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## **French consumers know the benefits of pulses, but do not choose them: An exploratory study combining indirect and direct approaches**

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## 12 **Introduction**

13 Pulses have been cultivated for the past 11 000 years (Fortin, 2006), but have attracted far more  
14 attention over the last decade, because of their great potential to increase global food security and  
15 enhance environmental sustainability. According to the Food and Agriculture Organization (FAO),  
16 pulses are leguminous crops harvested exclusively for dry seed (i.e. dried beans, lentils, and peas), but  
17 excluding crops used mainly for oil extraction, e.g. soybeans, and those that are harvested green, e.g.  
18 green peas (FAO, 2016). Deep roots allow pulse plants to adapt to unfavorable conditions (Iriti &  
19 Varoni, 2017), so that they can be cultivated almost everywhere. Pulses are unique in the vegetable  
20 kingdom in that they fix nitrogen from the atmosphere, fertilizing the soil, and therefore increasing  
21 biodiversity (FAO, 2016; Schneider et al., 2015). In addition to these positive consequences for the  
22 environment, pulses present several advantages from a nutritional point of view. Many national and  
23 international authorities now highlight the benefits of regular human consumption of pulses. The  
24 United Nations declared 2016 to be the International Year of Pulses, under the slogan “nutritious seeds  
25 for a sustainable future” (FAO, 2016).

26

27 Besides being a major source of plant-based proteins, pulses are rich in dietary fibers, complex  
28 carbohydrates, minerals, and vitamins, an almost ideal basis for a healthy diet (Curran, 2012; Mudryj,  
29 Yu, & Aukema, 2014). Increasing pulse consumption to four times per week or more has been  
30 associated with a reduced risk of coronary heart disease (Bazzano et al., 2001). The high fiber content  
31 of pulses may have positive effects on short-term satiety (McCrary, Hamaker, Lovejoy, &  
32 Eichelsdoerfer, 2010), and weight loss. Pulse consumption can also present health benefits for specific  
33 populations. Frequent consumption of pulses, especially lentils, helps to prevent type 2 diabetes in  
34 older adults because of the low glycemic index (Becerra-Tomás et al., 2017). Folate, a vitamin present  
35 in pulses, reduces the risk of neural illness in newborn babies, while iron, a mineral also present in  
36 pulses, is known to prevent anemia in women, children, and babies (FAO, 2016).

37

38 Despite these benefits, pulse consumption in France has declined, from 7.2 kg in 1920 to 1.7 kg per  
39 person per year in 2016, although health authorities recommend eating pulses at least twice a week  
40 (ANSES, 2017a; HCSP, 2017). Some hypotheses to explain low consumption in France are related to  
41 consumer issues, e.g. poor knowledge of pulses, bad memories of pulses at the school canteen; the  
42 need to plan ahead for pre-soaking, or the lack of recipe ideas and motivation (Lecerf, 2016). Cultural  
43 prejudice against pulses, seen as “the poor man’s meal”, might also explain low consumption  
44 (Magrini, 2016; Rio, 2017). Packaging-related issues may lower consumer expectations: pulses are  
45 often sold in cans, generally perceived as poor quality food, in comparison with foods in the form of  
46 prepared dishes or raw products (Champ, Magrini, Simon, & Le Guillou, 2015). Finally, other reasons

47 could be related to the food product itself, such as the time required for soaking pulses, except for  
48 lentils (12 hours or overnight), and unwanted digestive effects, e.g. flatulence (Champ et al., 2015;  
49 Lecerf, 2016; Magrini, 2016; Rio, 2017). These hypotheses have not yet been experimentally tested,  
50 requiring new studies to validate them. No scientific study to date has directly investigated mental  
51 representation of pulses among consumers in France.

52 In a French study, declared consumption of pulses was significantly higher (0.3 times more) in men  
53 than in women (CREDOC, 2007). Different consumer profiles in relation to pulses have also been  
54 reported in countries other than France. In Finland, frequent consumption of beans was significant in  
55 young consumers (25-34 years old), and in consumers with a high level of education (Jallinoja, Niva,  
56 & Latvala, 2016). In Canada, pulse consumption was low among young Canadians (18-34 years old),  
57 and people living alone, but higher among consumers with a university education (IPSOS, 2010). Such  
58 studies, assessing consumption or willingness to consume specific products, are usually based on  
59 direct, declarative methods (web-based surveys, online interviews, or focus groups). One possible  
60 limitation of declarative methods is the potential dissociation between what participants think or say  
61 about their behavior and what they actually do (Köster, 2003).

62

63 Mental representations of food play an important role in consumer behavior and may affect inference,  
64 judgment, and food-product choice (Bartels & Johnson, 2015). Better knowledge of such mental  
65 representations may help to develop strategies to increase pulse consumption in France. A mental  
66 representation is an image that an individual has of a product, a person, an idea, or a situation.  
67 According to Gallen (2005), representations are defined as cognitive products and individual mental  
68 processes that come from the interaction of individuals with their environment, allowing them to code  
69 the meaning of the stimuli and store this information in memory. Consumers' mental representations  
70 can be investigated through direct (i) or indirect (ii) methods.

71 (i) Direct methods are typically questionnaires or surveys that ask people to describe their choices  
72 or the reasons for their choice, to gather information about their attitudes and behaviors. In direct  
73 methods, the questions focus on the main goal of the study, which generally results in consumers  
74 becoming aware of the research objective. Among potential biases linked to surveys and  
75 questionnaires (Mathers, Fox, & Hunn, 2009), the best known is social desirability bias, where  
76 participants seek to present a positive image of themselves to the researcher. Participants thus tend to  
77 “under-report socially undesirable attitudes and behaviors and to over-report more desirable attributes”  
78 (Latkin, Edwards, Davey-Rothwell, & Tobin, 2017). Answering a questionnaire is a complex  
79 cognitive task: it implies understanding the meaning of the questions, accessing information stored in  
80 memory, adapting this information to the situation, and then estimating the reliability of the chosen

81 answer in relation to all other possible answers (Krosnick, 1991). Participants may therefore select the  
82 first answer acceptable to them without going through the entire cognitive process.

83 (ii) In contrast, indirect questioning methods are thought to provide access to “unconsciously  
84 latent psychosocial constructs” (Antonak & Livneh, 1995). In cognitive psychology, indirect tests  
85 assess the retention of information without direct reference to the source of information (Nicolas,  
86 1994; Perruchet & Nicolas, 1998). This type of “questioning” reduces the risk of respondents  
87 becoming aware of the research objective, and thus reduces the potential bias that could be generated  
88 if the goal of the study is known. As a consequence, results obtained by indirect methods are thought  
89 to be more reliable. Rather than asking respondents directly about their behaviors and motivations,  
90 questions are formulated in terms of other people (i.e., your friend, your family, or your students) or  
91 imaginary situations (i.e., at school, at the supermarket, or in a restaurant) (Belk, 2006).

92

93 The aim of this study was to understand the representation of pulses among French non-vegetarian  
94 consumers, using both (i) an indirect approach, with a dish-composition task, based on the use of six  
95 scenarios evoking real-life situations, and (ii) a direct method, with an online questionnaire. The direct  
96 method was expected to provide access to explicit knowledge and beliefs about food-product  
97 characteristics, while the indirect method was thought likely to generate more spontaneous behaviors  
98 in relation to food choice. The representations obtained through each approach were hypothesized to  
99 be different, yet complementary. Combining these two approaches should therefore provide broader  
100 access to consumers’ mental representations of pulses. If potential barriers are identified, suitable  
101 strategies can then be developed to increase pulse consumption.

102

## 103 **Material and methods**

### 104 *2.1 Participants*

105 Participants had to be over 18 years old, with no specific or restrictive diet (e.g. vegetarian, or gluten-  
106 free), no food allergies, and no severe dislike of any foods. Another condition was that participants  
107 had to be in the habit of preparing meals several times a week, for themselves and/or their household,  
108 to avoid including people unused to composing dishes. To recruit participants, flyers were posted  
109 around the city in public places (university, gyms, libraries, and cultural centers). Those who replied  
110 were invited to attend an interview where researchers verified that all the above eligibility criteria were  
111 met, thus retaining 120 participants for the study. Table 1 gives an overview of the participants’ main  
112 characteristics. The median age was 35, and the mean age was 39, whether for men or for women. The  
113 conditions of the study were explained, and all participants signed informed consent forms before

114 beginning the study. To ensure participation throughout the study, participants would receive 20€ each  
115 for participation only if they had completed both tests.

116

117 *Please insert table 1 here*

118

119 All 120 participants performed two tasks. The dish-composition task, which evoked real-life situations  
120 by means of scenarios, required participants to compose suitable dishes, using images of food  
121 products. One week later, participants were required to complete an online questionnaire, based on the  
122 same set of images.

123

## 124 *2.2 Material*

### 125 *2.2.1. Construction of a set of images common to both tasks*

126 Food images were used for both the dish-composition task and the online survey, to provide identical  
127 stimuli throughout both tasks. A set of food images was therefore constructed, taking several criteria  
128 into consideration. First, all the food products belonged to the French food repertoire, and were chosen  
129 to represent the four main categories of food recommended by the *French national health and*  
130 *nutrition program* (PNNS) to compose a main dish. Food products were presented in the form of raw  
131 ingredients. The MFPE group included only foods of animal origin: meat, fish, poultry, and eggs. The  
132 Pulse group was composed of dried beans, lentils, and peas. The Starch group was composed of  
133 cereals and potatoes. The Vegetable group was composed of products commonly considered as  
134 vegetables by French consumers, whatever their botanic classification (broccoli, carrots, green beans,  
135 tomatoes, and zucchini).

136 All food products were purchased from supermarkets, and then photographed in exactly the same  
137 conditions. An equivalent volume of each raw product was presented in the center of a white porcelain  
138 plate, on a blue background. Blue, rarely a natural food color, was chosen as the background, to create  
139 good contrast with the white plate (Charbonnier, van Meer, van der Laan, Viergever, & Smeets, 2016).  
140 All photos were taken on the same day, in the same lighting conditions. During the entire photo shoot,  
141 the angle of shooting, the distance between the center of the plate and the camera lens, the position of  
142 the plate on the table, and the table itself were maintained constant.

143 After the photos had been standardized via Photoshop ® (luminosity, color intensity, etc.), all twenty  
144 images were printed (9cmx13cm) and plasticized. A pre-test was carried out on a small sample of  
145 participants (n=30) to ensure that each image was identifiable, that photo quality was good, and that  
146 the amount of food was perceived as similar for each image.

147

148           2.2.2. *Creation of scenarios for the dish-composition task*

149 The dish-composition task used scenarios to create equal and comparable conditions for all  
150 participants. Six scenarios evoking real-life conditions encompassed the diversity of situations in  
151 which people make food choices (Table 2). The Everyday scenario was conceived as the control for  
152 this study. The Budget scenario evoked the constraints of waiting for payday. The Guest scenario  
153 placed participants in a social context. The Vegetarian scenario necessarily included a guest with a  
154 vegetarian diet, because participant selection criteria excluded vegetarians. For the no-cooking, out-of-  
155 home context, both the more ordinary Self-service scenario, and the more prestigious Restaurant  
156 scenario take into account French consumer food habits: they bring food from home for lunch 34% of  
157 the time; they often have lunch at the canteen (24%), or at fast-food eateries, pubs, and restaurants  
158 (21%); they eat at a friend or family member’s house 18% of the time (ANSES, 2017a). Participants  
159 were given the written description for each scenario (Table 2), also presented orally, accompanied by  
160 the following instructions: “In this situation, compose a main dish using three images”.

161

162           *Please insert table 2 here*

163

164           2.2.3. *Construction of the online questionnaire*

165 The online questionnaire was used to obtain information about each food product individually. Ten  
166 question scripts were created to obtain ratings of different food properties by means of a 5-point  
167 ordered category scale (Table 3).

168

169           *Please insert table 3 here*

170

171           2.3. *Procedure*

172           2.3.1. *Indirect approach: Dish-composition task*

173 All sessions were individual, lasted about 45 minutes, and took place in the laboratory. Images were  
174 placed on a table in front of the participant, in the form of a randomized 5 x 4 rectangle (Figure 1), to  
175 avoid any effect of order or position. The experimenter asked the participant to identify each food in  
176 the images, before presenting the first scenario and asking the participant to compose a main dish,  
177 using only three images, although four food groups were represented. This parameter was used to  
178 obtain information about the relative importance of each food group for the participant.

179 After putting the cards back on the table, participants were asked to compose another dish for the same  
180 scenario, without using the same picture triplet. For each scenario, each participant composed five  
181 dishes. Once five dishes had been created, a new scenario was presented, with the same instructions.  
182 The order of the scenarios was randomized for each participant so as not to bias the results by an order  
183 effect.

184

185 *Please insert figure 1 here*

186

187 *2.3.2. Direct approach: questionnaire*

188 Seven to ten days after the dish-composition task, participants were asked to complete an online self-  
189 reported questionnaire. To maintain a constant level of attention throughout the task, participants only  
190 evaluated sixteen of the images used in the dish-composition task (Figure 1). To obtain this set of 16  
191 images, one product was excluded from each food group, on the basis of low consumption in France  
192 compared to other products in that food group (i.e. sausage, white beans, and gnocchi), while tomato  
193 was excluded from the Vegetable group as it may also be used for seasoning or sauce. Both the order  
194 of the food images and the order of the questions for each image were randomized.

195

196 *2.4. Analysis*

197 *2.4.1. Indirect approach: Dish-composition task*

198 The frequency with which each product was chosen by a participant for all of the scenarios was then  
199 converted into a rank. The product most frequently chosen by a participant obtained the highest rank.  
200 A Friedman test on the sum of ranks was used to determine if there were significant differences in  
201 product choice. A multiple pairwise comparison using the Nemenyi / Two-tailed test was then used to  
202 compare the frequency of choice of products in all scenarios.

203 The frequency of choice for pulses by each participant in each scenario was also converted into a rank  
204 as described above. A Friedman test was used to determine if the pulse chosen was different in relation  
205 to the scenario. A Nemenyi / Two-tailed test was performed to compare the choice of pulses across  
206 scenarios.

207 The two variables related to the intrinsic characteristics (age and sex) of the participants were used to  
208 construct a contingency table. A Correspondence Analysis (CA) with SPAD (version 5, Coheris,  
209 France) was used to visualize relationships between consumer profiles and product choices. The CA  
210 method is based on a test of independence between participant characteristics and product choice,  
211 according to a chi-square statistic.



212           2.4.2. *Direct approach: questionnaire*

213 For each item in the questionnaire, the answers given by each participant were ranked for each food.  
214 The product with the “lowest” score (left side of the scale) was given the lowest rank, while the  
215 product with the highest score (right side of the scale) obtained the highest rank. A Friedman test was  
216 performed on the sum of ranks and then a Nemenyi / Two-tailed test was used to compare the rank of  
217 each product for each question.

218           2.4.3. *Complementarity between the two methods*

219 Due to the difference in the nature of the data obtained by each method (frequencies for the dish-  
220 composition task, and ordinal data for the questionnaire), each dataset was converted into numerical  
221 format using the appropriate multivariate analysis. For the dish-composition task results, a  
222 Correspondence Analysis (CA) was carried out on the frequency of choice for each product in each  
223 scenario. The first three dimensions accounted for 96% of the total variance (respectively, 60, 28 and  
224 8% for axes 1 to 3). In contrast, a Multiple Correspondence Analysis (MCA) was carried out on the  
225 questionnaire results. The first three dimensions accounted for 73% of the total variance (respectively  
226 47, 16 and 10% for axes 1 to 3).

227 A Pearson Principal Component Analysis (PCA) was then performed, using the principal coordinates  
228 of the CA and the MCA as active variables. The first three dimensions were used as observations. The  
229 correlation matrix thus obtained made it possible to compare the results of the dish-composition task  
230 with those of the questionnaire (supplementary table).

231 The confidence interval was set at 95% for all the analyses. The XLSTAT for Windows (Addinsoft,  
232 version 2018-1) was used for both univariate and multivariate analyses.

233

234 **Results**

235 *3.1. Dish-composition task*

236           3.1.1. *Reliability of the indirect method*

237 Before going into detail about food-product choice, we looked at the choices made by participants  
238 during their very first dish-composition (by scenario), and after each of the five repetitions of the dish-  
239 composition task. The frequency of choice for each food group in each scenario, taking into account  
240 all the dishes created, is shown in Table 4. These results give an overview of repeatability across the  
241 five dishes within the same scenario, but also of the variability of food-product selection between  
242 scenarios. The results in Table 4 show that participants’ choice of food groups was consistent for each  
243 of the successive repetitions of the dish-composition task.

244

245 *Please insert table 4 here*

246

### 247 *3.1.1. Global frequency of choice for each food image*

248 The frequency of choice for each food image is presented in Figure 2. The Friedman test showed  
249 significant differences across food products ( $p$ -value  $< 0.0001$ ). Overall, the Vegetable group were the  
250 most frequently chosen (38%). In this group, the most frequently chosen product was tomatoes,  
251 followed by carrots, zucchini, green beans, and broccoli. The MFPE group represented 27% of  
252 choices: chicken was the most frequently chosen product, followed by beef, salmon, egg, and sausage.  
253 Within the Starch group (25% of choices), rice was the most frequently chosen product, followed by  
254 potato, tagliatelli, semolina, and gnocchi. The Pulse group, at only 10%, was chosen significantly less  
255 frequently for main-dish composition. Within the Pulse group, lentils were the most frequently chosen  
256 product, followed by red beans, red lentils, chickpeas, and white beans.

257

258 *Please insert figure 2 here*

259

### 260 *3.1.2. Frequency of choices for pulses, in each scenario*

261 As food products from the Pulse group were generally those least often chosen in the dish-composition  
262 task, it was important to see if the choice of pulses was the same in each scenario. Figure 3 shows that  
263 participants chose Pulse-group products differently for each scenario ( $p$ -value  $< 0.0001$ ). Compared to  
264 the Everyday scenario (11%), considered as control, Pulse-group product frequency of choice was  
265 significantly higher in the Self-service (16%), Restaurant (23%), and Vegetarian (24%) scenarios. In  
266 the Vegetarian scenario, the range of possible choices was lower than in the other scenarios, with  
267 participants using only two of the five images from the MFPE group. In order to take this difference  
268 into account, the frequency of choice for each product was calculated on the basis of 17 possible  
269 choices, excluding those never used in the Vegetarian scenario (Table 4). Even after taking this  
270 correction into consideration, the choice of Pulse-group products was still more frequent in the  
271 Vegetarian scenario than in the Everyday scenario.

272

273 *Please insert figure 3 here*

274

### 275 *3.1.3. Influence of participant characteristics on food-choice frequency for pulses*

276 A Correspondence Analysis (CA) was used to study the associations between participant  
277 characteristics and food-product choices. *Khi<sup>2</sup> test was significant (p-value<0.0001)*. Participants were  
278 separated into four groups, based on age and sex. The CA represented in Figure 4 shows how food-  
279 product choices vary between participants with different characteristics (age and sex). The distance  
280 between the points representing food products approximates the chi-square distance between food-  
281 product frequency of choice. *Axis 1 represents 58% and axis 2 represents 27% of the total variance.*  
282 Axis 1 distinguishes participants by age and axis 2 by sex; participants under 40 years of age used the  
283 images of red beans, chickpeas, and red lentils more often than older participants. In contrast,  
284 participants over 40 chose eggs and gnocchi more frequently than younger participants. Men favored  
285 MFPE products, especially red meat. Men over 40 chose sausage more often, while women over 40  
286 tended to choose white beans and broccoli more often.

287

288 *Please insert figure 4 here*

289

290 *3.2 Direct approach: online questionnaire*

291 *3.2.1. Scores given to the different food images*

292 Table 5 shows a synthesis of the mean score for the sixteen food products, according to the ten  
293 evaluation criteria (question scripts). For each column, the highest score indicates the food most  
294 representative of that criterion: e.g. the fanciest, the most representative of men's food habits, the  
295 healthiest, the most well-liked, and the most frequently eaten. *The results from the Friedman tests*  
296 *showed that there were significant differences across the products for all questions.* Compared to other  
297 food groups, pulses were rated by participants as the food group most difficult to prepare, best adapted  
298 (along with the Vegetable group) for a vegetarian diet, and with the exception of lentils, the least  
299 frequently eaten and the least well liked.

300 If we look closer, participant ratings put pulses in second place, behind vegetables, as products that are  
301 relatively good for health and the environment, and behind MFPE products, but still quite rich in  
302 proteins. All pulses, except red lentils, were identified as being in the medium price range, neither  
303 ordinary nor fancy, and corresponding to a neutral food habit, rather than particularly feminine or  
304 masculine. Ratings for red lentils placed them just behind salmon, as the second most fancy product.

305

306 *Please insert table 5 here*

307

308 The MCA (Figure 5) reveals the modalities associated with each food product for each question. Axis  
309 1 represents 47% of the total variance, with axis 2 representing 16%. Question scripts and response  
310 modalities are both clearly represented and well distributed. Axis 1 is characterized by food considered  
311 by participants as very expensive, and “very bad” for the health and for the environment. The products  
312 associated with these characteristics are from the MFPE group, which are opposed on this axis to plant  
313 products from the other three groups (Pulse, Vegetable, and Starch). The positive part of Axis 2 is  
314 characterized by food considered difficult to prepare, “not liked at all”, and “never consumed” by  
315 participants. All the pulses (except lentils, in a central position) are associated with these negative  
316 characteristics. Foods consumed “at least once a day”, but also considered very bad for the health are  
317 found on the negative part of axis 2. The products corresponding to these characteristics are mostly  
318 from the Starch group.

319

320 *Please insert figure 5 here*

321

### 322 3.3. Complementarity of the two approaches

323 The correlation matrix (Supplementary table) allows us to visualize the links between the results  
324 obtained by each of the two methods. *Correlations coefficients greater than 0.997 are significant at  $\alpha=$*   
325 *5%, and correlations coefficients greater than 0.988 are significant at  $\alpha= 10%$ .* Food choices in the  
326 Everyday scenario were significantly correlated with the consumption frequency declared in the online  
327 questionnaire for each food product. They were also correlated with “not adapted to a vegetarian diet”,  
328 “rich in proteins”, “not good” for either health or the environment, and corresponding to “very  
329 masculine food habits”. Products chosen in the Restaurant scenario were highly correlated with the  
330 “very expensive” and “difficult to prepare” modalities. Products chosen in the Guest scenario were  
331 significantly correlated with the “very expensive”, “corresponding to very masculine habits”, “not  
332 adapted for a vegetarian diet” and “not good for the environment” modalities. The products chosen in  
333 the Budget scenario were correlated with the characteristics “good for health [and] the environment”,  
334 and “poor in proteins”. They tended to be considered “very cheap”.

335 Food choices in the Vegetarian scenario were significantly not “very fancy”. In this scenario,  
336 consumers tended not to choose products that they considered “not adapted for a vegetarian diet”  
337 (coefficient correlation: -0.927), but there was, surprisingly, no significant correlation between the  
338 products chosen in the Vegetarian scenario and those considered to be “adapted for a vegetarian diet”  
339 (coefficient correlation: 0.668). Products chosen in the Vegetarian scenario also tended to be  
340 considered as not “rich in proteins”, not “very expensive” and not corresponding to “very masculine

341 food habits". In the Everyday scenario, consumed products were also declared as not adapted to a  
342 vegetarian diet in the questionnaire with a significant correlation coefficient of 0.998.

343

344

## 345 **Discussion**

346

347 One of the main objectives was to understand mental representations of pulses among French non-  
348 vegetarian consumers, and to identify potential barriers to pulse consumption. We therefore combined  
349 an indirect and a direct method, to determine the specific properties attached to pulses in the minds of  
350 consumers. We tried to understand how these properties could influence the consumption of pulses,  
351 and to propose levers to increase pulse consumption. Three main results will be discussed: the interest  
352 of combining these two methods, how mental representations of pulses can explain low pulse  
353 consumption, and why knowledge about pulses does not necessarily result in higher consumption. We  
354 then propose strategies to increase pulse consumption in France.

355

### 356 *4.1. Interest of combining the two methods*

357 To our knowledge, our study was the first to combine an innovative indirect approach with a more  
358 classical direct approach, in order to understand mental representations of pulses among French  
359 consumers. When it was possible, the same factors were studied by the two methods (consumption,  
360 difficulty to cook, product adapted for a vegetarian diet, perception of price). Depending on the  
361 parameter studied, the use of the two methods gave complementary or convergent information about  
362 consumers' mental representations of pulses.

363 The two methods obtained similar results, with a high correlation coefficient between the results of the  
364 dish-composition task in the Everyday scenario and the declared consumption frequency in the  
365 questionnaire. This means that, in the dish-composition task, participants did not make random  
366 choices, and that their choices genuinely reflected their declared consumption habits. This is an  
367 argument in favor of the reliability of the dish-composition task, and of the use of the Everyday  
368 scenario as the control in our study.

369 In the Restaurant scenario, which was meant to evoke a no-cooking, prestigious context, participants  
370 tended to choose products that they considered difficult to prepare, and to exclude those they  
371 considered easy to prepare. This result was not found in other scenarios, indicating that this scenario is  
372 suitable for the study of participants' mental representations of products they consider difficult to  
373 prepare.

374 These correspondences between the results of the two methods are a good indicator of the reliability of  
375 the dish-composition task with evoked scenarios (indirect method). This method was also shown to be  
376 repeatable within a given scenario, while producing different results for different scenarios. This  
377 exploratory study therefore provides a preliminary validation of the dish-composition task, which  
378 produced results comparable to those obtained with the questionnaire (direct method). Further studies  
379 will be necessary to confirm the reliability of the indirect method. In particular, reproducibility must  
380 still be confirmed, by studying several subsets of consumers from within a given population. This task  
381 may also be tested with different food products and new scenarios.

382 For other results, we did not find the expected correlations between the two methods. For example, the  
383 dish-composition task in the Budget scenario, meant to be an indicator of the price of products, was  
384 not significantly correlated with the declared price obtained through the questionnaire. Many studies  
385 have questioned whether consumers are reliable when asked about food price and its importance in  
386 choice. Price is often reminiscent of a purchase situation, which is usually complex. Consumers may  
387 take other factors into account when referring to the price of products. In particular, consumer attitudes  
388 toward price may be influenced by whether the price is judged acceptable or not, taking into account  
389 all available information about the product (Grunert, 2006). In our study, the products considered to be  
390 expensive were chosen in many scenarios, including the control scenario. Information about price  
391 seems to be accessible only for products considered to be cheap. Such products were chosen more  
392 often in the Budget scenario than in the control, and less often in the Restaurant scenario. Although  
393 products considered unsuitable for a vegetarian diet tended to be chosen less frequently in the  
394 Vegetarian scenario, somewhat surprisingly this scenario was not significantly correlated with  
395 products considered suitable for vegetarians. As the participants were not themselves vegetarian, we  
396 had to include another person in the scenario to create the need to choose food adapted for a vegetarian  
397 diet. Our explanation is the following: participants had some knowledge of vegetarian food products,  
398 but did not consider them to be fancy (significant correlation coefficient: 0.998), and thus perceived  
399 them to be unsuitable for an invited guest. Social norms tend to consider healthy foods less acceptable  
400 in social situations (Zorbas et al., 2018). Participants also used significantly more often in the Guest  
401 scenario products judged unsuitable for a vegetarian diet.

402

403 The absence of a clear relationship between the results of the two methods for these two examples can  
404 be seen as an advantage of the indirect method when accessing representations that are difficult to  
405 obtain accurately with direct questioning. The questionnaire provided access to consumer knowledge  
406 and beliefs about food, while the dish-composition task provided access to food habits and attitudes  
407 towards food. Questionnaire responses are more likely than the dish-composition task to suffer from  
408 social desirability bias. For the dish-composition task, participants were not asked to give structured

409 answers; instead, they were asked to make choices visualizing themselves in different scenarios.  
410 Consumers were not required to focus their attention on a specific food item, allowing them to answer  
411 spontaneously, without speculating on the specific aim of the study. In the Everyday scenario,  
412 participants significantly chose products that are not good for health or for the environment,  
413 suggesting that social desirability was not a major concern. In contrast, when answering the  
414 questionnaire, participants were asked to focus their attention on specific products. By doing so, they  
415 may have been tempted to imagine what might be a “suitable” answer, or what answer was expected  
416 by the experimenters, and therefore to answer accordingly.

417

#### 418 *4.2. A low global consumption of pulses, evidenced by both methods*

419 The choices observed when people are immersed in an evoked situation are thought to reflect the  
420 actual choices they would make in the corresponding real-life situation. The overall use of pulses  
421 during the dish-composition task was low, amounting to only 10% of all choices. Pulse images were  
422 by far the least chosen: these four images were among the six least used by participants. Thus, the  
423 dish-composition task indirectly revealed a low level of pulse consumption among participants,  
424 confirmed by the low self-declared consumption frequency of pulses, obtained from the questionnaire.  
425 The low consumption revealed by both tasks is in accordance with recent food consumption records  
426 in France, which highlighted a very low consumption of pulses (ANSES, 2017b). This shows that,  
427 based on pulse consumption, our participant sample is representative of French consumers in general.  
428 Our study thus allowed us to go further than consumption data, by accessing consumers’ mental  
429 representations of pulses.

#### 430 *4.3. How representations of pulses can explain their low consumption*

431 The factor that is the most highly correlated with declared non-consumption of food in our study was  
432 dislike. Hence, one of the most obvious reasons that can explain the low consumption of pulses is that  
433 they are declared to be least liked, with the exception of lentils, the pulse best appreciated by  
434 participants. A Canadian survey (IPSOS, 2010) highlighted that, when asking non-consumers to  
435 choose the relative importance of a number of factors regarding why they did not eat pulses, not liking  
436 the taste or texture of pulses emerged by far as the most important factor. Interestingly, in the same  
437 survey, taste was also the most frequent reason given for eating pulses by the group of “light,  
438 moderate, and heavy consumers”. Several models are proposed in the literature listing the factors  
439 involved in food choices. Among these factors, taste is considered to be one of the main drivers of  
440 food choice and intake (Shepherd & Raats, 2006). In a study about the links between attitudes and  
441 beliefs toward various types of food, taste was shown to have the highest relationship with attitudes  
442 for most products (Shepherd & Towler, 1992). Yet the study also highlighted that perception of  
443 sensory attributes is not the only factor affecting food choices, despite its high impact on attitudes.

444 Another interpretation emerged from both methods used in our study. First, in the dish-composition  
445 task, participants chose pulses more often with the Restaurant and Self-service scenarios than with the  
446 Everyday scenario. The common point of these two scenarios suggests a situation in which  
447 participants do not have to prepare their meal themselves. This has to be put into perspective, using the  
448 responses to the questionnaire, which showed that participants considered pulses as the products most  
449 “difficult to cook”. From this result, we can state that the difficulty of cooking pulses is one of the  
450 main obstacles to their consumption, as hypothesized by other authors (Lecerf, 2016; Rio, 2017).  
451 Because of this perceived difficulty, participants seem to avoid eating pulses when they have to  
452 prepare them themselves. Our results indicate a negative correlation between difficulty of preparation  
453 and consumption frequency, which can be considered as an obstacle to consumption in general. This  
454 result is consistent with the IPSOS-REID survey, which indicates that, along with taste, not knowing  
455 how to prepare or cook pulses is the second most frequent reason for not eating them (IPSOS, 2010).  
456 In our study, “difficult preparation” should be interpreted cautiously, because consumers may mean  
457 “technically difficult” and/or “difficult to plan for, in the context of daily duties”. Preparing a pulse  
458 dish at home involves careful planning, to allow for the necessary soaking period, in addition to the  
459 time required for the cooking process. As lentils were the only pulses not considered “difficult to  
460 cook”, the time required for soaking and cooking is probably the main reason why consumers seek to  
461 avoid preparing other pulses. It is widely recognized that there is an increasing demand for  
462 convenience in meal preparation, which allows consumers to save time and avoid wasting a lot of  
463 physical and mental energy (Scholderer & Grunert, 2005). In this context, at-home pulse preparation  
464 may represent too much time and effort, and thus be incompatible with the time already taken up by  
465 work, social life, and leisure activities.

466 Along with taste, price and healthiness are often proposed as important determinants of food choice.  
467 The argument of price as a driver in food choice is well-known in the literature and concerns many  
468 products (Darmon & Drewnowski, 2015). In our study, the role of price as a lever of consumption is  
469 not clear. The products rated most expensive were declared to be consumed the most, and used the  
470 most in the dish-composition task in the Everyday scenario. But there was no correlation between  
471 declared price and the food chosen in the Budget scenario. It has been shown that perceived price  
472 does not involve the price of the product alone. Attitude towards price is influenced by the relationship  
473 between the objective price of the product and some reference price postulated by consumers (Grunert,  
474 2006; Ritson & Petrovici, 2001). This reference price is integrated with other product information  
475 when forming attitudes towards purchase (Grunert, 2006). The influence of price may be  
476 heterogeneous between food categories, because other characteristics specific to a food type may come  
477 first (e.g. safety for meat, and brand for chocolate, according to Ritson and Petrovici, 2001).

478 Our results also showed that pulses were more often used in the Vegetarian scenario than in the other  
479 scenarios. From a methodological point of view, the Vegetarian scenario was deliberately not defined,



480 so that participants could interpret this scenario according to their representations of what a vegetarian  
481 diet may be. Consumers tend to use a unique word (“vegetarian”) when referring to different types of  
482 diets excluding meat and poultry. These diets include the vegan diet (no animal products at all), the  
483 lacto-ovo-vegetarian diet (including dairy products and eggs), and the pesco-vegetarian diet (including  
484 fish, eggs, and dairy products) (Tonstad, Butler, Yan, & Fraser, 2009). In our study, participants  
485 placed in a vegetarian context could thus be expected to exclude beef, chicken, and sausage but might  
486 still select salmon and eggs from the MFPE group, depending on their definition of a vegetarian diet.  
487 Thus, in the Vegetarian scenario, participants could choose food products either among the four  
488 groups (selected egg and salmon from the MFPE group), or only among the three plant-based food  
489 groups, or among fewer groups, by choosing two or three products from the same food group. In this  
490 scenario, choice of products from the MFPE group was divided by four compared to the Everyday  
491 scenario. After correcting the results of the Vegetarian scenario to take into account the total number  
492 of products chosen in this scenario, the increase in Pulse choice appears to be the highest compared to  
493 other plant products. Pulse choice after correction was multiplied by 1.8 compared to the Everyday  
494 scenario, while Starch products were not more frequently chosen and Vegetable products were only  
495 multiplied by 1.1. This is consistent with Pulse and Vegetable group products being rated in the  
496 questionnaire as the foods best adapted for a vegetarian diet. The congruence between the results of  
497 the two methods for Pulse group products indicates that consumers considered pulses as products for  
498 vegetarians. This result is coherent with a study in Finland, which identified an association between  
499 beans and vegetarianism (Jallinoja et al., 2016). A similar result was also obtained from a Canadian  
500 survey (IPSOS, 2010). Pulses may be selected by vegetarian consumers who know the importance of  
501 their high protein, fiber, and micronutrient content. This frequent consumption by vegetarians seems to  
502 be known by non-vegetarians, who tend to associate pulses with a vegetarian diet. This mental  
503 representation of pulses as a “niche product” for vegetarians could represent a barrier to consumption  
504 by [non-vegetarian consumers, since frequently consumed products were declared as not adapted to a](#)  
505 [vegetarian diet in the questionnaire.](#)

506

#### 507 *4.4. Knowledge about pulses does not necessarily result in higher consumption*

508 Some studies have found that one of the main barriers for not adopting a plant-based diet is the lack of  
509 information (Lea, Crawford, & Worsley, 2006; Poquet, Chambaron-Ginhac, Issanchou, & Monnery-  
510 Patris, 2017). Adequate knowledge is therefore regarded as a necessary - though not sufficient -  
511 requirement for healthy sustainable food choices (Frick, 2018). In our study, questionnaire results  
512 highlighted that pulses were considered as more eco-friendly and healthy products than all the MFPE  
513 products, but less so than vegetables. In addition, pulses were evaluated as products with a relatively  
514 high protein content, just below all the foods of animal origin. This suggests that our participants have

515 relevant knowledge about pulses; they know about their protein content, and their benefits for health  
516 and the environment. Yet it seems that this knowledge was not used during the dish-composition task,  
517 or that it may have been accessed, but that taste preferences, habits, and other characteristics were  
518 considered to be more important.

519 The literature on nutrition knowledge and food choice is contradictory. Some researchers have shown  
520 that nutrition knowledge is positively correlated with making healthy food choices, while other  
521 researchers highlight a very weak relationship between nutrition knowledge and food choice. One  
522 study mentioned that much of the literature fails to clarify the influence of specific aspects of nutrition  
523 knowledge on relevant dietary outcomes (Spronk, Kullen, Burdon, & O'Connor, 2014). Merely having  
524 nutritional knowledge may not be sufficient to modify food choices. One example in France is the  
525 Programme National Nutrition Santé (PNNS), which explicitly formulates simple health  
526 recommendations for consumers “Pour votre santé, ne mangez pas trop gras, trop salé, trop sucré” (For  
527 your health, do not eat foods that are too fatty, too salty, or too sweet), yet consumer food choices are  
528 not always optimal (Chambaron, Chisin, Chabanet, Issanchou, & Brand, 2015).

529

#### 530 *4.5. Perspectives: how to include more pulses in French food habits*

531 As knowledge about the benefits of pulses seems to be insufficient to encourage their consumption,  
532 there is a need to find other levers, not based on communication about their protein content and their  
533 interest for health and the environment. Our study allowed us to identify such levers.

534 Out-of-home meals could provide an opportunity to increase daily consumption of pulses in France.  
535 We have shown in our study that the Restaurant and Self-service scenarios increase the frequency of  
536 pulses being chosen. These two scenarios reflect an authentic food habit among French consumers,  
537 with 44% of lunches consumed outside the home for adults aged 18 to 44, compared to only 28% for  
538 adults aged 45 to 64 (ANSES, 2017a). More recipes with pulses could be proposed in cafeterias and  
539 restaurants, giving consumers the opportunity to get to know or rediscover pulses. By encountering the  
540 taste of pulses more often, consumers could come to appreciate them more and more, become more  
541 familiar with them, and curious about preparing pulse-based dishes for themselves. It will be necessary  
542 to help people to acquire knowledge of how to cook pulses properly, by proposing new recipes with  
543 different levels of difficulty, stating the time needed, and taking into consideration the different types  
544 of consumers and the type of foods they like.

545 In our study, participants used pulses similarly in the Guest scenario and the Everyday scenario, which  
546 indicates that they do not exclude pulses from a situation of social interaction. This means that pulses  
547 do not necessarily have a bad reputation among participants. In all scenarios, younger participants  
548 chose red beans, chickpeas and red lentils more frequently, which suggests a “young” product image

549 for these particular pulses, probably linked to the fact that they are imported from other food cultures.  
550 Questionnaire results indicate that participants considered red lentils to be more fancy than other  
551 pulses, and fancier even than beef. All these results indicate that certain pulses can benefit from a  
552 positive image. One strategy to increase consumption could thus be to capitalize on this image in order  
553 to create innovative foods targeting specific consumers. For example, new products could be created  
554 in small formats, like snacks or ready-to-eat dishes, to encourage red bean and chickpea consumption,  
555 for young consumers. These products could be inspired by other cultures, with a variety of recipes  
556 containing pulses, from Mexico (red beans) or India (chickpeas). To increase the attractiveness of  
557 these new products, it is necessary to work not only on their organoleptic properties, but also to take  
558 into account their extrinsic properties to attract young consumers' interest. For example,  
559 communication should focus on national brands, local and seasonal products, and use the internet and  
560 social media, rather than broadcasting on television / radio (ANSES, 2017a).

561 One final strategy that can be proposed, based on the results of our study, is not to present pulses as a  
562 food for vegetarians only. It is necessary to overcome the perceived gap between non-vegetarians and  
563 vegetarians, and to encourage all consumers to increase pulse consumption. The main barrier to this  
564 shift is probably that non-vegetarians feel that they lack information on how to compose meals around  
565 pulses if they do not refer to a traditional recipe. In France, traditional recipes involving pulses usually  
566 contain meat (Rio, 2017). It would therefore be interesting to study how French people associate  
567 pulses with other food products. Do they use pulses as a substitute for starches, since French  
568 recommendations classified them in the same group for many years? Do they use pulses as a substitute  
569 for vegetables, due to their commonly perceived healthiness, as evidenced in our study? Do they use  
570 pulses as a substitute for meat, due to their acknowledged high protein content? Answering these  
571 questions would give us more information regarding the place that pulses have in French food habits,  
572 and thus help us to develop new strategies.

573

#### 574 *4.6. Strengths and limitations*

575 One of the strengths of our study was the use of two distinct, yet complementary methods to identify  
576 consumer representations that explained low pulse consumption. Some of the properties attributed to  
577 pulses by consumers were detected by both methods, suggesting that they are strong barriers to  
578 consumption. The price factor was tested by both approaches, but only the indirect approach revealed  
579 a link between this factor and low consumption. Such a result could reflect potential involvement of  
580 implicit attitudes, which have been shown to predict actual behaviors (Marty et al., 2017). More  
581 research will be necessary to confirm the importance of the barriers identified by the indirect method  
582 in our study. Other indirect approaches or implicit methods could be used to test the impact of these  
583 factors on pulse choice and consumption.

584 One of the main limitations to our study is that consumer behavior is not measured in real-life  
585 conditions. It is possible that food products chosen in an evoked context might not systematically be  
586 chosen in real life. Further studies will be necessary to ensure that scenarios provide a level of  
587 immersion sufficient for participants to react as they would in an authentic real-life situation. Another  
588 limitation relates to the questionnaire, which contained ten questions for each image. Only sixteen of  
589 the twenty food products were therefore presented online, so that participants could maintain an  
590 adequate level of attention throughout the task.

591

## 592 **Conclusion**

593 By combining an indirect method (a dish-composition task with an evoked situation) with a direct  
594 method (an online questionnaire), we identified several reasons to explain the low consumption of  
595 pulses in France. Our findings provide new evidence of potential barriers to pulse consumption, linked  
596 to taste, perceived difficulty of (lengthy) preparation, and the persistent image of pulses as a food  
597 clearly associated with a vegetarian diet.

598 Participants possessed theoretical knowledge about pulses: they were aware of their environmental and  
599 health benefits, as well as their high protein content. Yet this awareness did not lead them to modify  
600 their food behavior by increasing their consumption of pulses. Our results showed that participants  
601 lacked practical knowledge of pulses. More information is necessary about how to cook pulses, how to  
602 associate them with other ingredients to create pulse-based dishes, and on what occasions it is  
603 appropriate to serve pulses.

604 To date, communication campaigns in France have simply told consumers to increase their  
605 consumption of pulses. Our study identifies other strategies that could prove effective: familiarity can  
606 be increased by focusing on out-of-home meals; trendy innovative products can be developed to fit  
607 consumer profiles; communication campaigns clearly presenting pulses as a “food for all” can modify  
608 erroneous and limited mental representations. Consumers may thus be encouraged to choose pulses  
609 more frequently in their everyday lives, with the resulting benefits for their health and for the  
610 environment.

611

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751



Figure 1.

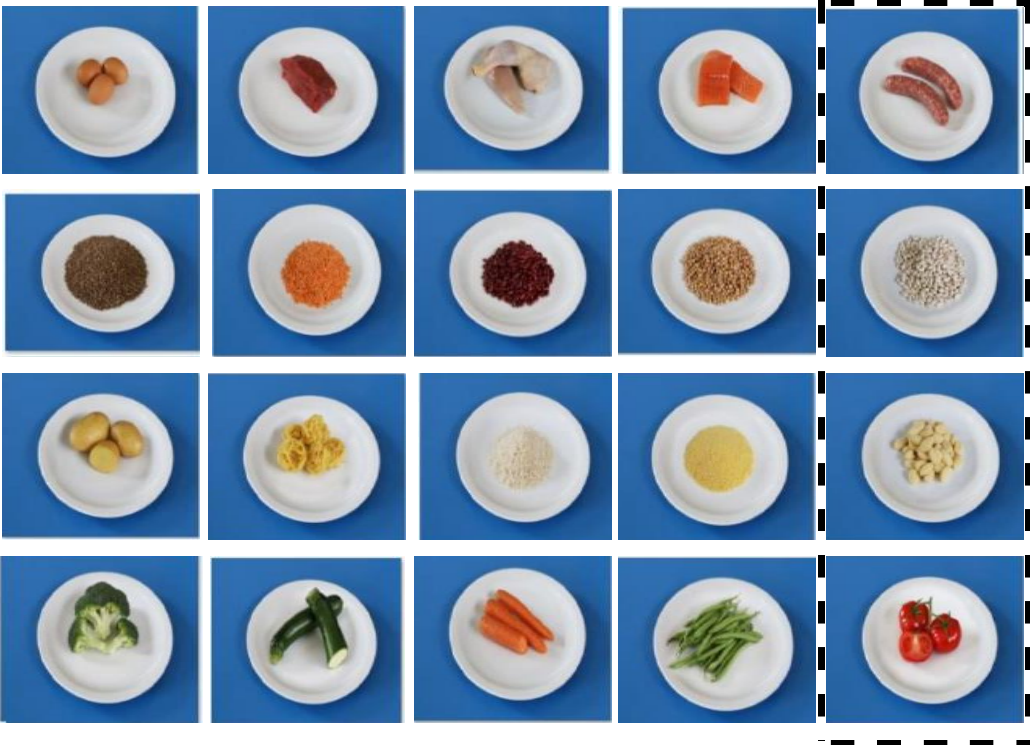


Figure 2

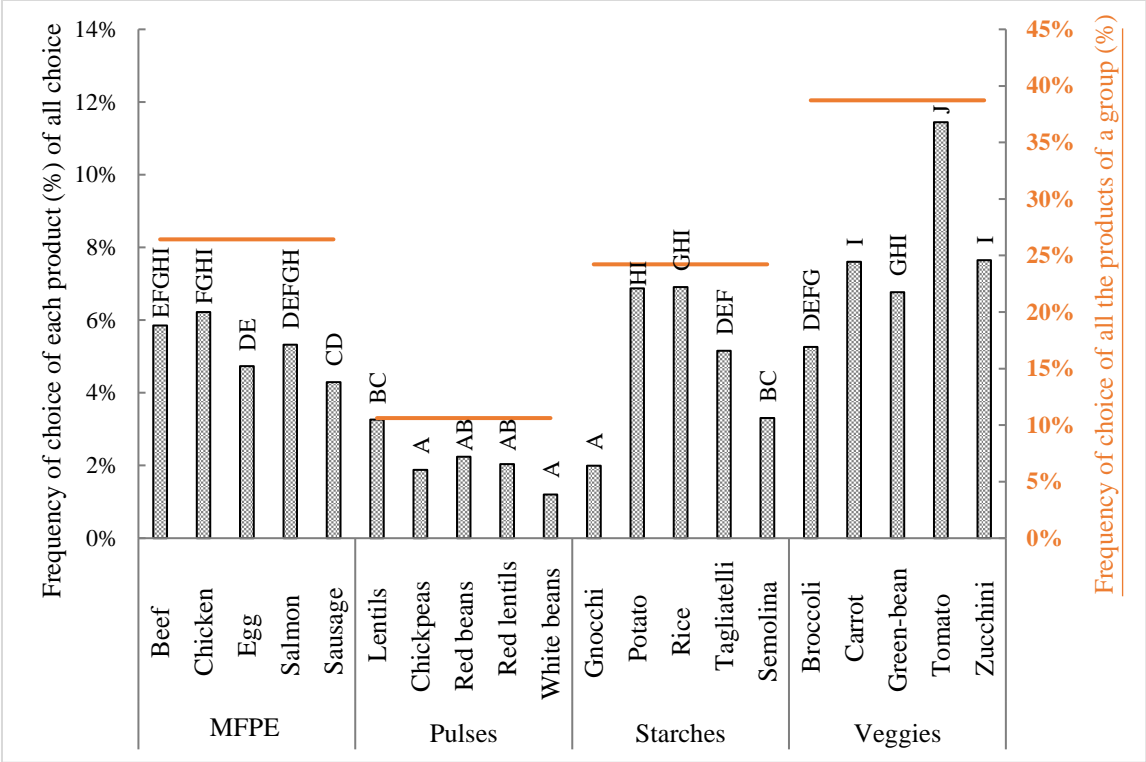


Figure 3

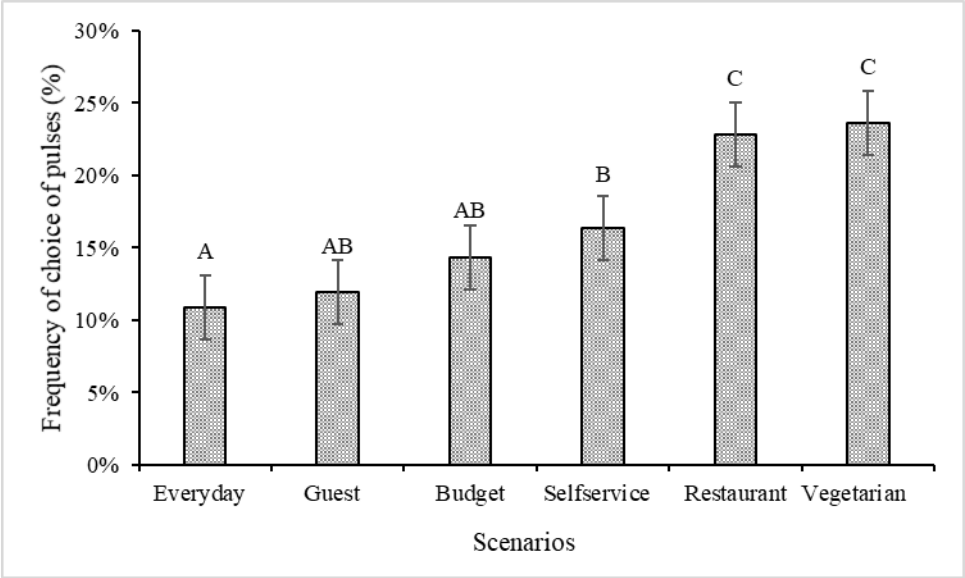


Figure 4

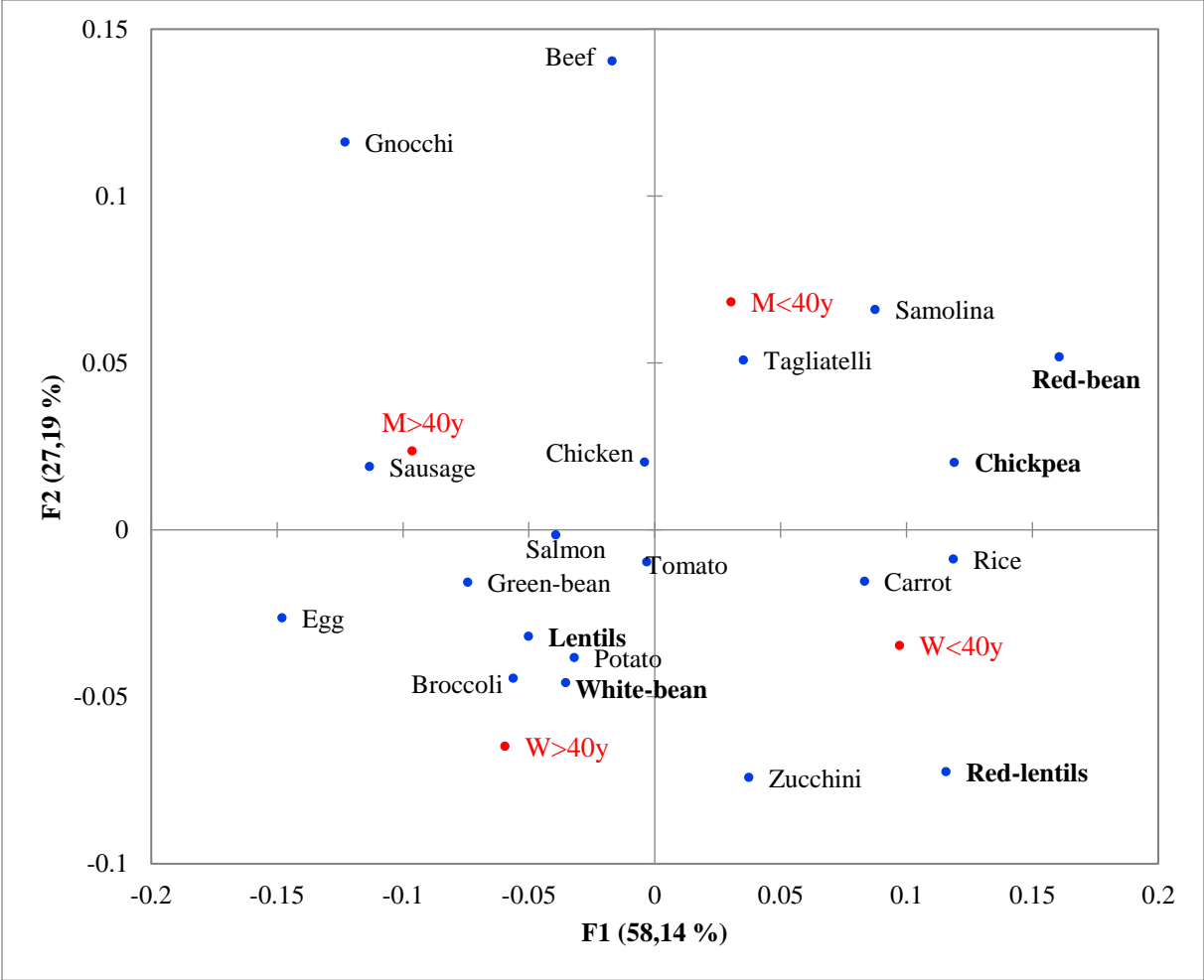


Figure 5

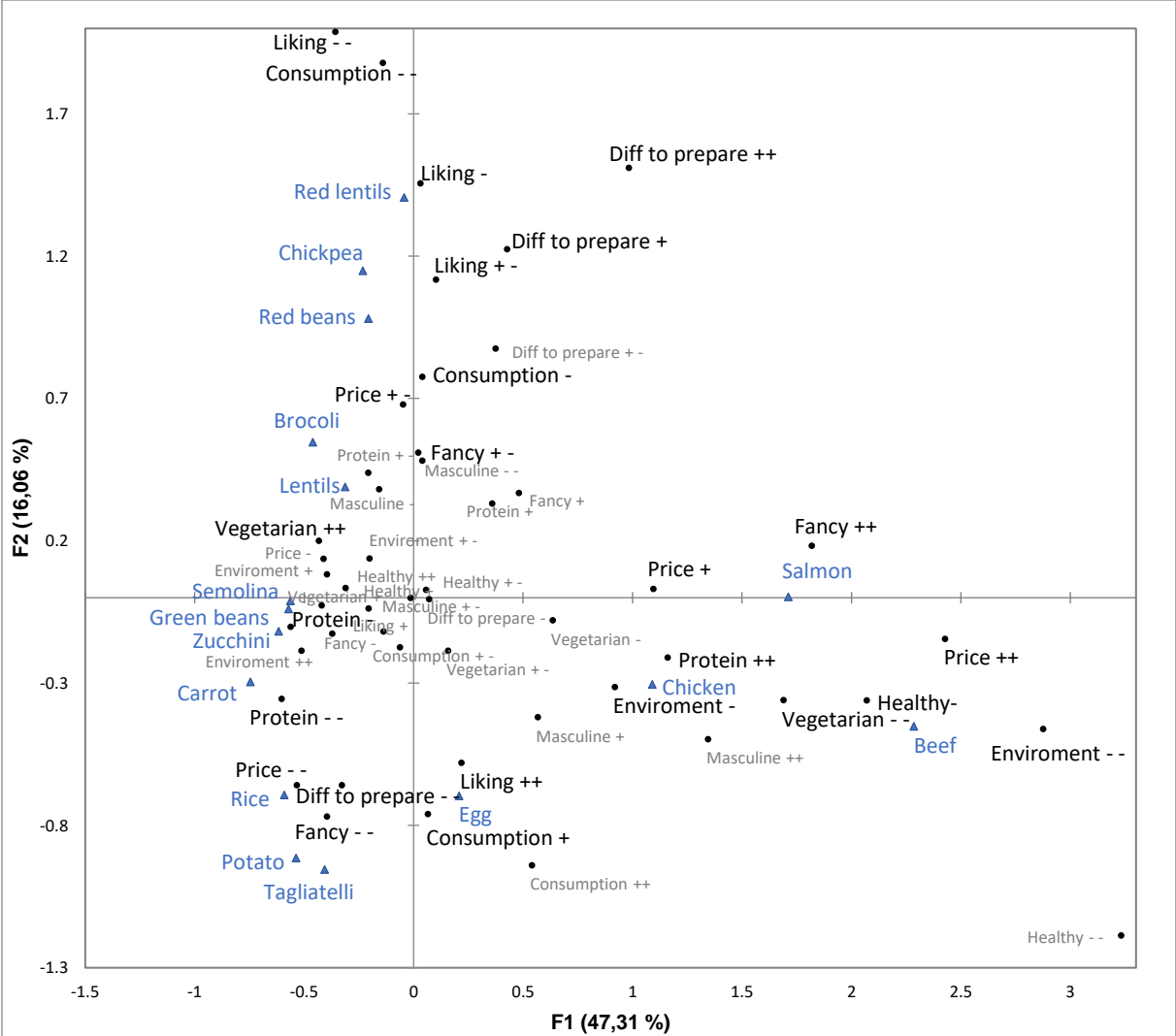


Table 1

Characteristics	Categories	Number of participants	%
Sex	Male	60	50
	Female	60	50
Age	<40 years	66	55
	>40 years	54	45
Education level	High	41	34
	Medium	40	33
	Low	39	33
Household composition	Family	33	28
	Couple	47	39
	Living alone	40	33

Table 2

Title of the scenario*	Script*
Everyday “as control”	In an everyday meal at your home, you have to prepare the meal.
Self-service	You decide to eat at the self-service cafeteria. All the foods represented in the images are on the menu.
Restaurant	You won a dinner at a four-star restaurant during a competition. The restaurant concept invites you to create a dish from a list of ingredients, in order to test the chef’s talents.
Budget	At the end of the month, after you paid most of your bills, you do not have a lot of money left and you have to prepare a cheap meal
Vegetarian	You invited a friend for a meal, which you have to prepare. You have to remember that your friend is vegetarian.
Guest	You and your partner decided to invite the couple who just moved in next door for a meal at your place.

\* Participants were given only the text of the scenario (Script, without Title). The “Title” was created merely to identify scenarios in this paper.

Table 3

Question scripts	Response modalities
	on a 5-point ordered category scale
Rate each food according to its level of ordinariness or fanciness	From “very ordinary” to “very fancy”
Taking into consideration your habits, rate each food according to difficulty of preparation	From “easy” to “difficult”
Rate each food according to its price (Consider the presentation you consume most often)	From “not expensive” to “very expensive”
Rate each food according to masculine or feminine food habits	Rating from “very feminine” to “very masculine”
Rate each food according to its suitability for a vegetarian diet	From “not at all adapted” to “very well-adapted”
Rate each food according to its effect on health	From “very bad” to “very good”
Rate each food according to your food preferences	From “I do not like it at all” to “I like it very much”
Rate each food according to its impact on the environment	From “very bad” to “very good”
Rate each food according to its protein content	From “poor in proteins” to “rich in proteins”
Rate each food according to your frequency of consumption	From “never” to “at least once a day”



Table 4

Scenario		Dish 1	Dish 2	Dish 3	Dish 4	Dish 5	Total Scenario
<b>All 20 images taken into account</b>							
Everyday	MFPE	30%	30%	30%	28%	30%	30%
	Pulses	6%	6%	6%	11%	7%	7%
	Starches	25%	26%	23%	23%	24%	25%
	Veggies	39%	39%	41%	38%	38%	39%
Self-service	MFPE	32%	31%	32%	31%	30%	31%
	Pulses	8%	7%	11%	13%	14%	10%
	Starches	27%	26%	23%	23%	21%	24%
	Veggies	33%	35%	34%	33%	35%	34%
Restaurant	MFPE	34%	34%	34%	32%	29%	33%
	Pulses	18%	14%	12%	15%	14%	15%
	Starches	16%	20%	21%	20%	20%	19%
	Veggies	33%	32%	33%	33%	38%	34%
Guest	MFPE	35%	31%	33%	33%	31%	33%
	Pulses	4%	8%	9%	9%	8%	8%
	Starches	29%	24%	23%	21%	22%	24%
	Veggies	32%	36%	36%	37%	39%	36%
Budget	MFPE	26%	25%	25%	23%	23%	24%
	Pulses	8%	10%	8%	8%	13%	9%
	Starches	31%	28%	27%	27%	27%	28%
	Veggies	36%	37%	41%	42%	38%	39%
Vegetarian	MFPE	9%	8%	7%	9%	7%	8%
	Pulses	12%	18%	17%	14%	14%	15%
	Starches	25%	23%	25%	29%	28%	26%
	Veggies	54%	52%	51%	47%	51%	51%
<b>Only 17 images taken into account, excluding those not used in the vegetarian scenario*</b>							
Vegetarian	MFPE	8%	7%	6%	8%	6%	7%
	Pulses	10%	15%	14%	12%	12%	13%
	Starches	21%	20%	21%	25%	24%	22%
	Veggies	46%	44%	43%	40%	43%	43%

\* Beef, sausage, and chicken were never selected in the vegetarian scenario.

Table 5

	Product	Fancy	Difficult to prepare	Expensive	For men	For vegetarians	Healthy	Food preference	Eco-friendly	High protein	Consumption
MFPE	Beef	12.03 <sup>ab</sup>	10.50 <sup>ab</sup>	15.18 <sup>a</sup>	13.87 <sup>a</sup>	1.95 <sup>e</sup>	4.85 <sup>g</sup>	8.99 <sup>abcd</sup>	3.59 <sup>e</sup>	13.55 <sup>a</sup>	10.81 <sup>ab</sup>
	Chicken	8.43 <sup>de</sup>	8.96 <sup>bc</sup>	9.62 <sup>b</sup>	4.57 <sup>cde</sup>	10.88 <sup>e</sup>	11.81 <sup>defg</sup>	7.63 <sup>abcd</sup>	10.74 <sup>e</sup>	5.20 <sup>a</sup>	6.61 <sup>ab</sup>
	Egg	6.16 <sup>fg</sup>	7.23 <sup>def</sup>	5.90 <sup>efg</sup>	5.87 <sup>bcd</sup>	10.84 <sup>d</sup>	11.59 <sup>cdef</sup>	8.95 <sup>abcd</sup>	10.89 <sup>d</sup>	4.88 <sup>ab</sup>	10.26 <sup>a</sup>
	Salmon	13.98 <sup>a</sup>	8.60 <sup>ab</sup>	11.83 <sup>a</sup>	9.50 <sup>fg</sup>	1.99 <sup>e</sup>	6.64 <sup>bcd</sup>	9.50 <sup>a</sup>	4.62 <sup>e</sup>	12.67 <sup>a</sup>	10.62 <sup>cd</sup>
Pulses	Chickpeas	8.79 <sup>cd</sup>	12.00 <sup>a</sup>	7.74 <sup>def</sup>	9.28 <sup>cde</sup>	10.59 <sup>ab</sup>	8.03 <sup>cde</sup>	5.15 <sup>f</sup>	9.50 <sup>abc</sup>	9.96 <sup>c</sup>	3.63 <sup>g</sup>
	Lentils	7.93 <sup>def</sup>	5.74 <sup>ab</sup>	7.22 <sup>def</sup>	10.51 <sup>ef</sup>	5.94 <sup>a</sup>	7.57 <sup>ab</sup>	9.41 <sup>bcd</sup>	6.89 <sup>ab</sup>	13.22 <sup>bc</sup>	11.60 <sup>de</sup>
	Red beans	9.03 <sup>cd</sup>	7.87 <sup>a</sup>	9.00 <sup>cde</sup>	5.84 <sup>bcd</sup>	11.08 <sup>ab</sup>	11.87 <sup>cdef</sup>	9.35 <sup>ef</sup>	11.13 <sup>abc</sup>	5.07 <sup>c</sup>	9.32 <sup>fg</sup>
	Red lentils	12.24 <sup>ab</sup>	10.26 <sup>a</sup>	7.59 <sup>bc</sup>	7.97 <sup>g</sup>	11.13 <sup>ab</sup>	10.57 <sup>bc</sup>	8.45 <sup>ef</sup>	9.99 <sup>abc</sup>	10.79 <sup>c</sup>	6.63 <sup>g</sup>
Starches	Potato	4.64 <sup>g</sup>	5.72 <sup>ef</sup>	4.83 <sup>h</sup>	11.73 <sup>b</sup>	9.49 <sup>abc</sup>	6.60 <sup>defg</sup>	9.98 <sup>ab</sup>	10.15 <sup>ab</sup>	5.86 <sup>d</sup>	11.29 <sup>ab</sup>
	Rice	5.76 <sup>g</sup>	11.48 <sup>ef</sup>	8.31 <sup>gh</sup>	10.01 <sup>bcd</sup>	10.44 <sup>abc</sup>	7.73 <sup>cdef</sup>	6.03 <sup>abcd</sup>	9.56 <sup>bcd</sup>	9.63 <sup>d</sup>	4.31 <sup>ab</sup>
	Semolina	6.61 <sup>efg</sup>	11.43 <sup>c</sup>	10.33 <sup>gh</sup>	5.56 <sup>de</sup>	10.68 <sup>bc</sup>	9.28 <sup>efg</sup>	5.77 <sup>cde</sup>	9.45 <sup>bcd</sup>	9.90 <sup>d</sup>	3.20 <sup>ef</sup>
	Tagliatelli	5.51 <sup>g</sup>	5.41 <sup>f</sup>	5.12 <sup>h</sup>	9.79 <sup>bc</sup>	9.48 <sup>c</sup>	7.35 <sup>fg</sup>	8.91 <sup>abc</sup>	8.45 <sup>cd</sup>	5.71 <sup>d</sup>	10.92 <sup>a</sup>
Veggies	Broccoli	10.60 <sup>bc</sup>	10.70 <sup>bc</sup>	15.16 <sup>cd</sup>	6.38 <sup>g</sup>	3.80 <sup>ab</sup>	8.53 <sup>a</sup>	10.84 <sup>de</sup>	4.48 <sup>a</sup>	13.23 <sup>d</sup>	8.17 <sup>de</sup>
	Carrots	6.58 <sup>efg</sup>	8.03 <sup>cde</sup>	5.34 <sup>fgh</sup>	8.78 <sup>fg</sup>	8.85 <sup>ab</sup>	5.98 <sup>a</sup>	7.77 <sup>abcd</sup>	8.17 <sup>a</sup>	5.90 <sup>d</sup>	6.02 <sup>abc</sup>
	Green beans	8.82 <sup>cd</sup>	4.86 <sup>cd</sup>	4.57 <sup>cde</sup>	11.06 <sup>g</sup>	8.19 <sup>a</sup>	5.65 <sup>a</sup>	9.87 <sup>abcd</sup>	7.44 <sup>a</sup>	6.15 <sup>d</sup>	11.93 <sup>bc</sup>
	Zucchini	8.89 <sup>cd</sup>	7.22 <sup>cde</sup>	8.28 <sup>cde</sup>	5.28 <sup>g</sup>	10.68 <sup>ab</sup>	11.97 <sup>a</sup>	9.42 <sup>abcd</sup>	10.98 <sup>a</sup>	4.28 <sup>d</sup>	10.67 <sup>ab</sup>

For each question, products with the same letter were chosen with comparable frequency (Nemenyi / two-tailed test;  $p < 0.05$ )