26%
Chemicals	20%	22%	23%
Algae	33%	34%	35%
Vegetables	70%	75%	79%
Meat	23%	22%	25%
Flowers	52%	60%	64%
Beans	38%	35%	38%
Extracts	52%	49%	50%
Vitamins	23%	17%	19%
Minerals	30%	29%	32%
Animal Skins or Bones	12%	13%	15%
Roots	44%	46%	49%
Food Dyes	36%	42%	45%
Grains	26%	21%	27%
Clay	14%	16%	18%
Sea Weed	41%	52%	56%
Beneficial Microorganisms	10%	11%	11%
Leaves	42%	47%	55%
Bark	26%	26%	28%

**Table 3-5.** Percentages of US, UK, and AUS respondents rating various flavor sources as acceptable for natural foods and beverages.

<b>Flavor Sources</b>	<b>US</b>	<b>UK</b>	<b>AUS</b>
Fruit Juice	68%	65%	68%
Fruit	80%	79%	81%
Insects	17%	24%	23%
Chemicals	9%	9%	11%
Algae	29%	32%	33%
Vegetables	73%	76%	81%
Meat	42%	42%	49%
Flowers	45%	50%	57%
Beans	49%	49%	54%
Extracts	46%	42%	43%
Vitamins	26%	21%	20%
Minerals	31%	32%	33%
Animal Skins or Bones	21%	25%	27%
Roots	49%	48%	56%
Food Dyes	11%	13%	14%
Grains	46%	39%	46%
Clay	9%	11%	12%
Sea Weed	42%	55%	59%
Beneficial Microorganisms	10%	14%	15%
Leaves	41%	45%	54%
Bark	26%	25%	28%

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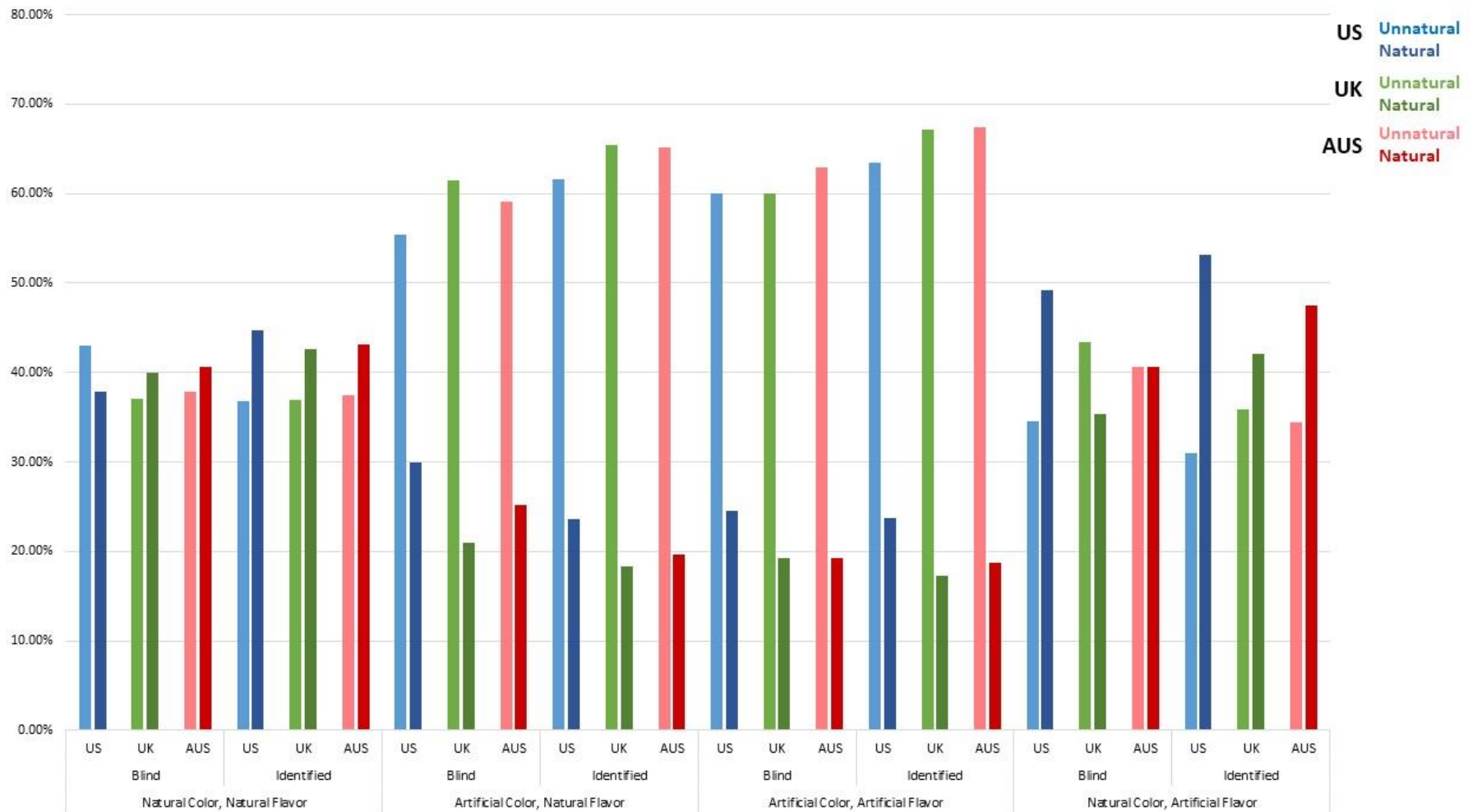
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1577 **Figure 3-1.** Percentage of US, UK, and AUS respondents who rated products represented by ingredient statements with natural or  
 1578 artificial colors or flavors as natural or unnatural.

1579 **General Discussion**

1580 Respondents from all three regions perceived the Strawberry Puree (Natural Color, Natural  
1581 Flavor) and the Blueberry Yogurt (Natural Color, Artificial Flavor) to be more natural than the  
1582 Flamin' Hot Cheetos® (Artificial Color, Natural Flavor) and the Gummy Candy (Artificial  
1583 Color, Artificial Flavor). Both statements, in addition to having plant based ingredients  
1584 (Strawberry Puree Concentrate, Blueberries, Fruit and Vegetable Juice), are shorter ingredient  
1585 statements. Both contain about 15 ingredients, which is much shorter than the Cheetos statement  
1586 that contains over 20. Of the four statements, the Gummy Candy is the shortest. This somewhat  
1587 supports the conclusions made in Chapter 2, that shorter ingredient statements are perceived to  
1588 be more natural than longer ingredient statements, like the Cheetos. It adds an additional  
1589 element, which suggests that consumers look at statement length and ingredients to make  
1590 decisions about naturalness. Though the gummy candy statement was the shortest, it contains  
1591 artificial colors, artificial flavors, and ingredients with chemical sounding names. This  
1592 combination outweighed the length of the statement and the product was perceived to be less  
1593 natural. Comparing the naturalness scores of Cheetos and Yogurt, it may be possible that  
1594 artificial flavors are more acceptable additives than artificial colors. Artificial colors are  
1595 commonly associated with health conditions like ADD and ADHD, so it may be this negative  
1596 association that gives greater weight to colorants on perceptions of naturalness. It may also be  
1597 because artificial colorants are more clearly listed on ingredient statements, whereas flavors are  
1598 simply listed as “artificial flavors”. A chain of multiple artificial colors (such as Yellow 5, Red  
1599 40, Yellow 6, Blue 1, from the Gummy Candy statement) is more visible and therefore more  
1600 influential.

1601           The Cheetos and Gummy Candy statements were perceived to be significantly less  
1602 natural by participants from all three regions. Their ingredient statements contain artificial  
1603 colors, which are clearly stated using their chemical names (Red 40, for example). Including the  
1604 identity of the statement appears to have an impact on perceptions of naturalness. Adding the  
1605 product identity increased naturalness scores for the Puree and Yogurt and decreased naturalness  
1606 scores for the Cheetos and the Gummy Candy. This may indicate that the product as a whole is  
1607 primarily how consumers make judgements about product naturalness. Secondary to this is the  
1608 individual parts, or ingredients, that make up the whole. The Strawberry Puree, for example,  
1609 contains ingredients like Monocalcium Phosphate, Sodium Alginate, and Methylcellulose.  
1610 Chambers et al. found that consumer perceived ingredients with chemical sounding names to be  
1611 less natural than ingredients with common names (Sodium Bicarbonate vs. Baking Soda, for  
1612 example) (Chambers, 2018). Though participants could see these chemical sounding ingredients  
1613 in the Puree statement, the name Strawberry Puree increased their perceptions of naturalness.  
1614 When unidentified, respondents from the UK and Australia gave slightly higher scores to the  
1615 Puree, the statement with Natural Colors and Natural Flavors. Americans, on the other hand, still  
1616 perceived the yogurt to be more natural than the Puree. This indicates that ingredients in the  
1617 statement affect perceptions and it is more than just the color and flavor additives that consumers  
1618 use as clues of product naturalness. This supports Evans' conclusion that food content is  
1619 important in perceptions of product naturalness (Evans, 2010). In addition to containing artificial  
1620 colors (and artificial flavors in the Gummy Candy), the Cheetos and Candy statements contain  
1621 chemical sounding ingredients or ingredients that may be novel to consumers. This could be  
1622 explain why these statements, even when unidentified, received significantly lower naturalness  
1623 scores. When identified, the scores dropped even lower. Chambers also found that novelty of

1624 ingredients also affects perceptions of naturalness, as sorghum flour was rated as less natural  
1625 than wheat flour (Chambers, 2018).

1626           The Cheetos and Gummy Candy are also likely associated with more processing. Rozin  
1627 discovered that highly processed products were perceived as less natural than products with less  
1628 processing (Rozin, 2006). Strawberry Puree mostly involves physical processing, which was  
1629 found by Rozin to be more natural to consumers than chemical processing (Rozin, 2005).  
1630 Blueberry Yogurt is produced through fermentation, which consumer may see as being more  
1631 natural than extrusion or gel formation. An additional explanation for the drop in score when the  
1632 Cheetos and Gummy Candy were identified could be related to health. Compared to Strawberry  
1633 Puree and Blueberry Yogurt, Cheetos and Gummy Candy are not healthy products. Dominick  
1634 found that 63% of their survey participants associated natural foods with “Improved nutritional  
1635 value” (Dominick, 2018). A snack product and candy product are not commonly associated with  
1636 being nutritious foods and it may be because of this that they received lower naturalness scores  
1637 once identified. Forty-eight percent of American respondents, 45% of UK respondents, and 57%  
1638 of Australian respondents disagreed with the statements “In my opinion, artificially  
1639 colored/flavored foods are not harmful for my health”. There is still a large group of consumers  
1640 that is concerned about color and flavor additives in foods and beverages. This likely influenced  
1641 naturalness scores for the two statements that contain four artificial colors each along with  
1642 artificial flavors in the Candy. Respondents that agreed with the statement were more likely to  
1643 perceive all of the products as natural.

1644           Thoughts about appropriate sources of natural colors and flavors were similar between  
1645 the US, UK, and Australia. Of the three countries, Australians made more selections for both  
1646 color and flavor sources and Americans made the least. This could mean that Americans are

1647 more particular about colorants and flavorants or that Australians are more open minded about  
1648 natural additive sources. It could also mean that Americans are less willing to participate in  
1649 Check All That Apply questions. Respondents believe that plant derived additives are much  
1650 more appropriate than animal, insect, or microbial derived additives or additives that come from  
1651 the earth, like minerals. The most selected color and flavor sources include Fruit, Fruit Juice,  
1652 Vegetables, and Flowers. These results mostly align with the FDA's definition of natural flavor  
1653 (CFR, 2018). The largest discrepancy was that participants from the UK associated insects as  
1654 being an appropriate source of color much more frequently than Americans and Australians. This  
1655 could indicate that respondents from the UK are less prone to neophobia and are more accepting  
1656 of the use of insects as ingredients in foods and beverages.

1657

## 1658 **Limitations**

1659 There were some limitations with this study. Only four ingredient statements were used  
1660 to measure perceptions of naturalness. In addition, all of the products used were food products.  
1661 More research could be done using more products and beverages to verify the results of the  
1662 present study. Only three English-speaking countries participated in the online survey. Further  
1663 research is needed to understand the naturalness perceptions of consumers from Latin America,  
1664 Africa, Asia, and other European countries.

1665

## 1666 **Conclusion**

1667 The results from this experiment illustrate that there are many cues that consumers use  
1668 when determining the naturalness of a food or beverage. Possibly the most important factor is the  
1669 product as a whole. When statements were identified, naturalness ratings for the Strawberry

1670 Puree and Blueberry yogurt increase whereas naturalness ratings for the Flamin' Hot Cheetos®  
1671 and Gummy Candy decreased. The presence of artificial colors and artificial flavors appears to  
1672 have an impact on naturalness perceptions, but other ingredients or additives also influence  
1673 perceptions. Between artificial colors and flavors, the former may influence naturalness  
1674 perceptions more so than flavors. This could possibly be due negative health associations with  
1675 artificial colors or the manner in which they are listed on ingredient statements. In addition to  
1676 colorants and flavorants affecting perceptions of naturalness, ingredients with chemical sounding  
1677 names and novel ingredients also influence consumers. Along with content, process also has and  
1678 affect. The two more processed products, Cheetos and Gummy Candy, were perceived to be less  
1679 natural than the less processed products. Finally, the perceived healthiness of a product likely  
1680 impacts consumers beliefs about naturalness as the less healthy products were deemed less  
1681 natural than the fruit based products. All of these factors combine to form the idea of naturalness  
1682 in the mind of a consumer.

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1751 **Chapter 4 - Naturalness Perceptions of Whole Foods and the Impact**  
1752 **of the Ingredient Statement**

1753 **Abstract**

1754 Natural food is a controversial topic in the United States due to the lack of a formal  
1755 definition. The US, however, is not the only country that does not have firm rules about what  
1756 constitutes a food as natural. Many researchers have looked to consumers to help define natural  
1757 foods, but there has been a lack of research on how ingredient statements affect perceptions of  
1758 naturalness. Work has been published on consumer perceptions of the naturalness of ingredients,  
1759 but no work has been done to understand perceptions of whole foods with and without their  
1760 corresponding ingredient statements. The objective of this study was to understand how  
1761 consumers from three English-speaking countries perceived the naturalness of four non-  
1762 processed food products when shown subcomponent statements with and without product  
1763 identification. An online survey was launched in the United States, United Kingdom, and  
1764 Australia, targeting 1000 consumers in each country. Results show that both product identity and  
1765 ingredient/subcomponent statement influence perceptions of naturalness. However, the statement  
1766 is more influential than product identity when the statement contains a high volume of unfamiliar  
1767 ingredients with chemical sounding names. This research helps to form a more complete picture  
1768 about the factors involved in consumer perceptions of naturalness.

1769

1770 **Introduction**

1771 Food preference is an important for food producers, helping gain more understanding of how  
1772 consumers make selections while shopping. With so many options in the grocery store,

1773 consumers not only have to decide between competing brands and prices, but also have to decide  
1774 if they want to purchase organic or “natural” foods. “Natural” foods, in particular, are of interest  
1775 due to the lack of a formal definition. In the United States, the U.S. Department of Agriculture  
1776 (USDA) and the Food and Drug Administration (FDA) are responsible for “Natural” label claims  
1777 (Parasidis, 2015). The USDA is responsible for “Natural” claims on meat, poultry, and egg  
1778 products and the FDA is responsible for “Natural” claims on all other foods and beverages  
1779 (Parasidis, 2015). Both of these organizations do not have an official definition for the term,  
1780 leading to confusion and uncertainty on the part of the consumer and frustration on the part of  
1781 food producers. The USDA and FDA do, however, have guidelines for “Natural” foods. While  
1782 the FDA decided not to define the term in the 1990’s, they do not restrict the use of the claim  
1783 except on products with “added color, synthetic substances, and flavors” (Department of Health  
1784 and Human Services, 2015). The USDA guidelines specify that foods with the “Natural” claim  
1785 cannot contain artificial ingredients or added colors and must be minimally processed (FSIS,  
1786 2015). Other countries have similar organizations that may have different responsibilities and  
1787 different rules regarding the “Natural” claim. The European Union does not have a definition for  
1788 natural foods, but does have regulations about the use of “Natural” for flavor additives  
1789 (European Parliament, 2008). The United Kingdom states that “Natural” foods must contain  
1790 ingredients that come from nature and are not interfered with by humans. “Natural” foods must  
1791 also not contain chemical additives or flavorings that are produced by a chemical industry or  
1792 extracted by a chemical process (Food Standards Agency, 2008). Australia and New Zealand  
1793 have similar guidelines for “Natural” foods. Williams states that these foods should not contain  
1794 any additives or be “significantly altered” physically, chemically, or biologically (Williams,  
1795 2009).

1796 With the lack of a formal definition, researchers have studied consumers and their internal  
1797 definitions and perceptions of “Natural” foods to better understand these foods. In their review,  
1798 Román et al. found that consumers think “Natural” foods should have no artificial colors, no  
1799 additives, and no human intervention (Román, 2017). Similarly, Abrams and Meyers found that  
1800 focus group participants consider food natural if it does not contain any additives, preservatives,  
1801 hormones, or chemicals (Abrams, 2010). Dominick found that consumers associate the “Natural”  
1802 food label with a lack of preservatives, hormones, and antibiotics. These consumers also  
1803 associated the label claim with increased nutritional value and animal welfare and with safer  
1804 food in general (Dominick, 2018). Additionally, consumers believe that physical changes to food  
1805 are more acceptable than chemical changes, that both processing and content are important, and  
1806 the presence of an E-number on a label is seen as less natural (Rozin, 2005; Rozin 2006; Evans  
1807 2010; Siegrist, 2017). Chambers et al. studied consumer perceptions of naturalness related to  
1808 specific food ingredients. Of the 630 consumers included in their survey, no more than 69% of  
1809 respondents rated the ingredients as natural. They confirmed that a chemical sounding name is  
1810 perceived as less natural than a common name for food ingredients. They also found evidence  
1811 that familiarity with ingredients and neophobia influence the naturalness perceptions of food  
1812 ingredients (Chambers, 2018).

1813 It is common to study consumer perceptions of whole (non-processed) food products or food  
1814 ingredients. McMackin used focus groups to understand the perceptions of whole grains among  
1815 consumers in the United Kingdom. They found that there are several barriers that prevent  
1816 consumers from purchasing foods made with whole grains. In addition to a lack of knowledge  
1817 about what whole grains are, their health properties, and how to cook with them, McMackin  
1818 concluded that the largest barrier was related to negative perceptions of the sensory properties

1819 (McMackin, 2013). Bus used a paper questionnaire to study Australian consumers' perceptions  
1820 of whole milk, reduced fat milk, and soymilk. Participants had similar perceptions about the  
1821 body and bone-related benefits of the three beverages, but believe that whole milk is more likely  
1822 to trigger allergies and disease and soymilk is better at preventing disease. They even conclude  
1823 that there is some degree of "magical thinking" when it comes to perceptions about soymilk  
1824 (Bus, 2003). Font-i-Furnols and Guerrero conducted a review of studies relating to perceptions  
1825 and behaviors associated with meat. They examine consumer expectations of quality, beliefs  
1826 about meat and meat production, visual perceptions relating to meat color and marbling,  
1827 perceptions and preferences for mean texture, and perceptions of and preferences for meat flavor  
1828 and aroma (Font-I-Furnols, 2014). Castro used an online survey to study consumer perceptions  
1829 about insect-based ingredients in food products. Of the thirteen countries studied, only China,  
1830 Thailand, Brazil, Peru, and Mexico had a greater percentage of consumers willing to try food  
1831 products made with insect-based ingredients (Castro, 2018).

1832       There has also been research conducted on perceptions of food and food labeling. Such  
1833 research has studied the effect of product name and description on perception, the impact of label  
1834 claims and ingredient claims on expectations liking, the effect of pictures and photographs on  
1835 expectations and perceptions, and the impact of organic certification logos on preference and  
1836 willingness to pay. Additionally, use of and beliefs about nutrition labels and how these labels  
1837 affect expectations and sensory perceptions has been studied (Campos, 2011; Piqueras-Fiszman,  
1838 2015; Schouteten, 2015; Janssen, 2012).

1839       Aside from Chambers' work on consumer naturalness perceptions of food ingredients, no  
1840 work has been done to study the naturalness perceptions of whole foods. Additionally, little work  
1841 has been done to analyze the influence of ingredient statements on the perceptions of whole

1842 foods. This study was conducted to address this gap in knowledge. The objectives of this study  
1843 were (1) to understand consumer perceptions of naturalness related to whole foods when shown a  
1844 blind subcomponent statement compared to when shown an subcomponent statement along with  
1845 the product identity and (2) to compare differences in perceptions across various demographic  
1846 among three English-speaking countries.

1847

## 1848 **Materials & Methods**

1849 A standardized online questionnaire was used to gather data for this study in three  
1850 countries: United States (US), United Kingdom (UK), and Australia (AUS).

1851

### 1852 **Questionnaire**

1853 The survey was launched using Qualtrics Survey Software (Provo, UT, USA).  
1854 Participants were compensated using a reward system offered by Qualtrics. Respondents were  
1855 shown four subcomponent statements taken from whole foods. The foods used include a Peach,  
1856 Cherries, a Banana, and a Chicken Egg. Each statement includes the macro and micronutrients  
1857 that make up each food. The statements were transcribed from images found on the internet  
1858 created by James Kennedy and were standardized so that they were all similar in format. Certain  
1859 names were changed or expanded. Aqua, for example, was changed to water. The E-number of  
1860 was used in the original images for many subcomponents, but was less specific for the food  
1861 colors. Therefore, items such as E160a were expanded to Carotene E160a to match other items in  
1862 the statements such as Fiber E460. The first two product statements shown to respondents were  
1863 shown without the identity of the product and participants were asked to rate the naturalness of  
1864 the food on a 9-point scale ranging from “1 – Not At All Natural” and “9 – Extremely Natural”.



1865 Following these questions, the identity of the food was revealed on a separate page of the survey  
1866 without the corresponding subcomponent statement. Respondents were asked, “The ingredient  
1867 statement on the previous page is an actual list for a fresh Peach/fresh Cherries. How natural do  
1868 you think this food is now?”. For the next two products, the Banana and the Chicken Egg,  
1869 participants were given the identity of the food along with the subcomponent statement and were  
1870 asked to rate their perceived naturalness of the product. The questionnaire was formatted in this  
1871 manner to understand how the name of a product affects consumer perceptions of food  
1872 naturalness.

1873 Participants were also asked various demographic questions including gender, age,  
1874 race/ethnicity (using race demographics commonly used in each country/region), education level,  
1875 income (using income brackets commonly used in each country/region), and number of children.  
1876 They were asked how often they read ingredient statements, how often they pay attention to the  
1877 source of coloring/flavoring on labels, importance of color/flavor on the label, and likelihood to  
1878 purchase based on the presence of artificial colors and artificial flavors in food. Participants were  
1879 shown a list of commonly colored foods and beverages and asked to rate the frequency in which  
1880 they consume those foods. Finally, participants were shown various items from the Health and  
1881 Taste Attitudes Scale to understand the relation between naturalness perceptions and other food  
1882 based behaviors. The questionnaire can be found in the appendix.

1883

## 1884 **Consumers**

1885 One thousand participants from the US, UK, and Australia were recruited. English speaking  
1886 countries were chosen so that comparisons could be made across cultures that speak a common  
1887 language with slight variations in spelling and wording. Gender, age, and estimate of household

1888 grocery shopping were used to recruit participants. Participants were not included if they were  
1889 under 18 years of age or did less than 40% of the grocery shopping for their household. Gender  
1890 quotas were set to 50% males and 50% females. Age quotas were set to 20-25% for participants  
1891 aged 18-23, 24-41, 42-52, and 53-73 and 10% or less for participants 74 years or older. Rather  
1892 than using traditional age brackets, generational groups were used to understand differences in  
1893 perception based on age. The generational groups, from youngest to oldest, were  
1894 Centennials/Gen Z, Millennials/Gen Y, Gen X, Baby Boomers, and the Silent Generation.

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**Table 4-1.** Demographic percentages\*

<b>Demographic Characteristics</b>	<b>Categories</b>	<b>US</b>	<b>UK</b>	<b>AUS</b>	
Gender	Male	48%	50%	48%	
	Female	52%	50%	52%	
Age	Centennials/Gen Z	25%	15%	14%	
	Millennials/Gen Y	18%	23%	24%	
	Gen X	26%	26%	26%	
	Baby Boomers	20%	26%	26%	
	Silent Generation	11%	10%	10%	
Race/Ethnicity	American Indian/Alaska Native	1%			
	Asian	4%	5%	12%	
	Black/African/Caribbean	10%	3%	1%	
	Hispanic/Latino	6%	0%	1%	
	Caucasian/White	77%	90%	82%	
	Aboriginal/Torres Strait			1%	
	Pacific Islander	0%		1%	
	Other	1%	<1%	1%	
	Prefer Not to Answer	1%	2%	1%	
Education	High School or Less	25%	34%	33%	
	Associate Degree/Some College	32%	18%	25%	
	College Degree	27%	33%	27%	
	Post Graduate	16%	13%	15%	
		Prefer Not to Answer	1%	2%	1%
	Number of Children	No Children	66%	64%	63%
One Child		14%	16%	16%	
Two Children		16%	14%	15%	
Three Children		3%	5%	4%	
Four or More Children		2%	1%	2%	

\* Percentages were based on 932, 959, and 969 respondents from the US, UK, and AUS, respectively.

1901

1902

1903

1904 **Table 4-2.** Income demographic percentages\*

1905	<b>Demographic Characteristics</b>	<b>Categories</b>	<b>US</b>	<b>UK</b>	<b>AUS</b>
1906		Less than \$52,000	27%		
1907		\$52-103,999	25%		
1908		\$104-155,999	17%		
1909		\$156-207,999	12%		
1910		\$208-259,999	10%		
1911		\$260,000 or more	6%		
1912	Income	Less than £20,000		33%	
1913		£20,000 - £39,999		33%	
1914		£40,000 - £59,999		16%	
1915		£60,000 - £79,999		5%	
1916		£80,000 - £99,999		4%	
1917		£100,000 or more		3%	
1918		Less than \$52,000			39%
1919		\$52-103,999			32%
1920		\$104-155,999			15%
1921		\$156-207,999			5%
1922		\$208-259,999			1%
1923		\$260,000 or more			1%
1924		Prefer Not to Answer	3%	6%	7%

1918 \* Percentages were based on 932, 959, and 969 respondents from the US, UK,  
1919 and AUS, respectively.

1920 **Analysis**

1921 Excel (Microsoft Office Pro ver. 2013) was used to calculate means and percentages, for  
1922 descriptive statistics, and for chi-square tests for significance (p-values less than 5% were  
1923 considered significant). XLSTAT (Addinsoft, New York, NY, USA) was used for Analysis of  
1924 Variance. Prior to analysis, the 9-point naturalness scales were converted to 3-point scales to  
1925 understand larger trends in perceptions. The reduced scale was converted to 1-Unnatural, Neither  
1926 natural no unnatural, and 3-Natural. Respondents with incomplete surveys were removed from

1927 the analysis. It has been found that some survey respondents are inattentive and may answer  
1928 questions without thinking or may check boxes without fully reading the questions (Baker and  
1929 Le Guin, 2007; Allen, 1996). A fake or “cheater” question was included in the survey to identify  
1930 these respondents (Yang et al., 2015). Participants who reported consuming ‘Live worms’ or  
1931 ‘Pickled chicken’ in the past week were excluded from the survey. After exclusion, 932  
1932 respondents from the US, 959 from the UK, and 969 from Australia were included in the  
1933 analysis.

1934

## 1935 **Results & Discussion**

### 1936 **United States**

1937 American naturalness perceptions varied based on the food presented and the presence of  
1938 product identity. The first product shown to the respondents, the unidentified Peach, received the  
1939 lowest mean naturalness score. This product significantly differed from all other products and  
1940 was perceived natural by 22% of respondents (Figure 4-1). When identified, the average  
1941 naturalness score raised significantly and was perceived to be natural by 75% of American  
1942 respondents. There was also a significant difference between the unidentified and identified  
1943 Cherries. The identified Cherries received the highest average naturalness score and were  
1944 perceived to be natural by 77% of American respondents versus 41% when unidentified. There  
1945 was no significant difference between the Chicken Egg and the Banana, which were considered  
1946 natural by 40% and 37% of respondents, respectively. The former was also not significantly  
1947 different from the unidentified Cherries.

1948 For the American respondents, there were no significant differences in naturalness  
1949 perceptions for the identified Peach, identified Cherries, Banana, and Chicken Egg for any of the

1950 demographics. Males perceived the unidentified Peach and unidentified Cherries to be more  
1951 natural and females perceived the unidentified Peach and unidentified Cherries to be less natural.  
1952 Younger participants, specifically the Millennials, perceived these products to be more natural,  
1953 and older generations perceived these products as less natural. Participants with more education,  
1954 higher incomes, and with children perceived the unidentified Peach and Cherries as more natural  
1955 than others in their respective demographic groups. American respondents who read ingredient  
1956 statements more often and who pay attention to the source of color and flavor on statements  
1957 more often perceived these products as more natural. Additionally, respondents who reported  
1958 that the source of color and source of flavor in foods is important and respondents who are likely  
1959 not to purchase a food if it contains artificial colors or artificial flavors also perceived these  
1960 products as more natural. Race/ethnicity was not a good predictor of naturalness perceptions.

1961 American respondents who frequently consume commonly colored foods perceived the  
1962 unidentified Peach and Cherries to be more natural. There were no significant differences,  
1963 however, for Juice consumption for both products, and for Dressing and Soda consumption for  
1964 the Cherries. Respondents who agreed that they are particular about the healthiness of foods and  
1965 that artificially colored and artificially flavored foods are not harmful for health also perceived  
1966 the unidentified Peach and Cherries to be more natural. Similarly, respondents who look for only  
1967 Non-GMO ingredients in the foods they eat and always look for natural ingredients in snack  
1968 foods perceived both of these products to be more natural. Americans that try to eat foods that do  
1969 not contain additives and who would like to eat only organically grown vegetables perceived  
1970 only the unidentified Peach to be more natural.

1971

1972

1973 **United Kingdom**

1974 As with the Americans, the unidentified Peach was perceived to be the least natural. It  
1975 was considered natural by 15% of UK respondents and significantly differed from all other  
1976 products (Figure 4-1). When identified, the score rose significantly as was perceived to be  
1977 natural by 78% of respondents. The identified Cherries received the highest mean naturalness  
1978 score and were perceived to be natural by 82% of UK respondents. The unidentified Cherries  
1979 (31% natural) were significantly different from the identified Cherries, but did not differ  
1980 significantly from the Chicken Egg, which was considered natural by 39% of respondents. The  
1981 unidentified cherries also did not differ significantly from the Banana, perceived as natural by  
1982 35% of respondents, though there was a significant difference in naturalness perceptions between  
1983 the Banana and the Chicken Egg.

1984 Similar to the Americans, there were little to no significant differences for the identified  
1985 Peach, identified Cherries, Banana, and Chicken Egg. There were no significant differences  
1986 among UK respondents by gender or by race/ethnicity. Additionally, number of children was a  
1987 poor predictor of naturalness perceptions. Younger generations, specifically the Millennials,  
1988 perceived the products to be more natural. Respondents with more education and higher incomes  
1989 rated the products as more natural than others in their demographic groupings. Respondents who  
1990 report reading ingredient statements more often perceived the unidentified Peach, unidentified  
1991 Cherries, and the Banana to be more natural than those who read statements less frequently.  
1992 Those who report paying attention to the source of color and flavor on ingredient statements  
1993 perceived the unidentified Peach and Cherries to be more natural. Respondents who reported that  
1994 the source of color in foods was important to them perceived the unidentified Peach to be more  
1995 natural. UK respondents who state that they are likely not to purchase a food if it contains

1996 artificial colors or artificial flavors perceived the unidentified Peach and Banana to be more  
1997 natural.

1998 UK respondents who frequently consume commonly colored foods perceived the  
1999 unidentified Peach and unidentified Cherries as more natural. There were no significant  
2000 differences for Fruit Juice for the former and for Cookies, Breakfast Cereal, Fruit Juice, and Soda  
2001 for the latter. Respondents who frequently consume Flavored Gelatin and Sports Drinks  
2002 perceived the Banana to be more natural. Those who believe that artificial colored foods and  
2003 artificially flavored foods are not harmful for health, who try to eat foods that do not contain  
2004 additives, and who would like to eat only organically grown vegetables perceived the  
2005 unidentified Peach and Cherries as more natural. UK respondents who agree that they look for  
2006 only Non-GMO ingredients in the foods they eat perceived the unidentified Peach, unidentified  
2007 Cherries, and Banana as more natural. Respondents who agree that they always look for natural  
2008 ingredients in the snack foods they consume perceived the identified Peach as more natural.  
2009 There were no significant differences for any of the products based on the statement “I am  
2010 particular about the healthiness of food”.

2011

## 2012 **Australia**

2013 Similar to the US and UK participants, Australian respondents perceived the unidentified  
2014 Peach to be the least natural product. It considered natural by 19% of the respondents and was  
2015 significantly different from all other products (Figure 4-1). The identified Peach scored  
2016 significantly higher and did not differ significantly from the identified Cherries. The former was  
2017 considered natural by 81% of respondents and the latter by 82%. When unidentified, the Cherries  
2018 scored significantly lower and were perceived natural by 35% of Australian respondents. There



2019 was no significant difference between the unidentified Cherries and the Chicken Egg (37%  
2020 natural) and no significant difference between the Chicken Egg and the Banana (33%), although  
2021 the unidentified Cherries were significantly different from the Banana.

2022 As with UK respondents, there were little to no significant differences for the identified  
2023 Peach, identified Cherries, Banana, and Chicken Egg for the studied demographics. Males  
2024 perceived the unidentified Peach and Cherries to be more natural and females perceived the  
2025 unidentified Cherries to be less natural. Younger generations, specifically the Millennials,  
2026 perceived the unidentified Peach, unidentified Cherries, and Chicken Egg to be more natural and  
2027 older generations perceived the Chicken Egg to be less natural. Respondents with more  
2028 education perceived the unidentified Peach and Cherries to be more natural. Those with higher  
2029 income, who have children, and who pay attention to the source of flavor in foods perceived only  
2030 the unidentified Peach to be more natural. Australian respondents who read ingredient statements  
2031 more often perceived the unidentified Peach and Cherries to be more natural than those who read  
2032 ingredient statements less frequently. Race and level of attention to the source of color in foods  
2033 were poor predictors of naturalness perceptions for Australian respondents. Additionally, there  
2034 were no significant differences for any of the products based on importance of color and flavor  
2035 source in food and likelihood not to purchase a food with artificial colors or artificial flavors.

2036 Australian respondents who frequently consume commonly colored foods perceived the  
2037 unidentified Peach and unidentified Cherries as more natural. There were no significant  
2038 differences for Cookies, Breakfast Cereal, and Soda for the unidentified Peach and for Breakfast  
2039 Cereal, Fruit Juice, and Soda for the unidentified Cherries. Respondents who frequently consume  
2040 Toaster Pastries, Flavored Gelatin, and Energy Drinks perceived the Banana as more natural and  
2041 respondents who frequently consume Toaster Pastries, Popsicles, Flavored Gelatin, Yogurt, Fruit

2042 Juice, and Sports Drinks perceived the Chicken Egg as more natural. Australians who believe  
2043 artificially colored and artificially flavored foods are not harmful for health and who always look  
2044 for natural ingredients in snack foods perceived the unidentified Peach and Cherries as more  
2045 natural. Those who stated that they are particular about the healthiness of foods perceived only  
2046 the unidentified Cherries as more natural. Those who agree that they try to eat foods that do not  
2047 contain additives perceived the Banana as more natural than those who disagreed with this  
2048 statement. Respondents who would like to eat only organically grown vegetables and who look  
2049 for only Non-GMO ingredients in the foods they eat perceived only the Chicken Egg as more  
2050 natural than other respondents.

2051

### 2052 **Cross Country Comparison**

2053           There were no significant differences in mean naturalness scores between the US, UK,  
2054 and Australia. All three countries scored the unidentified Peach as the least natural and these  
2055 scores significantly differed from all of the other products tested. When identified, the scores  
2056 increased significantly, with Australians giving slightly higher mean scores and Americans  
2057 giving slightly lower mean scores. All three countries also rated the identified Cherries as the  
2058 most natural. Generally, there was no significant difference in naturalness scores between the  
2059 identified Cherries and the identified Peach although UK respondents gave a significantly higher  
2060 score to the identified Cherries than US respondents gave to the identified Peach. The Cherries  
2061 were given significantly lower naturalness scores when unidentified, with UK respondents rating  
2062 them as significantly less natural than US respondents. There were no significant differences  
2063 between the Chicken Egg scores and no significant differences between the Banana scores. The

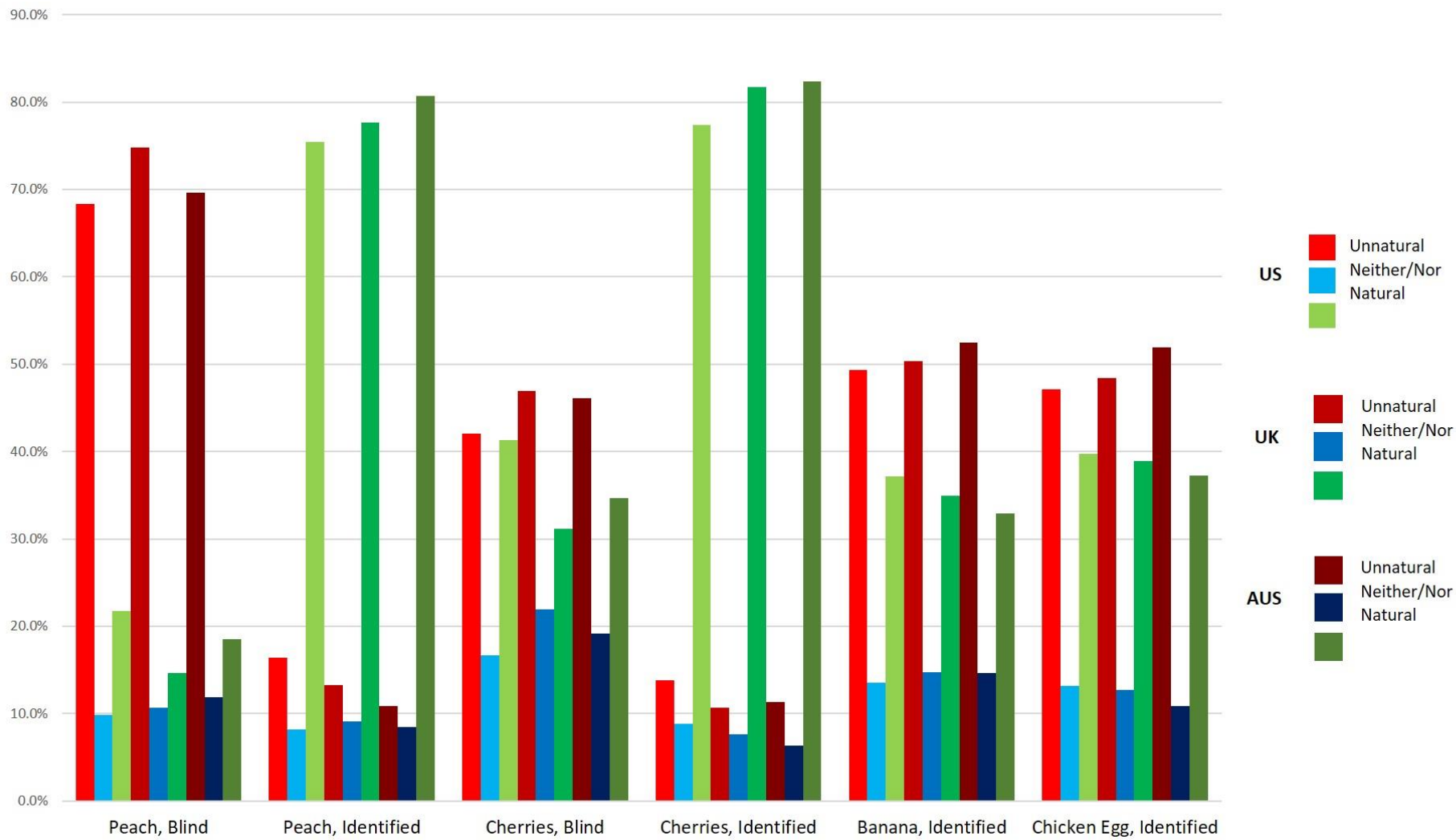
2064 US and UK respondents, however, gave the Chicken Egg significantly higher naturalness scores  
 2065 than the Australian respondents gave to the Banana.

2066

2067 **Table 4-3.** US, UK, and Australian respondent perceptions of  
 2068 naturalness of four whole food products.

2069	<b>Product*Country</b>	<b>Response</b>
2070	Cherries, Identified*UK	7.42 <sup>a</sup>
2071	Cherries, Identified*AUS	7.40 <sup>ab</sup>
2072	Peach, Identified*AUS	7.27 <sup>ab</sup>
2073	Peach, Identified*UK	7.17 <sup>ab</sup>
2074	Cherries, Identified*US	7.16 <sup>ab</sup>
	Peach, Identified*US	7.01 <sup>b</sup>
	Cherries, Blind*US	4.91 <sup>c</sup>
	Cherries, Blind*AUS	4.64 <sup>cd</sup>
	Chicken Egg*UK	4.62 <sup>cd</sup>
	Chicken Egg*US	4.62 <sup>cd</sup>
	Cherries, Blind*UK	4.44 <sup>de</sup>
	Chicken Egg*AUS	4.40 <sup>de</sup>
	Banana*US	4.33 <sup>de</sup>
	Banana*UK	4.30 <sup>de</sup>
	Banana*AUS	4.13 <sup>e</sup>
	Peach, Blind*US	3.45 <sup>f</sup>
	Peach, Blind*AUS	3.25 <sup>fg</sup>
	Peach, Blind*UK	3.03 <sup>fg</sup>
	Pr > F(Model)	< 0.0001
	Significant	Yes

\* Different letters denote a significant difference at  
 p≤0.05



**Figure 4-1.** US, UK, and Australian respondent naturalness ratings of whole foods

## General Discussion

Respondents from all three countries highly relied on product identity when rating a product as natural. The first product statement that was shown to respondents, the unidentified Peach, was deemed the least natural by all three countries. This subcomponent statement, as well as the statement of the other three products, contained subcomponents with long, chemical sounding names. While consumers may be familiar with more common components like Glucose or Sucrose, they are likely unfamiliar with the Fatty Acids and Amino Acids. Names like Octadecatrienoic Acid or Isoleucine may cause consumers to think more about chemistry and components that come from a lab, rather than naturally occurring substances. This confirms conclusions made by Chambers et al. They found that consumers rated ingredients with chemical names and ingredients they were less familiar with as unnatural (Chambers, 2018). The statements for the Peach, Cherries, Banana, and Chicken Egg contain both such components. Without knowing the identity of the product they were scoring, consumers perceived the unidentified Peach to be unnatural. After the Peach and Cherries were identified, naturalness scores increased significantly. This supports the conclusion made in Chapter 3 that the product as a whole has a large impact on perceptions of naturalness. The identified Peach and Cherries were the only products that received mean scores above a five on the naturalness scale. Although the product contained the same subcomponents, once consumers knew that these subcomponents were in a fresh Peach and fresh Cherries, their perceptions changed.

The identity of the Banana and Chicken Egg were never hidden from consumers in this survey. Both of these products were rated as significantly less natural than the Peach and Cherries, with mean naturalness scores less than five. Although these questions had a similar format, consumers were shown the ingredient statement and the product identity at the same time

for the Banana and Chicken Egg, whereas the Peach and Cherries were identified on a following page without seeing the statement for a second time. This indicates that when the product identity and subcomponent statement are combined, the statement holds more weight. This adds to the results from Chapter 3, where it appeared that the product identity held more weight than the sum of its parts. However, the Banana and Chicken Egg statements differ from the statements presented in Chapter 3. The product statements in Chapter 3 follow typical labeling guidelines and therefore did not contain near as many ingredients with long, chemical sounding names as the statements in the current study. Exposure to a high volume of long chemical names may cause a shift in the minds of consumers, with more weight being put on the statement than the product identity when making judgements about naturalness. This shift appears to be somewhat universal since there were no significant differences between the US, UK, and Australia, and relatively few significant differences between the studied demographics. This also explains why product identity was more influential with the Peach and Cherries since consumers could no longer see the subcomponent statement when rescoring product naturalness. Siegrist found that inclusion of an E-number on an ingredient statement significantly decreased perceptions of naturalness (Siegrist, 2017). All four of the product statements contained E-numbers and these likely affected perceptions of naturalness. Less so for the identified Peach and Cherries, since consumers could no longer see them when rating naturalness. Another factor that likely influenced consumers is the length of the statements. All four products had long statements and when this was visible to consumers, as with the Banana and the Chicken Egg, it decreased perceptions of naturalness.

## **Limitations**

There were some limitations to this study. The survey only included four whole food products, three of which were fruits. Additional research can be conducted using vegetables, meats, and grains or beverages like cow's milk and fruit juice. Additionally, only three English-speaking countries were studied. More research is needed to validate these results with consumers in other regions like Latin America, Africa, Asia, and other European countries.

## **Conclusion**

It is evident that consumers rely on a combination of cues to make decisions about the naturalness of a food or beverage product. Both product identity and ingredients/subcomponents that make up the product are two of these cues that consumers look to when forming perceptions. When exposed to just a product name, especially for a whole food product like fruit or an egg, consumers are likely to perceive the product as natural. These perceptions can be altered, however, with the inclusion of an ingredient/subcomponent statement. A long statement with a high volume of unfamiliar chemical names causes consumers to rely more on the ingredient/subcomponent statement than the product identity when making decisions about naturalness. This is evident by the difference between the Peach and the Banana. The Peach received the lowest mean naturalness scores when unidentified and significantly higher scores when identified. The identity of the Banana on the other hand was never hidden from consumers. Since the consumer rescored the naturalness of the Peach without the ingredient statement attached, it was perceived as significantly more natural than the Banana, which was paired with its statement when consumers were asked to rate naturalness. The presence of unfamiliar, chemical sounding ingredients/subcomponents and ingredients/subcomponents with E-numbers

was more influential to consumers than the product identity as a whole and caused naturalness ratings to drop.

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ibJSgrEi-  
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## Appendix A - Natural Color Survey

### Screener

Q1. Which of the following best describes your gender?

- Male
- Female

Page Break 

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Q2. Which of the following best describes your age?

- Under 18 years
- 18 – 23
- 24 – 41
- 42 – 52
- 53 – 73
- 74 or older

Page Break 

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Q3. Please estimate the percentage of the household grocery shopping that you personally do.

- 0 – 20%
- 21 – 40%
- 41 – 60%
- 61 – 80%
- More than 80%

Page Break 

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### Survey

Q1. Please read the ingredient label and answer the following questions.

**Ingredients:** Corn, Vegetable Oil (Sunflower, Canola, and/or Corn Oil), Maltodextrin (Made from Corn), Salt, Cheddar Cheese (Milk, Cheese Cultures, Salt, Enzymes), Whey, Monosodium Glutamate, Buttermilk, Romano Cheese (Part-Skim Cow's Milk, Cheese Cultures, Salt, Enzymes), Whey Protein Concentrate, Onion Powder, Corn Flour, Natural and Artificial Flavor, Dextrose, Tomato Powder, Lactose, Spices, Artificial Color (Including Yellow 6, Yellow 5, and Red 40), Lactic Acid, Citric Acid, Sugar, Garlic Powder, Skim Milk, Red and Green Bell Pepper Powder, Disodium Inosinate, and Disodium Guanylate.

Based on the ingredient list above, how likely are you to purchase this food?

- Extremely unlikely
- Moderately unlikely

- Unlikely
- Slightly unlikely
- Neither likely nor unlikely
- Slightly likely
- Likely
- Moderately likely
- Extremely likely

Based on the ingredient list above, how natural do you think this food is?

- Not at all natural – 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- Extremely Natural – 9

Chose all of the following statements that you think apply to this ingredient list (Check all that apply)

- Too long
- Has artificial colors
- Too short
- Has chemical names
- I have a diagnosed allergy to one or more of the ingredients
- Has natural colors
- Food sounds gross
- Food sounds tasty
- Contains unnatural ingredients
- Ingredients come from nature
- Ingredients made in a lab
- Has unhealthy ingredients
- Ingredients cause cancer
- Has healthy ingredients
- Not appropriate for kids
- Don't recognize ingredients
- Extra color added
- Extra flavor added
- Ingredients cause Attention Deficit Disorder (ADD)/Attention Deficit Hyper Disorder (ADHD)

- I believe I am sensitive to one or more of these ingredients

Which of the following ingredients do you think are sources of **color** in this food? (Check all that apply)

- Corn
- Vegetable Oil (Sunflower, Canola, and/or Corn Oil)
- Maltodextrin (Made from Corn)
- Salt
- Cheddar Cheese (Milk, Cheese Cultures, Salt, Enzymes)
- Whey
- Monosodium Glutamate
- Buttermilk
- Romano Cheese (Part-Skim Cow's Milk, Cheese Cultures, Salt, Enzymes)
- Whey Protein Concentrate
- Onion Powder
- Corn Flour
- Natural and Artificial Flavor
- Dextrose
- Tomato Powder
- Lactose
- Spices
- Artificial Color (Including Yellow 6, Yellow 5, and Red 40)
- Lactic Acid
- Citric Acid
- Sugar
- Garlic Powder
- Skim Milk
- Red and Green Bell Pepper Powder
- Disodium Inosinate
- Disodium Guanylate

Page Break

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Q2. Please read the ingredient label and answer the following questions.

**Ingredients:** Enriched Bleached Flour (Wheat Flour, Barley Malt, Niacin, Reduced Iron, Thiamin mononitrate [Vitamin B1], Riboflavin [Vitamin B2], Folic Acid), Water, Sugar, Palm Oil, Dextrose, Palm and Soybean Oils with TBHQ and Citric Acid to protect flavor, Yeast. Contains 2% or less of each of the following: Soy Flour, Nonfat Dry Milk, Dried Honey, Eggs, Cinnamon, Cocoa, Wheat Starch, Leavening (Baking Soda, Sodium Acid Pyrophosphate), Corn Starch, Mono- and Diglycerides, Soybean Oil, Salt, Calcium Stearoyl Lactylate, Calcium Carbonate, Agar, Calcium Sulfate, Calcium Propionate and Potassium Sorbate (to preserve

freshness), Ascorbic Acid, Calcium Peroxide, Amylase Enzymes, Datem, Soy Lecithin, Natural Colors (Annatto Extract, Titanium Dioxide, Turmeric).

Based on the ingredient list above, how likely are you to purchase this food?

- Extremely unlikely
- Moderately unlikely
- Unlikely
- Slightly unlikely
- Neither likely nor unlikely
- Slightly likely
- Likely
- Moderately likely
- Extremely likely

Based on the ingredient list above, how natural do you think this food is?

- Not at all natural – 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- Extremely Natural – 9

Chose all of the following statements that you think apply to this ingredient list (Check all that apply)

- Too long
- Has artificial colors
- Too short
- Has chemical names
- I have a diagnosed allergy to one or more of the ingredients
- Has natural colors
- Food sounds gross
- Food sounds tasty
- Contains unnatural ingredients
- Ingredients come from nature
- Ingredients made in a lab
- Has unhealthy ingredients
- Ingredients cause cancer



- Has healthy ingredients
- Not appropriate for kids
- Don't recognize ingredients
- Extra color added
- Extra flavor added
- Ingredients cause Attention Deficit Disorder (ADD)/Attention Deficit Hyper Disorder (ADHD)
- I believe I am sensitive to one or more of these ingredients

Which of the following ingredients do you think are sources of **color** in this food? (Check all that apply)

- Enriched Bleached Flour (Wheat Flour, Barley Malt, Niacin, Reduced Iron, Thiamin mononitrate [Vitamin B1], Riboflavin [Vitamin B2], Folic Acid) (1)
- Water
- Sugar
- Palm Oil
- Dextrose
- Palm and Soybean Oils with TBHQ and Citric Acid
- Yeast
- Soy Flour
- Nonfat Dry Milk
- Dried Honey
- Eggs
- Cinnamon
- Cocoa
- Wheat Starch
- Leavening (Baking Soda, Sodium Acid Pyrophosphate)
- Corn Starch
- Mono- and Diglycerides
- Soybean Oil
- Salt
- Calcium Stearoyl Lactylate
- Calcium Carbonate
- Agar
- Calcium Sulfate
- Calcium Propionate and Potassium Sorbate
- Ascorbic Acid
- Calcium Peroxide
- Amylase Enzymes
- Datem
- Soy Lecithin
- Natural Colors (Annatto Extract, Titanium Dioxide, Turmeric)

Q3. Please read the ingredient label and answer the following questions,

**Ingredients:** Milk Chocolate (Sugar, Chocolate, Skim Milk, Cocoa Butter, Lactose, Milkfat, Soy Lecithin, Salt), Sugar, Cornstarch, Less than 1% - Corn Syrup, Dextrin, Coloring (Includes Blue 1 Lake, Yellow 6, Red 40 Lake, Blue 2 Lake, Yellow 6 Lake, Yellow 5 Lake, Blue 2), Gum Acacia.

Based on the ingredient list above, how likely are you to purchase this food?

- Extremely unlikely
- Moderately unlikely
- Unlikely
- Slightly unlikely
- Neither likely nor unlikely
- Slightly likely
- Likely
- Moderately likely
- Extremely likely

Based on the ingredient list above, how natural do you think this food is?

- Not at all natural – 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- Extremely Natural – 9

Chose all of the following statements that you think apply to this ingredient list (Check all that apply)

- Too long
- Has artificial colors
- Too short
- Has chemical names
- I have a diagnosed allergy to one or more of the ingredients
- Has natural colors
- Food sounds gross

- Food sounds tasty
- Contains unnatural ingredients
- Ingredients come from nature
- Ingredients made in a lab
- Has unhealthy ingredients
- Ingredients cause cancer
- Has healthy ingredients
- Not appropriate for kids
- Don't recognize ingredients
- Extra color added
- Extra flavor added
- Ingredients cause Attention Deficit Disorder (ADD)/Attention Deficit Hyper Disorder (ADHD)
- I believe I am sensitive to one or more of these ingredients

Which of the following ingredients do you think are sources of **color** in this food? (Check all that apply)

- Milk Chocolate (Sugar, Chocolate, Skim Milk, Cocoa Butter, Lactose, Milkfat, Soy Lecithin, Salt)
- Sugar
- Cornstarch
- Corn Syrup
- Dextrin
- Coloring (Includes Blue 1 Lake, Yellow 6, Red 40 Lake, Blue 2 Lake, Yellow 6 Lake, Yellow 5 Lake, Blue 2)
- Gum Acacia

Page Break

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Q4. Please read the ingredient label and answer the following questions.

**Ingredients:** Tapioca Syrup, Cane Sugar, Tapioca Syrup Solids, Pear Juice Concentrate, Water, Pectin, Citric Acid, Carrot Juice Concentrate, Sweet Potato Juice Concentrate, Sodium Citrate, Ascorbic Acid (Vitamin C), Sunflower Oil, Color (black carrot, blackcurrant, annatto extracts), Lemon Juice Concentrate, Carnauba Wax.

Based on the ingredient list above, how likely are you to purchase this food?

- Extremely unlikely
- Moderately unlikely
- Unlikely
- Slightly unlikely
- Neither likely nor unlikely

- Slightly likely
- Likely
- Moderately likely
- Extremely likely

Based on the ingredient list above, how natural do you think this food is?

- Not at all natural – 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- Extremely Natural – 9

Chose all of the following statements that you think apply to this ingredient list (Check all that apply)

- Too long
- Has artificial colors
- Too short
- Has chemical names
- I have a diagnosed allergy to one or more of the ingredients
- Has natural colors
- Food sounds gross
- Food sounds tasty
- Contains unnatural ingredients
- Ingredients come from nature
- Ingredients made in a lab
- Has unhealthy ingredients
- Ingredients cause cancer
- Has healthy ingredients
- Not appropriate for kids
- Don't recognize ingredients
- Extra color added
- Extra flavor added
- Ingredients cause Attention Deficit Disorder (ADD)/Attention Deficit Hyper Disorder (ADHD)
- I believe I am sensitive to one or more of these ingredients

Which of the following ingredients do you think are sources of **color** in this food? (Check all that apply)

- Tapioca Syrup
- Cane Sugar
- Tapioca Syrup Solids
- Pear Juice Concentrate
- Water
- Pectin
- Citric Acid
- Carrot Juice Concentrate
- Sweet Potato Juice Concentrate
- Sodium Citrate
- Ascorbic Acid (Vitamin C)
- Sunflower Oil
- Color (black carrot, blackcurrant, annatto extracts)
- Lemon Juice Concentrate
- Carnauba Wax

Page Break

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Q5. Please read the ingredient label and answer the following questions.

**Ingredients:** Wheat Flour, Sugar, Egg, Red 40, Baking Powder.

Based on the ingredient list above, how likely are you to purchase this food?

- Extremely unlikely
- Moderately unlikely
- Unlikely
- Slightly unlikely
- Neither likely nor unlikely
- Slightly likely
- Likely
- Moderately likely
- Extremely likely

Based on the ingredient list above, how natural do you think this food is?

- Not at all natural – 1
- 2
- 3
- 4
- 5
- 6
- 7

- 8
- Extremely Natural – 9

Chose all of the following statements that you think apply to this ingredient list (Check all that apply)

- Too long
- Has artificial colors
- Too short
- Has chemical names
- I have a diagnosed allergy to one or more of the ingredients
- Has natural colors
- Food sounds gross
- Food sounds tasty
- Contains unnatural ingredients
- Ingredients come from nature
- Ingredients made in a lab
- Has unhealthy ingredients
- Ingredients cause cancer
- Has healthy ingredients
- Not appropriate for kids
- Don't recognize ingredients
- Extra color added
- Extra flavor added
- Ingredients cause Attention Deficit Disorder (ADD)/Attention Deficit Hyper Disorder (ADHD)
- I believe I am sensitive to one or more of these ingredients

Which of the following ingredients do you think are sources of **color** in this food? (Check all that apply)

- Wheat Flour
- Sugar
- Egg
- Red 40
- Baking Powder

Page Break

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Q6. Please read the ingredient label and answer the following questions.

**Ingredients:** Enriched Corn Flour, Canola Oil, Salt, Yellow 5.

Based on the ingredient list above, how likely are you to purchase this food?

- Extremely unlikely
- Moderately unlikely
- Unlikely
- Slightly unlikely
- Neither likely nor unlikely
- Slightly likely
- Likely
- Moderately likely
- Extremely likely

Based on the ingredient list above, how natural do you think this food is?

- Not at all natural – 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- Extremely Natural – 9

Chose all of the following statements that you think apply to this ingredient list (Check all that apply)

- Too long
- Has artificial colors
- Too short
- Has chemical names
- I have a diagnosed allergy to one or more of the ingredients
- Has natural colors
- Food sounds gross
- Food sounds tasty
- Contains unnatural ingredients
- Ingredients come from nature
- Ingredients made in a lab
- Has unhealthy ingredients
- Ingredients cause cancer
- Has healthy ingredients
- Not appropriate for kids
- Don't recognize ingredients
- Extra color added
- Extra flavor added

- Ingredients cause Attention Deficit Disorder (ADD)/Attention Deficit Hyper Disorder (ADHD)
- I believe I am sensitive to one or more of these ingredients

Which of the following ingredients do you think are sources of **color** in this food? (Check all that apply)

- Enriched Corn Flour
- Canola Oil
- Salt
- Yellow 5

Page Break

---

Q7. Please read the ingredient label and answer the following questions.

**Ingredients:** Distilled White Vinegar, Water, Mustard Seed, Natural Color, Salt.

Based on the ingredient list above, how likely are you to purchase this food?

- Extremely unlikely
- Moderately unlikely
- Unlikely
- Slightly unlikely
- Neither likely nor unlikely
- Slightly likely
- Likely
- Moderately likely
- Extremely likely

Based on the ingredient list above, how natural do you think this food is?

- Not at all natural – 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- Extremely Natural – 9

Chose all of the following statements that you think apply to this ingredient list (Check all that apply)



- Too long
- Has artificial colors
- Too short
- Has chemical names
- I have a diagnosed allergy to one or more of the ingredients
- Has natural colors
- Food sounds gross
- Food sounds tasty
- Contains unnatural ingredients
- Ingredients come from nature
- Ingredients made in a lab
- Has unhealthy ingredients
- Ingredients cause cancer
- Has healthy ingredients
- Not appropriate for kids
- Don't recognize ingredients
- Extra color added
- Extra flavor added
- Ingredients cause Attention Deficit Disorder (ADD)/Attention Deficit Hyper Disorder (ADHD)
- I believe I am sensitive to one or more of these ingredients

Which of the following ingredients do you think are sources of **color** in this food? (Check all that apply)

- Distilled White Vinegar
- Water
- Mustard Seed
- Natural Color
- Salt

Page Break

---

Q8. Please read the ingredient label and answer the following questions.

**Ingredients:** Water, Sugar, Citric Acid, Natural Color.

Based on the ingredient list above, how likely are you to purchase this food?

- Extremely unlikely
- Moderately unlikely
- Unlikely
- Slightly unlikely
- Neither likely nor unlikely
- Slightly likely

- Likely
- Moderately likely
- Extremely likely

Based on the ingredient list above, how natural do you think this food is?

- Not at all natural – 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- Extremely Natural – 9

Chose all of the following statements that you think apply to this ingredient list (Check all that apply)

- Too long
- Has artificial colors
- Too short
- Has chemical names
- I have a diagnosed allergy to one or more of the ingredients
- Has natural colors
- Food sounds gross
- Food sounds tasty
- Contains unnatural ingredients
- Ingredients come from nature
- Ingredients made in a lab
- Has unhealthy ingredients
- Ingredients cause cancer
- Has healthy ingredients
- Not appropriate for kids
- Don't recognize ingredients
- Extra color added
- Extra flavor added
- Ingredients cause Attention Deficit Disorder (ADD)/Attention Deficit Hyper Disorder (ADHD)
- I believe I am sensitive to one or more of these ingredients

Which of the following ingredients do you think are sources of **color** in this food? (Check all that apply)

- Water
- Sugar
- Citric Acid
- Natural Color

Page Break 

---

Q9. Choose all of the sources you believe **natural colors** for food can come from. (Check all that apply)

- Fruit Juice
- Fruit
- Insects
- Chemicals
- Algae
- Vegetables
- Meat
- Flowers
- Beans
- Extracts
- Vitamins
- Minerals
- Animal Skins or Bones
- Roots
- Food Dyes
- Grains
- Clay
- Sea Weed
- Beneficial Microorganisms
- Leaves
- Bark

Q10. Choose all of the sources you believe **natural flavors** for food can come from. (Check all that apply)

- Fruit Juice
- Fruit
- Insects
- Chemicals
- Algae
- Vegetables
- Meat

- Flowers
- Beans
- Extracts
- Vitamins
- Minerals
- Animal Skins or Bones
- Roots
- Food Dyes
- Grains
- Clay
- Sea Weed
- Beneficial Microorganisms
- Leaves
- Bark

Q11. Choose all of the foods that you have consumed in the past week. (Check all that apply)

- Apples
- Bread
- Live worms
- Hot dogs/Frankfurters
- Beef
- Cheese
- Ice Cream
- Chocolate
- Pickled chicken
- Potato chips/crisps
- Strawberry yogurt
- Eggs
- Vegetable Stew

Page Break

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Q12. Based on the following ingredient list, how natural do you think this food is?

**Ingredients:** Invert Sugar, Corn Syrup, Strawberry Puree Concentrate, Sugar, Glycerin, Modified Cornstarch, Sodium Alginate, Citric Acid, Monocalcium Phosphate, Dicalcium Phosphate, Methylcellulose, Malic Acid, Fruit and Vegetable Juice for Color (Radish, Apple and Blackcurrant concentrates), Natural Flavors.

- Not at all natural – 1
- 2
- 3
- 4
- 5

- 6
- 7
- 8
- Extremely Natural – 9

Page Break

---

Q13. Based on the following ingredient list, how natural do you think this food is?

**Ingredients:** Enriched Corn Meal (Corn Meal, Ferrous Sulfate, Niacin, Thiamin Mononitrate, Riboflavin, and Folic Acid), Vegetable Oil (Corn, Canola, and/or Sunflower Oil), Seasoning (Maltodextrin (Made from Corn), Salt, Sugar, Monosodium Glutamate, Yeast Extract, Citric Acid, Artificial Color (Red 40 Lake, Yellow 6 Lake, Yellow 6, Yellow 5), Sunflower Oil, Cheddar Cheese (Milk, Cheese Cultures, Salt, Enzymes), Onion Powder, Whey, Whey Protein Concentrate, Garlic Powder, Natural Flavors, Buttermilk, Sodium Diacetate, Disodium Inosinate, Disodium Guanylate), and Salt.

- Not at all natural – 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- Extremely Natural – 9

Page Break

---

Q14. Based on the following ingredient list, how natural do you think this food is?

**Ingredients:** Corn Syrup, Sugar, Gelatin, Modified Food Starch (Corn), Fumaric Acid, Lactic Acid, Citric Acid, Sodium Citrate, Calcium Lactate, Sodium Lactate, Artificial Flavors, Yellow 5, Red 40, Yellow 6, Blue 1.

- Not at all natural – 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- Extremely Natural – 9

Page Break

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Q15. Based on the following ingredient list, how natural do you think this food is?

**Ingredients:** Cultured Grade A Non Fat Milk, Water, Modified Food Starch, Cane Sugar, Blueberries, Contains Less Than 1% of Kosher Gelatin, Fruit Juice and Vegetable Juice (For Color), Artificial Flavors, Sucralose, Malic Acid, Acesulfame Potassium, Vitamin A Palmitate, Vitamin D3, Sodium Citrate, Active Cultures L. Bulgaricus & S. Thermophilus.

- Not at all natural – 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- Extremely Natural – 9

Page Break

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Q16. This is an ingredient statement for Strawberry Puree. Based on the following ingredient list, how natural do you think this food is?

**Ingredients:** Invert Sugar, Corn Syrup, Strawberry Puree Concentrate, Sugar, Glycerin, Modified Cornstarch, Sodium Alginate, Citric Acid, Monocalcium Phosphate, Dicalcium Phosphate, Methylcellulose, Malic Acid, Fruit and Vegetable Juice for Color (Radish, Apple and Blackcurrant concentrates), Natural Flavors.

- Not at all natural – 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- Extremely Natural – 9

Page Break

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Q17. This is an ingredient statement for Flamin' Hot Cheetos. Based on the following ingredient list, how natural do you think this food is?

**Ingredients:** Enriched Corn Meal (Corn Meal, Ferrous Sulfate, Niacin, Thiamin Mononitrate, Riboflavin, and Folic Acid), Vegetable Oil (Corn, Canola, and/or Sunflower Oil), Seasoning (Maltodextrin (Made from Corn), Salt, Sugar, Monosodium Glutamate, Yeast Extract, Citric

Acid, Artificial Color (Red 40 Lake, Yellow 6 Lake, Yellow 6, Yellow 5), Sunflower Oil, Cheddar Cheese (Milk, Cheese Cultures, Salt, Enzymes), Onion Powder, Whey, Whey Protein Concentrate, Garlic Powder, Natural Flavors, Buttermilk, Sodium Diacetate, Disodium Inosinate, Disodium Guanylate), and Salt.

- Not at all natural – 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- Extremely Natural – 9

Page Break

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Q18. This is an ingredient statement for Gummy Candy. Based on the following ingredient list, how natural do you think this food is?

**Ingredients:** Corn Syrup, Sugar, Gelatin, Modified Food Starch (Corn), Fumaric Acid, Lactic Acid, Citric Acid, Sodium Citrate, Calcium Lactate, Sodium Lactate, Artificial Flavors, Yellow 5, Red 40, Yellow 6, Blue 1.

- Not at all natural – 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- Extremely Natural – 9

Page Break

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Q19. This is an ingredient statement for Blueberry Yogurt. Based on the following ingredient list, how natural do you think this food is?

**Ingredients:** Cultured Grade A Non Fat Milk, Water, Modified Food Starch, Cane Sugar, Blueberries, Contains Less Than 1% of Kosher Gelatin, Fruit Juice and Vegetable Juice (For Color), Artificial Flavors, Sucralose, Malic Acid, Acesulfame Potassium, Vitamin A Palmitate, Vitamin D3, Sodium Citrate, Active Cultures L. Bulgaricus & S. Thermophilus.

- Not at all natural – 1

- 2
- 3
- 4
- 5
- 6
- 7
- 8
- Extremely Natural – 9

Page Break

---

Q20. Based on the following ingredient list, how natural do you think this food is?

**Ingredients:** Water, Sugars (Sucrose, Glucose, Fructose, Maltose, Galactose), Fiber E460, Fatty Acids (Omega-6 Fatty Acid: Octadecadienoic Acid, Octadecenoic Acid, Hexadecanoic Acid, Octadecanoic Acid, Hexadecenoic Acid, Omega-3 Fatty Acid: Octadecatrienoic Acid), Amino Acids (Aspartic Acid, Glutamic Acid, Lysine, Serine, Alanine, Leucine, Glycine, Valine, Threonine, Arginine, Histidine, Proline, Cystine, Isoleucine, Tyrosine, Phenylalanine, Tryptophan, Methionine), Colors (Carotene E160a, Lutein E161b, Xanthophyll E161c), Ascorbic Acid (E300), Alpha-Tocopherol (E307), Flavors (Benzaldehyde, Linalool, Gamma- and Delta-Decalactone, Delta- and Gamma-Octalactone, 6-Pentyl-Alpha-Pyrone, Hexadecanoic Acid, (Z)-3-Hexen-1-yl Acetate, Ethyl Butanoate, (Z)-3-Hexanal, Hexanal, (E,E)-2,4-Decadienal, Benzaldehyde, Delta- and Gamma-Dodecalactone, Gamma-Jasmolactone, Terpinolene, 4-Decanolide, Beta-Damascenone, Carvomenthenal, Alpha-Terpineol, 3-Methyl-Butyl Acetate), Choline, Pantothenic Acid.

- Not at all natural – 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- Extremely Natural – 9

Page Break

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Q21. The ingredient statement on the previous page is an actual list for a fresh Peach. How natural do you think this food is now?

- Not at all natural – 1
- 2



- 3
- 4
- 5
- 6
- 7
- 8
- Extremely Natural – 9

Page Break

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Q22. Based on the following ingredient list, how natural do you think this food is?

**Ingredients:** Water, Sugars (Glucose, Fructose, Galactose, Maltose, Sucrose), Fiber E460, Ash, Fatty Acids (Octadecaenoic Acid, Omega-6 Fatty Acid: Octadecadienoic Acid, Omega-3 Fatty Acid: Octadecatrienoic Acid, Hexadecaenoic Acid, Octadecanoic Acid, Hexadecaenoic Acid, Tetradecanoic Acid), Amino Acids (Aspartic Acid, Glutamic Acid, Proline, Serene, Leucine, Alanine, Lysine, Phenylalanine, Glycine, Threonine, Valine, Arginine, Histidine, Isoleucine, Tyrosine, Methionine, Cysteine, Tryptophan), Colors (Carotene E160a, Lutein E161b, Xanthophyll E161c), Ascorbic Acid (E300), Alpha-Tocopherol (E307), Choline, Phytosterols, Flavors ((Z)-3-Hexenol, 2-Heptanone, Cinnamic Alcohol, Cinnamic Aldehyde, (E)-2,6-Nonanedial, (E)-2-Hexenal, Hexanal, Eugenol, Linalool, Benzaldehyde, Phenylacetaldehyde).

- Not at all natural – 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- Extremely Natural – 9

Page Break

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Q23. The ingredient statement on the previous page is an actual list for fresh Cherries. How natural do you think this food is now?

- Not at all natural – 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8

- Extremely Natural – 9

Page Break

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Q24. If a Banana was required to have an ingredient list, the following would be its actual ingredient statement. Based on the ingredient statement for a Banana, how natural do you think a Banana is?

**Ingredients:** Water, Sugars (Glucose, Fructose, Sucrose, Maltose), Starch, Fiber E460, Amino Acids (Glutamic Acid, Aspartic Acid, Histidine, Leucine, Lysine, Phenylalanine, Arginine, Valine, Alanine, Serine, Glycine, Threonine, Isoleucine, Proline, Tryptophan, Cystine, Tyrosine, Methionine), Fatty Acids (Palmitic Acid, Omega-6 Fatty Acid: Linoleic Acid, Omega-3 Fatty Acid, Linolenic Acid, Oleic Acid, Palmitoleic Acid, Stearic Acid, Lauric Acid, Myristic Acid, Capric Acid), Ash, Phytosterols, Potassium Sulfate (E515), Oxalic Acid, Ascorbic Acid (E300), Tocopherol (E306), Phylloquinone, Thiamin, Colors (Yellow-Orange E101 (Riboflavin), Yellow-Brown E160a), Flavors (3-Methylbut-1-yl Ethanoate, 2-Methylbutyl Ethanoate, 2-Methylpropan-1-ol, 3-Methylbutyl-1-ol, 2-Hydroxy-3-Methylethyl Butanoate, 3-Methylbutanal, Ethyl Hexanoate, Ethyl Butanoate, Pentyl Acetate), Ethanol (1510), Natural Ripening Agent (Ethene Gas).

- Not at all natural – 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- Extremely Natural – 9

Page Break

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Q25. If a Chicken Egg was required to have an ingredient list, the following would be its actual ingredient statement. Based on the ingredient statement for a Chicken Egg, how natural do you think a Chicken Egg is?

- Not at all natural – 1
- 2
- 3
- 4
- 5
- 6
- 7

- 8
- Extremely Natural – 9

Page Break

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## Demographic Questions

Q1. Which of the following best describes your gender?

- Male
- Female

Q2. Which of the following best describes your age?

- Under 18 years
- 18 – 23
- 24 – 41
- 42 – 52
- 53 – 73
- 74 or older

Q3. Which of the following best describes your race/ethnicity? (US)

- American Indian/Alaska Native
- Asian
- Black/African American
- Hispanic/Latino
- Native Hawaiian/Pacific Islander
- White/Caucasian
- Other (Please Specify)\_\_\_\_\_
- Prefer not to answer

Q3. Which of the following best describes your race/ethnicity? (UK)

- Asian
- Black/African/Caribbean
- Hispanic/Latino
- White/Caucasian
- Other (Please Specify)\_\_\_\_\_
- Prefer not to answer

Q3. Which of the following best describes your race/ethnicity? (AUS)

- Asian
- Black/African

- Hispanic/Latino
- Pacific Islander
- White/Caucasian
- Aboriginal/Torres Strait Islander
- Other (Please Specify)\_\_\_\_\_
- Prefer not to answer

Q4. Which of the following best describes your education level?

- High School or less
- Associate Degree/Some College/1-2 year Technical Degree
- College Degree/3-4 year Professional Degree
- Postgraduate College Degree
- Prefer not to answer

Q5. Which of the following best describes you total gross annual household income last year?

(US)

- Less than \$25,000
- \$25,000 - \$49,999
- \$50,000 - \$74,999
- \$75,000 - \$99,999
- \$100,000 - \$149,999
- More than \$150,000
- Prefer not to answer

Q5. Which of the following best describes you total gross annual household income last year?

(UK)

- Less than £20,000
- £20,000 - £39,999
- £40,000 - £59,999
- £60,000 - £79,999
- £80,000 - £99,999
- More than £100,000
- Prefer not to answer

Q5. Which of the following best describes you total gross annual household income last year?

(AUS)

- Less than \$52,000
- \$52,000 - \$103,999
- \$104,000 - \$155,999

- \$156,000 - \$207,999
- \$208,000 - \$259,999
- More than \$260,000
- Prefer not to answer

Q6. How many children do you have in your household?

- No Children
- 1 Child
- 2 Children
- 3 Children
- 4 or More Children

Page Break

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Q7. Please indicate how often you consume the following foods.

	Never	Once a month or less often	2-4 times a month	2-3 times a week	4 or more times a week
Toaster Pastries	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Hard Candy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cookies	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ice Cream	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Popsicles	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Flavored Gelatin (example Jell-O)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Chewing Gum	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Breath Mints	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Breakfast Cereal	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Flavored Crackers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Salad Dressing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fruit Yogurt	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fruit Juice	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Soft Drinks/Soda	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Energy Drinks	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sports Drinks	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q8. How often do you read ingredient statements when purchasing food products?

- Never
- Rarely
- Occasionally
- Most of the time
- Always

Q9. How often do you pay attention to the source of **food coloring** on ingredient labels when purchasing food products?

- Never
- Rarely
- Occasionally
- Most of the time
- Always

Q10. How often do you pay attention to the source of **food flavoring** on ingredient labels when purchasing food products?

- Never
- Rarely
- Occasionally
- Most of the time
- Always

Q11. When you read an ingredient label, how important is the source of **color**?

- Extremely important
- Very important
- Moderately important
- Slightly important
- Not at all important

Q12. When you read an ingredient label, how important is the source of **flavor**?

- Extremely important
- Very important
- Moderately important
- Slightly important
- Not at all important

Q13. How likely are you to *not* purchase a food if it contains **artificial colors**?

- Extremely unlikely
- Moderately unlikely
- Unlikely
- Slightly unlikely
- Neither likely nor unlikely
- Slightly likely
- Likely
- Moderately likely
- Extremely likely

Q14. How likely are you to *not* purchase a food if it contains **artificial flavors**?

- Extremely unlikely
- Moderately unlikely
- Unlikely
- Slightly unlikely
- Neither likely nor unlikely
- Slightly likely
- Likely
- Moderately likely
- Extremely likely

Page Break

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Please rate the extent to which you agree or disagree with the following statements

Q15. I am very particular about the healthiness of food.

- Strongly disagree
- Moderately disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Moderately Agree
- Strongly Agree

Q16. I always follow a healthy and balanced diet.

- Strongly disagree
- Moderately disagree

- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Moderately Agree
- Strongly Agree

Q17. It is important to me that my diet is low in fat.

- Strongly disagree
- Moderately disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Moderately Agree
- Strongly Agree

Q18. It is important to me that my diet contains a lot of vitamins and minerals.

- Strongly disagree
- Moderately disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Moderately Agree
- Strongly Agree

Q19. I eat what I like and I do not worry about the healthiness of food.

- Strongly disagree
- Moderately disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Moderately Agree
- Strongly Agree



Q20. I do not avoid any foods, even if they may raise my cholesterol.

- Strongly disagree
- Moderately disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Moderately Agree
- Strongly Agree

Q21. The healthiness of food has little impact on my food choices.

- Strongly disagree
- Moderately disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Moderately Agree
- Strongly Agree

Q22. The healthiness of snacks makes no difference to me.

- Strongly disagree
- Moderately disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Moderately Agree
- Strongly Agree

Q23. I do not care about additives in my daily diet.

- Strongly disagree
- Moderately disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree

- Agree
- Moderately Agree
- Strongly Agree

Q24. In my opinion, organically grown foods are not better for my health than those grown conventionally.

- Strongly disagree
- Moderately disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Moderately Agree
- Strongly Agree

Q25. In my opinion, artificially colored foods are not harmful for my health.

- Strongly disagree
- Moderately disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Moderately Agree
- Strongly Agree

Q26. In my opinion, artificially flavored foods are not harmful for my health.

- Strongly disagree
- Moderately disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Moderately Agree
- Strongly Agree

Q27. I try to eat foods that do not contain additives.

- Strongly disagree

- Moderately disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Moderately Agree
- Strongly Agree

Q28. I would like to eat only organically grown vegetables.

- Strongly disagree
- Moderately disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Moderately Agree
- Strongly Agree

Q29. I do not eat processed foods because I do not know what they contain.

- Strongly disagree
- Moderately disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Moderately Agree
- Strongly Agree

Q30. I look for only Non-GMO (Non-Genetically Modified Organism) ingredients on the food I eat.

- Strongly disagree
- Moderately disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree

- Moderately Agree
- Strongly Agree

Q31. I always look for natural ingredients in the snack foods that I eat.

- Strongly disagree
- Moderately disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Moderately Agree
- Strongly Agree

Q32. If I do not understand the name of an ingredient or if the name is unfamiliar, I do not buy the food product.

- Strongly disagree
- Moderately disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Moderately Agree
- Strongly Agree

Q33. I do not care about natural ingredients in the snack foods that I eat.

- Strongly disagree
- Moderately disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Moderately Agree
- Strongly Agree

Q34. I do not read ingredient statements and do not worry about natural ingredients.

- Strongly disagree
- Moderately disagree

- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Moderately Agree
- Strongly Agree

End of

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Survey