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1 **Do Extra Ingredients on the Package Lead to Extra Calorie Estimates?**

2

3 **Introduction**

4 People love to mix food up, for instance, coffee with milk, cake with fruit, vegetables
5 with mayonnaise, as the added ingredients can bring better taste. A food blogger listed
6 72 food pairings that he considered as most delicious ones: oatmeal with marmalade,
7 egg roll with seaweed ...¹, and to meet market demands, many food companies launch
8 new foods by adding extra ingredients to their base products. These included, for
9 instance, Oreo's mixed-fruit-and-ice-cream biscuits, Kraft Foods' vegetable-and-
10 seaweed Pacific soda crackers, and Yoplait's cherry-and-strawberry yoghurt. How
11 added food ingredients presented on the packaging of the new augmented food affect
12 consumer calorie estimation is however still unclear.

13 We define an added food ingredient (henceforth AFI) as the added food pairing
14 which declares, and becomes associated with, the new packaged food product. The
15 pairing effectively creates for this new packaged food product a distinct identity. An
16 AFI also goes beyond flavouring/seasoning (i.e. added food flavours; other additives)
17 by altering its nutritional composition (US Food Labelling Regulation, 1996, §14-16).
18 AFIs can be distinctive, visible and strongly evident (e.g. the fruits on the top of a
19 packaged fruitcake) or embedded or blended with other primary ingredients in the new
20 augmented packaged food product (e.g., the chocolate in the chocolate milk, the
21 strawberries in strawberry cookies, the leeks in pork & leek sausages). AFIs are usually
22 secondary regarding weight reported on the food label given their quantity (e.g., the

¹ See <http://tieba.baidu.com/p/1921491975>.

23 weight of leeks is usually 9% compared to 80% pork in pork & leek sausages), but they
24 become an essential characteristic and part of the identity of the new augmented
25 packaged food product. As AFIs become increasingly popular among consumers, they
26 bring opportunities and challenges to packaged product portfolio strategies. Extending
27 the product range satisfies heterogeneous consumer needs but also complicates
28 procurement, manufacturing, marketing and ultimately impacts finances (Kang and
29 Montoya, 2014). AFIs also raise great concerns among dietitians and health
30 practitioners and regulators (Haytowitz and Pehrsson, 2018). These warn that AFIs alter
31 food composition per se (Roe et al., 2015), and often mislead consumers by triggering
32 excessive calorie intakes (Wilder et al., 2007). For instance, some studies show that
33 adding a visible healthy AFI to an unhealthy served-on-a-plate base food (e.g., adding
34 fruits on a served cake) results in calorie underestimation of the augmented served-on-
35 a-plate food (Chernev and Gal, 2010; Jiang and Lei, 2014).

36 As a crucial marketing and consumer interaction tool, the packaging of the food
37 product on the retail shelf communicates aesthetic and sensory experiences, brand
38 information and product function assisting consumers in their purchase decisions. It is
39 reported that as many as 90% of consumers make their purchase decisions after visually
40 evaluating only the front pack of a product (Becker et al., 2015; De Pelsmacker et al.,
41 2011). Packaging cues, both visual and verbal, may become critical heuristics for
42 purchase decisions. Therefore, it is easy to understand that food manufacturers tend to
43 enrich their products appearance by including the AFIs on the food packaging (for
44 instance, the green cucumber on the packaging of Lay's cucumber-flavoured crisps, the

45 hazelnuts on the packaging of Hershey's hazelnut chocolate). As the features of AFIs
46 presented may vary, it is unclear whether and how could AFIs on the food packaging
47 affect consumers' calorie estimation of the new augmented packaged food. Answering
48 this question is important given the considerable evidence on the strong link between
49 calorie perception and product purchase, is theoretically distinct from, but also
50 complements what is known for calorie perception and product consumption on a plate
51 / meal evaluation context (Chernev and Gal, 2010; Jiang and Lei, 2014; Roe et al., 2015;
52 Wilder et al., 2007). Purchase and serving on a plate contexts do not overlap time-wise,
53 the former preceding the latter. Food consumption decisions are effectively made at the
54 packaged food purchase stage.

55 We investigate how AFIs presented on the packaging of the new augmented food
56 affect calorie estimation. Study 1 (1A and 1B) focus on calorie estimation when adding
57 AFIs to an unhealthy or healthy base packaged food. Study 2 tests an underlying
58 mechanism that leads to a calorie underestimation effect which occurs when adding a
59 healthy AFI to an unhealthy packed base food. The two remaining studies investigate
60 two boundary conditions regarding this effect. Specifically, Study 3 looks at whether
61 this effect intensifies when strengthening further the healthiness of the AFIs. Study 4
62 looks at whether this effect dissipates when the displayed form changes.

63 We contribute in three ways. We first expand the understanding of the effects of
64 AFIs. Prior studies have primarily focused on the influence of other package/food clues
65 over purchase behavior, e.g., the shape of the packaging, or the image of the food (Deng
66 and Srinivasan, 2013; Madzharov and Block, 2010; Raghurir and Krishna, 1999) or

67 looked at AFIs in a served-on-a-plate context; i.e., a meal-calorie evaluation process
68 (Chernev and Gal, 2010; Jiang and Lei, 2014). We investigate the influence of AFIs on
69 calorie estimation and healthiness perceptions in a context not studied before, namely
70 packaged food. Such consideration occurs at an earlier stage than meal evaluations and
71 complements current knowledge.

72 Next, AFIs' effect is an important topic for studying joint estimation and especially
73 biases when base foods and ingredients are concurrently presented in the evaluation
74 system as product attributes. In doing so, we add to the knowledge about packaging
75 effects (e.g., Deng and Srinivasan, 2013; Kozup et al., 2003; Madzharov and Block,
76 2010; Silayoi and Speece 2004; 2007; Underwood et al., 2001), visual versus verbal
77 cues (e.g., Carr et al., 1982; Houston et al., 1987; Underwood and Klein, 2002) and
78 calorie-based choice modelling literature (e.g., McFadden, 2001). In doing so, we
79 specifically contribute to food consumption policy debates (e.g., Bazerman, 2001;
80 Chandon and Wansink, 2007; Kivetz and Simonson, 2002; Scheibehenne et al., 2007;
81 Smith and Rogers, 2014; Swinburn et al., 2015; Wansink and Chandon 2006; Wilder et
82 al. 2007) and package-based consumer judgment error and heuristics (e.g.,
83 Raghunathan et al., 2006; Schulte-Mecklenbeck et al., 2013; Sevilla and Kahn, 2014;
84 Tversky and Kahneman, 1973).

85 Moreover, AFIs exert critical influence over consumer judgment as inferential cues
86 for product line extensions. Previous work on product line design has explored the
87 benefits of broadening product lines (e.g., Bayus and Putsis, 1999), product line
88 optimization (e.g., Netessine and Taylor, 2007), product cannibalization (Desai, 2001),

89 pricing (Draganska and Jain, 2006; Draganska et al., 2009) and brand equity effects
90 (Randall et al., 1998). Past work has not looked at consumer estimation and perception
91 differences when extending product lines by adding AFIs. Our work has a particular
92 meaning for food firms in not only improving their sales but also safeguarding ethics
93 and diligence towards society in firms' own efforts to combat the obesity epidemic and
94 deal with social accountability issues (Swinburn et al., 2015). The scenarios presented
95 in our study are widespread among food marketers and very close to what food
96 technologists face when developing new products or what nutritionists/ dieticians face
97 when they advise food firms and patients alike. Improving consumers' accuracy in
98 calorie estimation has substantial merit for decisions regarding adding AFIs and their
99 communication.

100

101 **Theoretical Background**

102 Presence of AFIs and consumer calorie estimation

103 During a decision-making process, consumer use of information depends on the
104 usability of that information, their cognitive resources and their motivation (Chaiken,
105 1980; Tversky and Kahneman, 1973). Chen et al. (1999) clarify that it is the level of
106 that consumer motivation and self-defined goals that guide the selection of sufficiency
107 and confidence thresholds. Concerning food, consumer motivation and self-defined
108 goals may involve lower accuracy targets, lower self-defence motives, weaker links to
109 social impression targets and less strict sufficiency and confidence thresholds. Intensive
110 calculation of calories based on complex combinations of size, volume, ingredients and

111 other are sidestepped, and simpler health-heuristics are opted for (Chandon and
112 Wansink, 2007). Opted simpler health-heuristics for calorie estimates will take
113 advantage of impressions about food healthiness (Chandon and Wansink, 2007;
114 Raghunathan et al., 2006; Wansink et al. 2004; Wertenbroch, 1998).

115

116 The relevance of the healthiness of the packaged base food

117 A healthy base: Healthier food is perceived to contain fewer calories, while an
118 unhealthier more calories. For packaged foods, consumers will also incorporate and
119 integrate visual cues on packaging as health heuristics (e.g. colour, pictures), in their
120 healthiness evaluation (Aydinoğlu and Krishna, 2011). As AFIs are often visually
121 prominent, the perceived healthiness of the augmented packaged food would be
122 determined by the healthiness of both the base food and the AFI that are added on the
123 packaging. When a healthy base packaged food is used, consumers do not need to find
124 excuses for consumption since the healthy base food matches well with consumers'
125 long-term health goal (Giner-Sorolla, 2001). When so, AFI's influencing role
126 diminishes, and the nature of its contribution becomes character-, or flavour- giving to
127 the healthy base food. Then, AFI's relevance is delegated to a subordinate level,
128 regardless of AFI's own healthy or unhealthy nature. The purchase of the main but
129 healthy base food makes consumers believe that they are pursuing a healthy goal. In
130 essence, consumers' commitment in, and taking of actions, to achieve this goal becomes
131 entrenched in the purchase of the base food (Fishbach et al., 2003; Koo and Fishbach,
132 2008). As a consequence, consumers have no conflict to resolve and correspondingly

133 can spend resources on calorie assessment, leading them to evaluate the total calories
134 of the combination more rationally and accurately. In such case, it becomes easier for
135 them to conclude a total calorie estimation of the combination to be higher than the
136 calorie estimation of the healthy base food alone. Thus:

137

138 H1a: When adding to a healthy base packaged food either a healthy or an
139 unhealthy AFI, consumer calorie estimation is higher than that of the base food alone.

140

141 An unhealthy base: When an unhealthy base packaged food is used, consumers face a
142 dilemma as the pleasure and hedonism usually brought by an unhealthy food may be at
143 the cost of long-term health (McClure et al., 2007; Okada, 2005; Prelec and
144 Loewenstein, 1998; Shiv and Fedorikhin, 1999). Therefore, the expected purchase of
145 unhealthy food initiates or intensifies psychological conflict. This conflict refers to the
146 coexistence of positive and negative thoughts or emotions (Kivetz and Simonsonm,
147 2002; Strahilevitz and Meyers, 1998). The minimizing guilt self-defence motive
148 becomes activated to identify a reason for self-indulgence and reduce conflict or opt for
149 ambivalence which in turn allows for exceptions and deviation (Xu and Schwartz,
150 2009). Consumers will then be inclined to elevate the weight importance and relevance
151 of low-fat and healthy AFI (Aydinoğlu and Krishna, 2011; Wansink and Chandon,
152 2006). As healthy AFI can provide consumers with justification for an unhealthy food
153 purchase, excessive attention is paid to the healthiness of the added AFI in consumers'
154 overall new augmented packaged food healthiness evaluations. When the expected (but

155 mostly unwanted) conclusion becomes likely (e.g., the augmented food is unhealthier),
156 an AFI-based health-heuristic processing is triggered to achieve a much more wanted
157 conclusion (Chaiken and Eagly, 1989; Eagly and Chaiken, 1993) while simultaneously
158 deserting the base food as a cue (e.g., Kunda, 1990). Attributing a heavy relative weight
159 to the healthier nature of the AFI leads to severe underestimation of overall calories. In
160 contrast, adding an unhealthy AFI to an unhealthy base food collides with consumer
161 demand for a purchase justification and precludes a hedonism-gratification excuse
162 allowing a more accurate (increased) calorie estimation for the new augmented food.
163 Accordingly, we consider:

164
165 H1b: When adding to an unhealthy base packaged food an unhealthy AFI,
166 consumer calorie estimation is higher than that of the base food alone.

167 H1c: When adding to an unhealthy base packaged food a healthy AFI, consumer
168 calorie estimation is lower than that of the base food alone.

169

170 External justification: As indicated by Hsee (1995, 1996), consumers select a healthier
171 food that fits to longer health goal rather than an unhealthier indulgent food, if they
172 cannot find a proper excuse to justify the latter. However, even with adequate cognitive
173 resources available, it is quite common for consumers to deliberately seek a justification
174 for the action that they will enjoy more when the criteria for evaluating the decision are
175 ambiguous (Cheema and Soman, 2006). Research from other domains uncover similar
176 results. In reviewing the motivated reasoning research, Kunda (1990, pp. 480, 483)
177 summarized that “the biasing role of goals is thus constrained by one’s ability to

178 construct a justification for the desired conclusion: people will come to believe what
179 they want to believe only to the extent that (motivated) reason permits.”

180 Consumers opting for a status of ambivalence or conflict reduction is facilitated when
181 additional external source justification exists (Cheema and Soman, 2006; Okada, 2005).

182 The presenting of a healthy AFI on an unhealthy packaged base food provide excuses
183 for temporal disqualification of utilitarian goals in favor of hedonic and taste enjoyment
184 goals together with an easier reconciling conflict and fact acceptance. The emotional
185 and adverse experiences of self-blame, regret, or remorse dissipate, guilt (Chernev,
186 2011) becomes accepted and excused, and indulgent consumption is temporarily
187 permitted. When provided with an external justification excuse, a healthy AFI-based
188 adjustment is not needed any longer for the consumption of an unhealthy base, and
189 estimation reverts closer to the facts. Thus:

190

191 H2: Provided that an external justification for an indulgent consumption is
192 present, the underestimation effect from adding to an unhealthy base food a healthy AFI
193 is mitigated.

194

195 Visual Presentation and Verbal Presentation of the Packaging

196 Regarding purchase decisions, product packaging cues operate in different ways
197 (Aydinoğlu and Krishna, 2011; Raghurir and Krishna, 1999; Sevilla and Kahn, 2014).

198 Visual packaging information attracts consumers’ attention first and set boundary
199 expectations for the use of the verbal elements; the latter is serving at a later stage as an

200 ‘advance judger’ platform of the visual ones (Alesandrini and Sheikh,1983; Houston et
201 al., 1987). Meanwhile, compared with verbal information, images are more efficient in
202 motivating people’s memory-stored sensory information (e.g., smell, taste) (MacInnis
203 and Price, 1987; Underwood and Klein, 2002) and provide consumers with diagnostic
204 heuristics for their judgment and purchase choice (Kisielius and Sternthal, 1986). Visual
205 cues are also more easily and faster accessed (Carr et al., 1982). When in heuristic mode,
206 visual cues are more likely to affect consumers’ judgment than verbal information
207 (Aydinoğlu and Krishna, 2011). Schulte-Mecklenbeck et al. (2013) show that, though
208 verbal cues are critical (weight equally as other studied cues such as price, calorie
209 information etc.), visual cues are most important in participants’ food choice decisions.
210 The visual-based effect and its salience will maintain the calorie underestimation effect
211 of adding a healthy AFI to an unhealthy base food. In contrast, a verbal element likely
212 dissipates the effect because it obliges consumers to engage in a more elaborate
213 cognitive process forcing them to delve longer and deeper in their own judgment (van
214 Osselaer, 2008: 721), undermine the effect of the triggered heuristic, and the salience
215 of the stimuli is downgraded (Rebollar et al., 2017) reversing earlier estimations. This
216 does not mean that verbal cues are unlikely to activate the diagnostic heuristic for
217 judgment. They do, but the effect is of a lesser extent. Thus:

218

219 H3: When adding a healthy AFI to an unhealthy base packaged food, and this is
220 presented in visual form (i.e., image), consumers perceive fewer food calories than that
221 of the base food alone. When this healthy AFI is presented in a verbal form, the
222 underestimation effect weakens.

223

224 **STUDIES AND METHOD**

225 **Study 1 (A and B)**

226 This study tests the differences in consumers' calorie estimation when healthy AFI
227 or unhealthy AFI are added to the packaging of a healthy or unhealthy packaged base
228 food (see Table 1 for a summary of the experimental design). This study has two
229 components, Study 1A and Study 1 B. In Study 1A, 232 students (123 male), age ranged
230 18 to 37 ($M=24.05$, $SD=2.98$) were recruited in a marketing survey before the launching
231 of a series of new packaged products. Two of the survey tasks were to estimate the
232 calorie content and the perceived healthiness of the packaged food. Crisps and milk
233 were chosen as the unhealthy and healthy base food respectively. The unhealthy
234 characteristic of crisps and the healthy feature of milk are well documented in the
235 literature (Adriaanse et al., 2009; Smith and Rogers 2014). We considered the use of a
236 drink and a snack item as an acceptable compromise because of their very distinct and
237 contrasting character (unhealthy versus healthy), their wide availability in packaged
238 forms and high expected frequency of regular purchases so to secure respondent
239 familiarity with the experimental contexts. Cucumber (as healthy) and BBQ (as
240 unhealthy) AFIs for crisps were chosen followed by walnut (as healthy) and chocolate
241 (as unhealthy) AFIs for milk, respectively. The participants were randomly assigned to
242 a 2 (base food: healthy vs unhealthy) \times 3 (AFI: health vs unhealthy vs no AFI) between-
243 subjects design. Participants were first told to read the following cover story:

244 *“Cuello (a made-up crisps brand)/Leit Leche (a made-up milk brand) has achieved*

245 good sales in snack/dairy market in recent years, and it is planning to launch a series
246 of new flavour chips/milk to further enhance its market share. Before taking actions
247 further, *it hopes to know consumers' opinions about its new crisps/milk and the product*
248 *packaging*".

249 Then, to decrease the variance caused by people's differences on calorie-content
250 knowledge, a reference calorie content was provided to each participant with five filler
251 questions. Specifically, after the introduction of cover story, participants in the healthy
252 base food group were first shown the real product picture of a glass of raw milk, while
253 those who were assigned to the unhealthy base food group were shown a plate of
254 homemade crisps, attached with a description: "Below is the picture of the real product
255 of a high rated homemade crisps/ raw milk in the market discovered by the marketing
256 department of Cuello/Leit Leche" (See Appendix 1 for stimuli used in Study 1A). Then,
257 they were asked to answer five filler questions, including 'the clarity of the picture',
258 'the attractiveness of the product', 'willingness to buy the displayed product', 'favored
259 packaging style', and "100g of the homemade crisps contains 1300KJ calories or 250ml
260 of the raw milk contains 700 KJ calories, where would you think is most proper to
261 present the calorie information 1300KJ/100g (or 700KJ/250ml) on the packaging?"

262 Next, participants entering into the focal study were told: "Below is a newly
263 developed crisps/whole milk that Cuello/Leit Leche is about to launch", and were
264 shown the front pack of either the packaged base food (i.e. the original crisps/milk), or
265 the base packaged food with either the healthy or unhealthy AFI (i.e., with either the
266 cucumber- or BBQ crisps, or the walnut- or chocolate whole milk. Each one of the four

267 conditions was shown separately and no participant compared any two conditions
268 together. They were then asked to answer four more filler questions on food
269 attractiveness (three items: “the food is very tempting to me”, “the food is very
270 appealing to me”, and “it would be very enjoyable if I ate this food; Cronbach’s $\alpha=.86$),
271 and clarity of pictures, as control variables. Finally, they were required to estimate the
272 calories (According to your estimation, the calories of this flavored crisps/milk
273 is.....KJ”) and perceived healthiness (using seven-point Likert scale (1=very unhealthy,
274 7=very healthy). The used questionnaire is available in the web-appendix.

275

276 Study 1A Results and Discussion

277 Table 1 and Table 2 provide a summary of the results. Our manipulation check
278 showed that, in the no AFI conditions (i.e., the packaged base food alone condition),
279 participants perceived the whole milk as healthier (5.27 vs. the middle value 4, $SD=.69$,
280 $t(36)=11.15$, $p=.00$), and perceived the crisps as unhealthier (2.58 vs. 4, $SD=.77$, $t(35)=$
281 -11.04 , $p=.00$). Also, the difference between the healthiness perception of these two
282 conditions was statistically significant ($F(1, 71)=245.83$, $p=.00$, $\eta^2=.78$). An ANOVA
283 revealed significant main effects on calorie estimation of base food ($F(1, 226)=128.73$,
284 $p=.00$, $\eta^2=.36$) and AFI ($F(2, 226)=28.15$, $p=.00$, $\eta^2=.20$). The interaction effect
285 between the base food and AFI ($F(2, 226)=29.88$, $p=.00$, $\eta^2=.21$) was also significant.

286 <Insert here: Table 1 >

287 <Insert here: Table 2 >

288 The contrast analysis shows that compared with presenting the unhealthy base food

289 alone (M=1331.94, SD=36.41), participants perceive lower calories when a healthy AFI
290 is presented concurrently (M=1128.75, SD=34.54, $F(1, 226)=15.89$, $p=.00$, $\eta^2=.13$),
291 while no significant change in calorie estimation was observed when an unhealthier
292 AFI was presented (M=1413.95, SD=186.05, $F(1, 72)=2.52$, $p=.12$, $\eta^2=.02$). The
293 healthiness perception increased significantly when adding a healthy AFI to a packaged
294 unhealthy base food (M=3.63, SD=.84), compared to that of the unhealthy base food
295 alone (M=2.58, SD=.77, $F(1, 226)=34.61$, $p=.00$, $\eta^2=.24$). No significant differences in
296 healthiness perception were observed between the conditions of adding an unhealthy
297 AFI to an unhealthy base food (M=2.29, SD=.69), and of the unhealthy base food alone
298 ($F(1, 226)=2.69$, $p=.10$, $\eta^2=.02$).

299 Higher calorie estimates were observed in the healthy base food with an AFI
300 condition than that of the healthy base food alone, no matter the AFI presented is
301 healthy (1044.19 vs 710.27, $F(1, 226)=47.92$, $p=.00$, $\eta^2=.29$) or unhealthy (1142.11 vs
302 710.27, $F(1, 226)=75.55$, $p=.00$, $\eta^2=.40$). Furthermore, compared to the healthy base
303 food alone condition, adding an unhealthy AFI to a healthy base food lead to decreased
304 healthiness perception significantly (4.24 vs 5.27, $F(1, 226)=75.55$, $p=.00$, $\eta^2=.40$) and
305 the perceived healthiness does not change significantly when presenting a healthy AFI
306 on the packaging of a healthy base food (5.42 vs 5.27, $F(1, 226)=.52$, $p=.47$, $\eta^2=.01$).

307 To sum up, compared with the two control conditions (i.e., the healthy and
308 unhealthy packed base food alone), a calorie underestimation effect was only observed
309 in the combination of an unhealthy base and a healthy AFI among the four manipulated
310 conditions (i.e., the 2 (AFI: healthy vs. unhealthy) \times 2 (packed base food: healthy vs.

311 unhealthy)). A contrast on healthiness perception shows that adding a healthy AFI on
312 the unhealthy packaged base food is accompanied with the most significant increase on
313 perceived healthiness than the base food alone, in contrast to all other three manipulated
314 conditions. This implies that, in principle, the enhanced healthiness perception is
315 brought by the added healthy AFI to the augmented base food and leads to consumers'
316 calorie underestimation.

317 However, a limitation in Study 1A is that the healthy and unhealthy base food
318 belong to different categories (milk and crisps). Although the results generated from
319 these common in daily consumption food items, provide valuable support to our
320 hypotheses, the different nature of the categories (solid versus liquid) may confound
321 the results. To provide a remedy, we conducted a post-hoc study (Study 1B) (n =163)
322 (85 males, aged 17 to 29 (M=19.75, SD=1.57) using a similar 2 (base food: healthy vs
323 unhealthy) \times 3 (AFI: healthy vs unhealthy vs no AFI) between-subjects design which
324 employs food items from the same solid food product category (snacks). These include
325 healthy (apple chips) and unhealthy (potato crisps) as base foods; cinnamon and
326 cucumber as healthy AFI, and BBQ as unhealthy AFI respectively (see appendix 2 for
327 the stimuli of Study 1B). The rest of the procedure is the same as in study 1A.

328

329 Study 1B Results and Discussion

330 The results of an ANOVA show significant main effects of base food
331 (F(1,157)=266.97, p=.00, η^2 =.63) and AFI (F(2,157)=3.95, p=.02, η^2 =.05), and a
332 significant interaction between food bases and AFI (F(2,157)=6.53, p=.02, η^2 =.08)

333 similar to our Study 1A findings. The contrast analysis shows that a lower calorie
334 estimate is also repeatedly observed in the unhealthy base with a healthy AFI condition
335 than that of the unhealthy base food alone (1088.40 vs 1295.83, $F(1, 157)= 4.87$, $p=.03$
336 $\eta^2=.06$). There is no significant difference between the calorie estimate of the unhealthy
337 base food with an unhealthy AFI and that of the base food alone (1382.14 vs 1295.83,
338 $F(1,157)=.89$, $p=.35$, $\eta^2=.01$). The calorie estimate of the healthy base food with AFI is
339 higher than that of the healthy base food alone, regardless of whether the AFI is healthy
340 (518.97 vs 628.86, $F(1,157)=5.44$, $p=.02$, $\eta^2=.06$) or unhealthy (518.97 vs. 610.71,
341 $F(1,157)=3.72$, $p=.06$, $\eta^2=.04$).

342 Moreover, we compared the perceived healthiness of food between different
343 conditions. The contrast analysis shows that in the base food only conditions,
344 participants perceived apple chips as healthy (5.28 vs. 4.0 the middle value, $t(29)=9.15$,
345 $p=.00$) and potato crisps as unhealthy (2.63 vs 4.0, $t(23)=-8.75$, $p=.00$), and perceived
346 the former to be healthier than the latter (5.28 vs 2.63, $F(1,51)=159.98$, $p=.00$, $\eta^2=.76$).
347 Further contrasts show that a higher perceived healthiness of the augmented food (3.32
348 vs 2.63, $F(1,157)=11.08$, $p=.00$, $\eta^2=.17$) was observed when adding a healthy AFI to
349 the unhealthy base food, whereas no significant difference was found on the perceived
350 healthiness (2.36 vs 2.63, $F(1,157)=1.74$, $p=.19$, $\eta^2=.02$) when adding an unhealthy AFI.
351 For healthy base food, a lower perceived healthiness was observed when adding an
352 unhealthy topping (4.71 vs 5.28, $F(1,157)=5.60$, $p=.02$, $\eta^2=.06$), and adding a healthy
353 topping increased, albeit not statistically significantly, the perceived healthiness (5.59
354 vs 5.28, $F(1, 157)=21.74$, $p=.19$, $\eta^2=.02$).

355 Study 1B results provide corroborative evidence for Study 1A findings and are
356 consistent either whether the comparison is between solid foods per se (potato vs apple
357 crisps) or between a solid food (potato crisps) and a liquid (milk). These allow accepting
358 H1a (when adding to a healthy base food either a healthy or an unhealthy AFI,
359 consumer calorie estimation is higher than that of the base food alone). They also allow
360 accepting H1b (when adding to an unhealthy base food an unhealthy AFI, consumer
361 calorie estimation is higher than that of the base food alone) and H1c (when adding to
362 an unhealthy base food a healthy AFI, consumer calorie estimation is lower than that of
363 the base food alone).

364

365 **Study 2**

366 This study examines the underlying justification-related mechanism for
367 underestimation effect occurring when adding a healthy AFI to an unhealthy base food
368 (H2). 108 students (55 male, age ranged 17 to 27, $M=20.44$, $SD=1.99$) were randomly
369 assigned to a 2 (external justification: present vs absent) \times 2 (AFI: no AFI vs healthy
370 AFI) between-subjects design. Like in Study 1, “Cuello” crisps were chosen as the
371 stimuli and cucumber as AFI. Participants were firstly informed of a cover story similar
372 to that in Study 1, i.e., we would like to learn their opinions regarding the packaging
373 design of a new product concerning the given brand. Then the participants were shown
374 the front pack of the original flavored “Cuello” crisps (See Appendix 3 for Study 2
375 stimuli) and were asked to complete the same questionnaire as in Study 1 and engaged
376 with the referencing of the original crisps calories (1300 KJ). Then, participants in the

377 external justification present group were asked to vividly imagine the following three
378 scenarios: (1) when they finished all their final exams with good marks; (2) when they
379 were awarded scholarship at the beginning of a new semester because of their hard
380 work in the previous semester; (3) when they received an internship offer from their
381 dream company. This procedure aims to involve the participants in an external
382 justification task (Khan and Dhar, 2006). Following, they were asked to choose among
383 the three scenarios the one in which they were most likely to reward themselves with
384 indulgent consumption. Next, they were asked to imagine that, under the chosen
385 scenario, they went shopping and bought a bag of the new cucumber flavored Cuello
386 crisps as a snack on a regular day (the same pictures as in Study 1 were used). Then
387 each participant was asked to estimate the calories and the perceived healthiness. In the
388 end, three questions were asked to test the extent to which each participant justifies
389 their consumption, including “How much do you think you should reward yourself on
390 that day?” “How much do you think you should treat yourself with delicious food on
391 that day?” and “How much do you feel you deserve delicious food on that day?” (0=not
392 at all; 10 = very much; Cronbach’s alpha=.82). The factor scores averaged from these
393 items were recorded as the external justification index.

394

395 Study 2 Results and Discussion

396 Manipulation checks show that participants in the external justification present
397 group have higher justification scores than those in the justification absent group (6.91
398 vs 4.83, $F(1,106)=27.55$, $p=.00$, $\eta^2=.21$). The ANOVA indicated a significant

399 interaction effect between justification and AFI on calorie estimation ($F(1,104)=19.52$,
400 $p=.00$, $\eta^2=.16$). The main effects of justification ($F(1,104)=24.83$, $p=.00$, $\eta^2=.19$) and
401 AFI ($F(1,104)=27.89$, $p=.00$, $\eta^2=.21$) were also significant. Contrast tests indicate that,
402 when external justification is absent, the calorie estimate of the unhealthy base food
403 with healthy AFI is significantly lower than that of the food base food alone (1076.09
404 vs. 1311.29, $F(1, 104)=47.33$, $p=.00$, $\eta^2=.31$). When external justification is present, no
405 significant difference is found regarding calorie estimates between the two respective
406 ones (1304.06 vs 1325.00, $F(1, 104)=.37$, $p=.54$, $\eta^2=.004$). The ANOVA on healthiness
407 perception also depicted a significant main effect of justification ($F(1,104)=14.20$,
408 $p=.00$, $\eta^2=.12$) and AFI ($F(1,104)=5.92$, $p=.02$, $\eta^2=.05$), but the interaction between the
409 two factors is not significant ($F(1,104)=1.20$, $p=.28$, $\eta^2=.01$). Higher healthiness
410 perception were observed when there was no justification than when an external
411 justification was provided (3.48 vs. 2.83, $F(1, 104)= 14.21$, $p= .00$, $\eta^2=.12$). This result
412 indicates that, in the absence of an external justification excuse, consumers deliberately
413 to judge the unhealthy food to be healthier so that their indulgent consumption of the
414 unhealthy food would be permitted. Supporting H2, these results reveal that it is
415 consumers' self-justification absence that, driving from the presence of healthy AFI,
416 contributes to their calorie underestimation on the augmented unhealthy packaged food
417 (see Table 1 and Table 2).

418

419 **Study 3**

420 This study tests whether the calorie underestimation effect when adding a healthy AFI

421 on an unhealthy base food (H1c) intensifies along increasing AFIs' perceived
422 healthiness. Based on results of a pretest² we identified that AFI stimuli with multiple
423 different vegetables were perceived as healthier than a cucumber-alone AFI stimuli.
424 Multiple different vegetables were also seen as a different condition but in essence
425 multiplicative regarding perceived healthiness compared to multiple pieces of a single
426 vegetable. Following, 87 students (45 male), age ranged 20 to 35 (M=24.56, SD=2.47)
427 attended a marketing survey involving a new packaged snack before launching, with
428 two tasks: estimating snack's calories content and perceived healthiness when one
429 healthy AFI (first manipulation) and when multiple different healthy AFIs were added
430 (second manipulation) to the packaging of an unhealthy packaged base food (control
431 condition). To maintain correspondence with Study 1, the control condition (i.e., crisps
432 as unhealthy base food) stimuli and the first manipulation (i.e., crisps with cucumber-
433 alone) stimuli remained the same. The second manipulation used an AFI with five
434 mixed vegetables (cucumber, tomato, eggplant, lettuce, and broccoli). The rationale is
435 that compared to the use of one healthy ingredient as AFI (first manipulation), the use
436 of a combined-mix/multiple healthy ingredients as AFIs (second manipulation)
437 strengthens healthiness' perceptions (i.e., the latter is healthier) (see Appendix 4 for the
438 stimuli of Study 3).

439 Participants were randomly assigned to three conditions (no AFI vs a single AFI

² 27 students (12 male, M_{age}=23.74, SD=1.81) attended the pre-test. They were invited to a marketing investigation about product packaging design before the launch of the new product "Cuello" crisps. Perceived healthiness was asked along with other three questions, including overall design of the packaging, the harmonious degree of the packaging, the clarity of the picture. ANOVA test show a significant effect of AFI on perceived healthiness (F(1,25)=4.64, p= .04). The "Cuello" crisps presented with an AFI consisting mixed vegetables was perceived healthier than that of the crisps with a cucumber-alone AFI (M_{mixed-vege}=4.15, SD= .99; M_{cucumber}=3.43, SD= .76).

440 vs multiple different AFIs) (N=29 in each). Each one of conditions was shown
441 separately and no participant compared any two conditions together. This study
442 followed a procedure similar to Study 1: participants first read the cover story, were
443 shown the real product picture of a homemade crisps and answered five filler questions,
444 among which the reference calorie information was provided through the question
445 “100g of the homemade crisps contains 1300KJ calories, where would you think is
446 most proper to present the calorie information 1300KJ/100g on the packaging?” Next,
447 participants were shown the front pack of either the original crisps, the cucumber crisps,
448 or the mixed-vegetable crisps; three more filler questions were answered, followed by
449 the estimation of the corresponding calories and healthiness perceptions.

450

451 Study 3 Results and Discussion

452 Manipulation check showed that compared with adding one healthy AFI (the
453 cucumber condition), participants perceived the augmented unhealthy food that adding
454 multiple AFIs to be healthier (3.52 vs. 4.07, $F(1, 56) = 4.84$, $p = .03$, $\eta^2 = .08$). ANOVA
455 showed a significant effect of presenting type on calorie estimation ($F(2, 84) = 17.57$,
456 $p = .00$, $\eta^2 = .30$), as well as on healthiness perception ($F(2, 84) = 14.17$, $p = .00$, $\eta^2 = .25$).
457 The same effect as in Study 1 was shown, i.e. compared with the situation of the packed
458 unhealthy base food alone, the perceived healthiness was enhanced in both healthy AFIs
459 added conditions: in the cucumber AFI condition: $M = 3.52$, $SD = .91$, vs $M = 2.76$,
460 $SD = .91$, $F(1, 84) = 9.42$, $p = .003$, $\eta^2 = .10$ and in the healthier mixed-vegetable AFI
461 condition: $M = 4.07$, $SD = 1.00$, $F(1, 84) = 28.10$, $p = .00$, $\eta^2 = .25$). Participants also

462 perceived the augmented crisps with the mixed-vegetable AFI as healthier than the
463 augmented crisps with the cucumber AFI ($F(1, 84)=4.98, p=.03, \eta^2=.06$). In
464 concordance with Study 1 findings, participants estimated fewer (and quite similar to
465 Study 1 figures) calorie content on the augmented packaged food when a cucumber-
466 alone healthy AFI was added ($M=1179.31, SD=161.20$) than the base food alone
467 ($M=1318.97, SD=201.52, F(1,84)=10.49, p=.002, \eta^2=.11$). Importantly, participants
468 perceive the unhealthy augmented packaged food with the more pronounced ‘healthier’
469 vegetable-mix AFI as having the least calories ($M=1063.79, SD=119.45, F(1,$
470 $84)=35.03, p=.00, \eta^2=.29$). Between the two healthy AFI manipulations, the mixed-
471 vegetable condition was estimated as having significantly fewer calories than the
472 cucumber-alone condition ($F(1, 84)=7.18, p=.009, \eta^2=.08$).

473 Study 3’s outcomes are consistent with Study 1’s outcomes confirming the initial
474 findings. H1c acceptance is repeated again, and the findings clarify that the calorie
475 underestimation effect when a healthy AFI is added on an unhealthy packaged based
476 food is a function of the strength of the perceived healthiness of the augmented food.
477 The calorie underestimation is intensified along a strengthened healthiness perception
478 of the AFI.

479

480 **Study 4**

481 This study tests the boundary effect of AFI forms (visual vs verbal) on unhealthy
482 food calorie estimates and considers explicitly if the verbal effects mitigate the
483 underestimation effect evident in the former studies. 127 students (65 male) (aged

484 M=24.97, SD=2.58) attended a marketing survey involving a new packaged snack
485 before launching, with two of the tasks designed as estimating the snack's calories
486 content and perceived healthiness. To generalize and expand on the previous results,
487 the pictorial representation of Maryla (a made-up brand which differs from that of the
488 previous studies) cookies were introduced as stimuli. Cookies without an AFI reflect
489 the control condition (unhealthy base food alone). Cookies with strawberry reflect an
490 unhealthy base food + healthy AFI and two manipulations were developed: the first has
491 the picture of strawberry (i.e., a visual condition) as AFI and the second has the text
492 'strawberry' on the packaging (a verbal condition) as AFI (with approximately similar
493 size as the picture). To note that the small chips on the cookies are strawberry chips.
494 Participants were randomly assigned to one of these three conditions. Study 1's
495 procedure was replicated here excerpt changing the brand name in the cover story as
496 "Maryla". After reading the cover story, participants were shown the picture of a plate
497 of referenced cookies (See Appendix 5 for the stimuli of Study 4). They were next asked
498 to complete five filler questions, including "100g of the handmade cookies contains
499 2200 KJ calories, where would you think is most proper to present the calorie
500 information 2200KJ/100g on the packaging?" to provide them with referencing calorie
501 information. The participants were later shown the front pack of packaged cookies
502 (containing six grab bags), either of the original flavour or strawberry flavour. Each one
503 of conditions was shown separately and no participant compared any two conditions
504 together. They were then asked to answer two questions relating attention, including
505 "the flavor of the cookies" and "how clear do you think the packaging informed that

506 the product it contains”. Then, four more filler questions, as well as to estimate the
507 calorie content and perceived healthiness of the new product. The filler questions
508 included the food attractiveness (three items, Cronbach’s $\alpha= 0.88$), the clarity of the
509 pictures, the harmony of the package design, the overall evaluation of the design of the
510 packaging. As a check on the effect of the AFI on consumers’ purchase behavior,
511 participants were also asked to report “to what extent are you tempting to purchase this
512 cookie”.

513

514 Study 4 Results and Discussion

515 Manipulation check shows that all participants correctly answered the flavor of the
516 cookies used in their participated condition. Moreover, an ANOVA test informed no
517 significant differences among three conditions on packaging’s informing mode
518 ($F(2,124)=.02$, $p=.985$, $\eta^2=.0$). This result rules out the explanation that the calories
519 underestimation effect in visual AFI condition is due to different consumer attention
520 generated by visual vs verbal AFIs presented on the packaging of base food.

521 An ANOVA shows that the presenting format of healthy AFI on the packed
522 unhealthy base food has a significant impact on the calorie underestimation effect ($F(2,$
523 $124)=7.89$, $p=.00$, $\eta^2=.11$). For the same unhealthy base food, consumers’ calorie
524 estimate with healthy AFI presented in pictures ($M=2024.42$, $SD=267.57$) was lower
525 than those under conditions of healthy AFI presented in words ($M=2157.14$,
526 $SD=175.50$) and the control no-AFI condition ($M=2208.33$, $SD=207.46$). The
527 underestimation effect is statistically significant when the healthy AFI is presented in

528 the picture on the packaging than there is no AFI added ($F(1, 124)=14.77, p=.00,$
529 $\eta^2=.11$). In contrast, no statistically significant difference was found between the
530 estimated calories of presenting healthy AFI in words than the no AFI condition ($F(1,$
531 $124)=1.13, p=.29, \eta^2=.01$).

532 Differences in the perceived product healthiness are also observed among the three
533 studied conditions ($M_{\text{AFI in picture}}=3.70$ vs $M_{\text{no AFI}}=3.05$ vs $M_{\text{AFI in words}}=3.19, F(2,$
534 $124)=5.74, p=.004, \eta^2=.09$). Respondents perceive the augmented unhealthy food to be
535 healthier when there is a healthy AFI presented in picture format on the packaging than
536 the base food alone, and the difference is statistically significant ($(F(1, 124)=10.36,$
537 $p=.002, \eta^2=.08$). However, no statistically significant differences were found in the
538 perceived healthiness between the condition of presenting the AFI in words on the
539 packaging and the base food alone ($F(1, 124)=.50, p=.48, \eta^2=.004$). These findings lend
540 support to accept H3 suggesting that the presentation form of AFI is a boundary for our
541 focus underestimation effect. The findings demonstrate that the calorie underestimation
542 effect retains its strength when the healthy AFI is presented in pictures on the packaging
543 of an unhealthy base food but weakens (albeit not disappearing) when the AFI is
544 presented in words.

545 An additional ANOVA shows that the AFI has a significant effect on consumers'
546 purchase intention ($F(2, 124)=3.46, p=.04, \eta^2=.05$). Further contrast shows that,
547 compared with the no AFI condition ($M=4.12, SD=1.17$), participants are tempted to
548 purchase the cookies when presenting the AFI in picture ($M=4.77, SD=1.36; F(1,$
549 $124)=5.54, p=.02, \eta^2=.04$), but no significant difference is observed when the AFI is

550 presented verbally ($M=4.17$, $SD=1.27$; $F(1, 124)=.03$, $p= .86$, $\eta^2=.00$).

551

552 **General discussion**

553 Overview of the findings

554 The current research explores the impact of AFIs presented on packaged foods on
555 consumers' estimates of food calories and perceived healthiness. Its differentiating
556 aspect, namely the investigation of AFIs as part of the packaged design, complements
557 and adds to previous research. In doing so, our work complements the literature by
558 focusing at an earlier stage than meal evaluations (e.g., Chernev and Gal, 2010; Jiang
559 and Lei, 2014) and adds by explaining the role of AFIs as a package/food clue (e.g.,
560 Deng and Srinivasan, 2013; Madzharov and Block, 2010; Raghuram and Krishna, 1999)
561 in consumer food choices. The impact of AFIs on calorie estimation and perceived
562 product healthiness choices depends on the interaction of the health-related nature of
563 the packaged base food and the AFI. This work also contributes to food consumption
564 policy debates (e.g., Bazerman, 2001; Chandon and Wansink, 2007; Kivetz and
565 Simonson, 2002; Scheibehenne et al., 2007; Smith and Rogers, 2014; Swinburn et al.,
566 2015; Wansink and Chandon 2006; Wilder et al. 2007) and package-based consumer
567 judgment error and heuristics (e.g., Raghunathan et al., 2006; Schulte-Mecklenbeck et
568 al., 2013; Sevilla and Kahn, 2014; Tversky and Kahneman, 1973). In doing so, this
569 work clarifies that combining a visual-based healthy AFI with an unhealthy food
570 packaged base triggers a consistent calorie under-estimation/product healthiness
571 perception over-estimation effect. This effect is mitigated when there is an external

572 justification or the AFI is in verbal form but it increases further if its visual form
573 involves multiple healthy ingredients. Study 1 shows that among the studied
574 combinations, the healthy (visual) AFI/unhealthy packaged base food leads to harmful
575 for the consumers results; this also occurs irrespectively of the solid or liquid nature of
576 the food product. We theorize complementing previous literature that a health-heuristic
577 is triggered to help consumers justify the indulgent and health harmful purchase. These
578 interface with consumers' motivation for justification, precluding them from a
579 hedonism-gratification excuse. Study 2 demonstrates that when an external justification
580 excuse is present, the effect is indeed no longer produced. Study 3 and 4 provide
581 evidence on the functioning of the effect. In Study 3, when the presented visual healthy
582 AFI expands from involving only one (cucumber) to involving many (mixed,
583 comprising five different vegetables), the effect increases even further but the effect is
584 weakened as shown in Study 4 when the AFI presented in verbal form. Comparing with
585 visual cues, verbal cues activate but they have as diagnostic heuristics a lesser effect.

586 As AFIs exert critical influence over consumer judgment as inferential cues, our
587 work also provides best marketing practice regarding broadening product lines (e.g.,
588 Bayus and Putsis, 1999) and especially product line optimization (e.g., Netessine and
589 Taylor, 2007) based on ethical and obesity prevention grounds.

590

591 Implications

592 Our research has implications for consumers, food enterprises, and policy makers.

593 First, our findings suggest that consumers should be cautious of the judgment bias

594 caused by the presence of an AFI on food packages, and raise their awareness regarding
595 nutrition implications and dietary effects. Packaged food with AFI are widespread and
596 consumers should be alerted of this biased judgment regarding the healthiness nature
597 of food, incorrect food calorie estimates, and erroneous calorie intake monitoring, so
598 they may not make informed purchase decisions that are consistent with their
599 expectations. Experts (like nutritionists and dieticians) should be alerted to the
600 conditions that generate how consumers become self-misled.

601 From the perspective of food manufacturers though, adding healthy AFI to
602 unhealthy base foods although may increase consumers' purchase intention and bring
603 higher profits, may not be sustainable as a marketing strategy in the long-term and has
604 immediate ethical implications. Self-misled consumers' purchases through seemingly
605 healthier food combinations instigates self-harm, damages consumers' own interests
606 and raises important ethical concerns and questions who consumers may blame later.
607 Future consumer reactions may lead to potential consumer blame-shifting away from
608 themselves and rejection of manufacturing/branding practices in the first instance.
609 Consumer reasoning may well be based on their own claims regarding industry versus
610 consumer power and knowledge imbalance, the consumers been self-seen as weaker
611 and less-knowledgeable. Reaching such a point may jeopardize not only consumer
612 loyalty, but increase mistrust and hurt brand (and product range) profits.

613 On the other hand, food enterprises can improve the promotion and sales of healthy
614 food by taking appropriate advantage of AFIs. Our work allows to suggest that food
615 enterprises can consolidate considerations on both sides of the firm's short-term profit

616 and public health, when they choose and present AFI in a way that minimizes consumer
617 bias and help consumers make healthier purchases. In branding and communication,
618 external justifications may be used as part of firms' communication strategy and an
619 explanation of the mechanism in operation. Transparency and explanation will not harm
620 either product/brand perceptions or profits. Consumers will likely reward such firms,
621 and their loyalty will increase as further trust is established in the food enterprises who
622 substantiate that they have consumers' interests at heart.

623 Finally, policymakers could introduce voluntary schemes to monitor and restrict
624 the improper presentation of AFIs, aiming to rule out the abuse of healthy AFIs on
625 unhealthy packaged food. Other relevant organizations could also endeavor to promote
626 consumer awareness of the biased impacts of AFI on consumer judgment and decision-
627 making.

628

629 Limitations and Future Research

630 Further research should test across the broader range of the food product matrix.
631 Though we consider the condition of one vs multiple AFI types, we do not examine
632 specific numerical thresholds nor what happens in a likely intermediate condition (i.e.,
633 multiple pieces of a single vegetable). Our research focuses on the most common
634 (namely, AFI on the packaging of packaged food) but such AFIs may be elusive.
635 There is a great diversity of AFI presentations. For instance, in the common
636 combination of cookies and milk, the cookies and milk can be treated as AFI for each
637 other. In other cases, there are AFI presented for decoration only, such as the cinnamon

638 stick in an ice cream cone. Further research may deal with the impact of AFI of these
639 different forms on consumers' calorie estimation and healthiness perceptions.

640 Future research may also test further additional sensory-arousing mechanisms that
641 can help understand how consumer perceive the calories of the augmented food. The
642 shape, colour, and the imagery of package, among other things, can arouse the sense of
643 taste (Piqueras-Fiszman et al., 2012; Spence, 2012). In our cucumber crisps, the calorie
644 underestimation effect may relate to an expected healthy taste or smell sense aroused
645 by the green colour of the cucumber presented on the package of the crisps. People may
646 also associate certain shapes with relevant food tastes (Spence and Gallace, 2011).
647 Irregular rectangles are associated with dark chocolate in a higher percentage of cocoa
648 (bitter), roundness shapes with milk chocolate (much sweeter), and rectangles with
649 cranberry juice (sour). Moreover, future research may consider introducing eye-
650 tracking experiments as an alternative instrument to explore the AFI phenomenon.
651 Adding functional type ingredients may be another area for further research. AFIs are
652 added to products such as detergents, essential oils, and air fresheners (e.g., typical AFIs
653 for detergent include ginger, lemon, and kumquat). It is likely that, consumers would
654 think the products are more natural and mild to the skin when more healthy AFIs are
655 added.

656

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Table 1: Experimental Design and Score Means (Standard Deviations)

Study	Variable	Scores					
1A		Solid Unhealthy Base	Solid Unhealthy Base + Healthy AFI	Solid Unhealthy Base + Unhealthy AFI	Liquid Healthy Base	Liquid Healthy Base + Healthy AFI	Liquid Healthy Base + Unhealthy AFI
	Calorie Estimation	1331.94 (244.12)	1128.75 (232.02)	1413.95 (186.05)	710.27 (155.68)	1044.19 (249.34)	1142.11 (222.86)
	Healthiness perception	2.58 (.77)	3.63 (.84)	2.29 (.69)	5.27 (.69)	5.42 (.96)	4.24 (1.05)
1B		Same As Above	Same As Above	Same As Above	Solid Healthy Base	Solid Healthy Base + Healthy AFI	Solid Healthy Base + Unhealthy AFI
	Calorie Estimation	1295.83 (338.13)	1088.40 (242.79)	1382.14(383.02)	518.97 (161.70)	628.86 (210.60)	610.71 (160.65)
	Healthiness perception	2.63 (0.77)	3.32 (0.80)	2.36 (0.62)	5.28 (0.75)	5.59 (0.83)	4.71 (1.08)
2		Solid Unhealthy Base + Present External Justification	Solid Unhealthy Base + Absent External Justification	Solid Unhealthy Base +Healthy AFI + Present External Justification	Solid Unhealthy Base +Healthy AFI + Absent External Justification		
	Calorie Estimation	1325.00 (119.27)	1311.29 (145.89)	1304.06 (99.73)	1076.09 (127.81)		
	Healthiness perception	2.68 (1.00)	3.19 (.79)	2.94 (1.13)	3.87 (.97)		
3		Solid Unhealthy Base	Solid Unhealthy Base + One AFI	Solid Unhealthy Base + Multiple AFIs			
	Calorie Estimation	1318.97 (201.52)	1179.31 (161.20)	1063.79 (119.45)			
	Healthiness perception	2.76 (.91)	3.52 (.91)	4.07 (1.0)			
4		Solid Unhealthy Base	Solid Unhealthy Base + AFI in pictures	Solid Unhealthy Base + AFI in text			
	Calorie Estimation	2208.33 (207.46)	2024.42 (267.57)	2157.14 (175.50)			
	Healthiness perception	3.05 (1.08)	3.70 (.89)	3.19 (.80)			

Table 2: ANOVA Results

Study	Variable	Overall*			Overall*			Overall*			Unhealthy Base			Healthy Base		
		IV: Base			IV: AFI			IV: Base × AFI			IV: AFI			IV: AFI		
		F(1)	p(1)	$\eta^2(1)$	F(2)	p(2)	$\eta^2(2)$	F(3)	p(3)	$\eta^2(3)$	F(4)	p(4)	$\eta^2(4)$	F(5)	p(5)	$\eta^2(5)$
1A	Calorie Estimation	128.73	.00	.36	28.15	.00	.20	29.88	.00	.20	17.13	.00	.24	41.69	.00	.42
	Healthiness perception	368.93	.00	.62	43.66	.00	.28	6.00	.00	.05	32.42	.00	.37	19.26	.00	.25
1B	Variable	Overall*			Overall*			Overall*			Unhealthy Base			Healthy Base		
		IV: Base			IV: AFI			IV: Base × AFI			IV: AFI			IV: AFI		
		F(6)	p(6)	$\eta^2(6)$	F(7)	p(7)	$\eta^2(8)$	F(9)	p(9)	$\eta^2(9)$	F(10)	p(10)	$\eta^2(10)$	F(11)	p(11)	$\eta^2(11)$
	Calorie Estimation	266.97	.00	.63	3.95	.21	.05	6.53	.00	.08	5.48	.01	.13	.31	.049	.07
	Healthiness perception	352.82	.00	.69	17.11	.00	.18	.79	.45	.01	12.01	.00	.25	6.92	.002	.14
2	Variable	Unhealthy Base			Unhealthy Base			Unhealthy Base			Justification Absent			Justification Present		
		IV: Justification			IV: AFI			IV: Justification × AFI			IV: AFI			IV: AFI		
		F(12)	p(12)	$\eta^2(12)$	F(7)	p(7)	$\eta^2(8)$	F(9)	p(9)	$\eta^2(9)$	F(10)	p(10)	$\eta^2(10)$	F(11)	p(11)	$\eta^2(11)$
	Calorie Estimation	24.83	.00	.19	27.89	.00	.21	19.52	.00	.16	38.06	.00	.42	.49	.49	.01
	Healthiness perception	14.20	.00	.12	5.92	.02	.05	1.20	.28	.01	7.95	.01	.13	.73	.40	.01
3	Variable	Unhealthy Base			Unhealthy Base			Unhealthy Base			Unhealthy Base			Unhealthy Base		
		IV: AFI (variety)			IV: AFI (variety)			IV: AFI (variety)			IV: AFI (variety)			IV: AFI (variety)		
		F(12)	p(12)	$\eta^2(12)$	F(12)	p(12)	$\eta^2(12)$	F(12)	p(12)	$\eta^2(12)$	F(12)	p(12)	$\eta^2(12)$	F(12)	p(12)	$\eta^2(12)$
	Calorie Estimation	17.57	.00	.30	17.57	.00	.30	17.57	.00	.30	17.57	.00	.30	17.57	.00	.30
	Healthiness perception	14.17	.00	.25	14.17	.00	.25	14.17	.00	.25	14.17	.00	.25	14.17	.00	.25
4	Variable	Unhealthy Base			Unhealthy Base			Unhealthy Base			Unhealthy Base			Unhealthy Base		
		IV: AFI (presenting format)			IV: AFI (presenting format)			IV: AFI (presenting format)			IV: AFI (presenting format)			IV: AFI (presenting format)		
		F(13)	p(13)	$\eta^2(13)$	F(13)	p(13)	$\eta^2(13)$	F(13)	p(13)	$\eta^2(13)$	F(13)	p(13)	$\eta^2(13)$	F(13)	p(13)	$\eta^2(13)$
	Calorie Estimation	7.89	.00	.11	7.89	.00	.11	7.89	.00	.11	7.89	.00	.11	7.89	.00	.11
	Healthiness perception	5.74	.00	.09	5.74	.00	.09	5.74	.00	.09	5.74	.00	.09	5.74	.00	.09

Note: * Overall refer to considering both the Healthy and Unhealthy Base Food

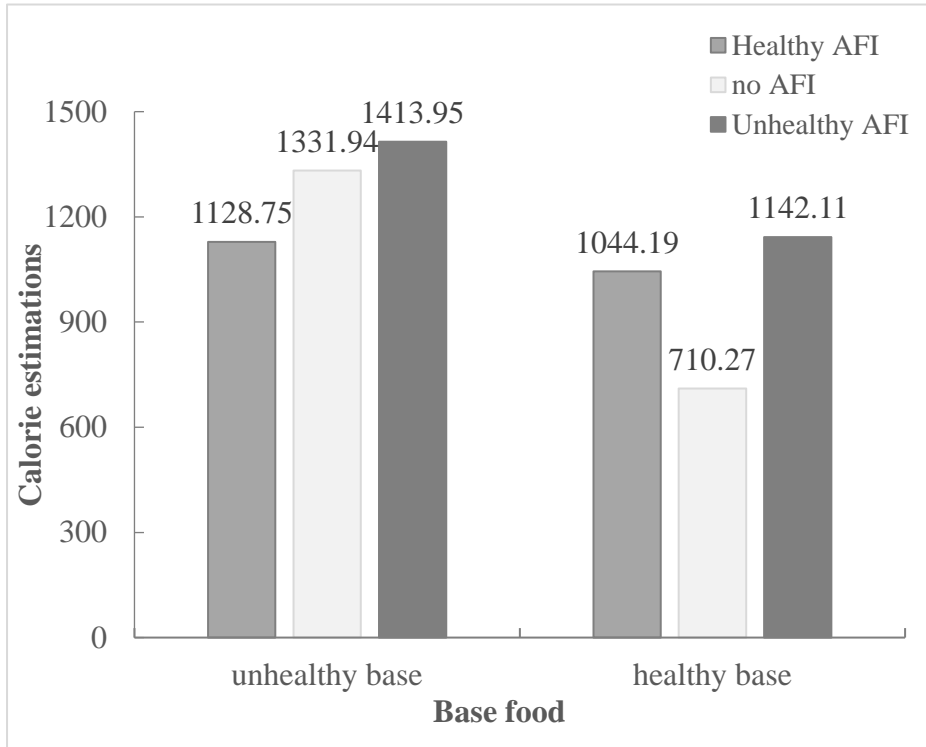


Figure 1 Results of calorie estimations of Study 1a

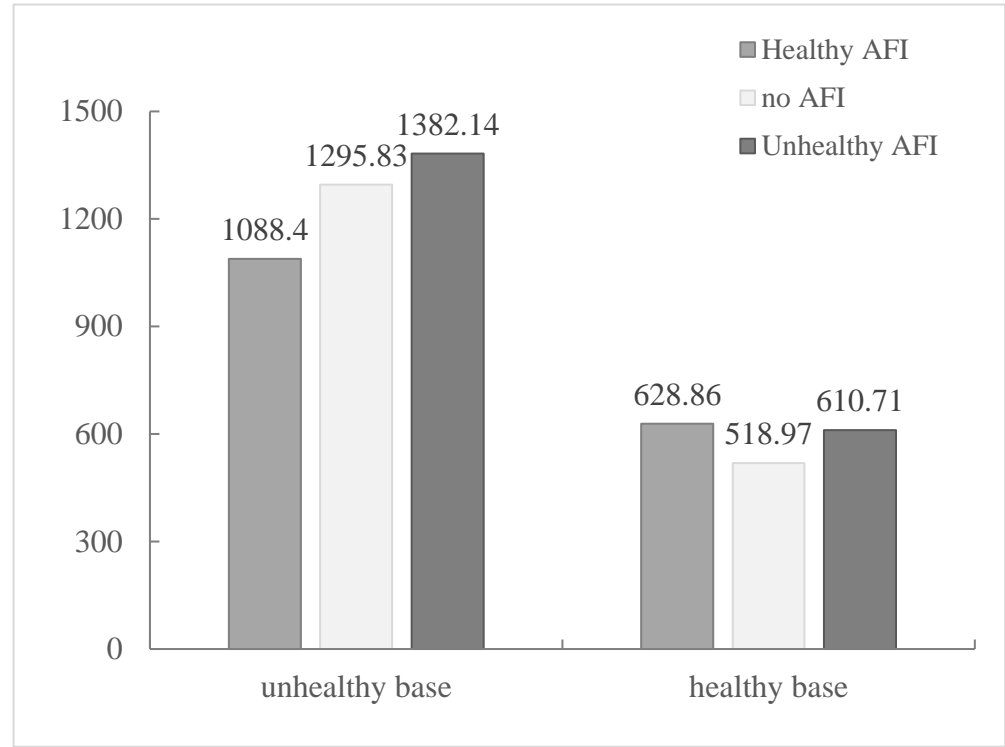


Figure 2 Results of calorie estimations of Study 1b

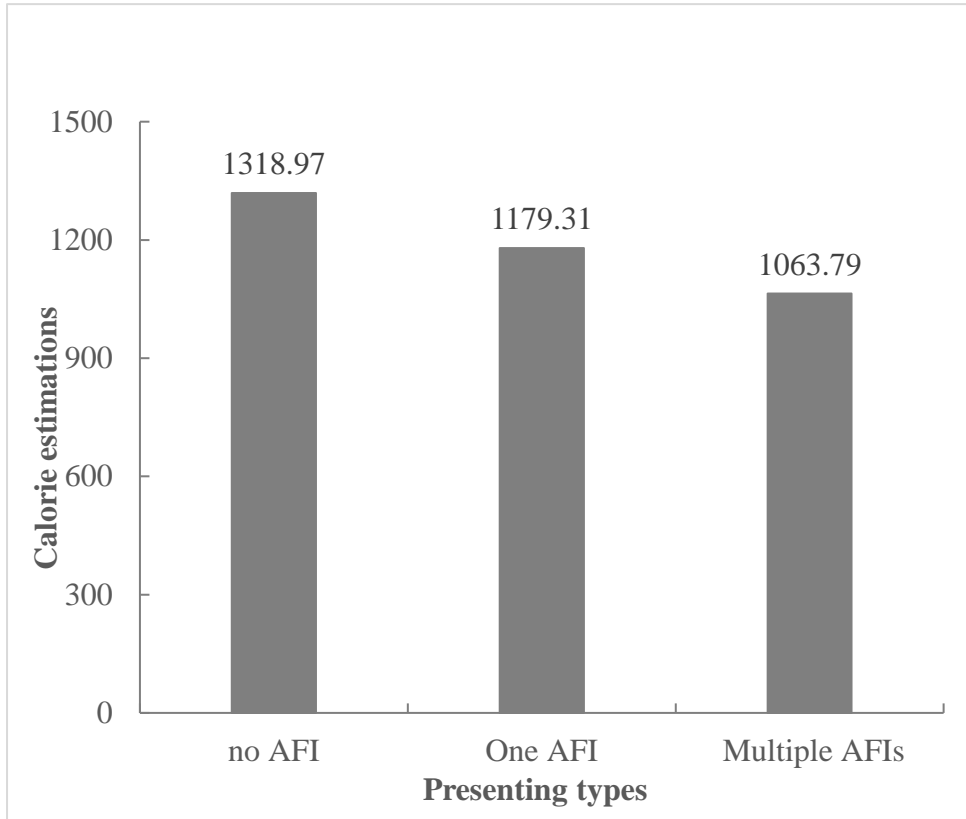


Figure 3 Results of calorie estimations of Study 3

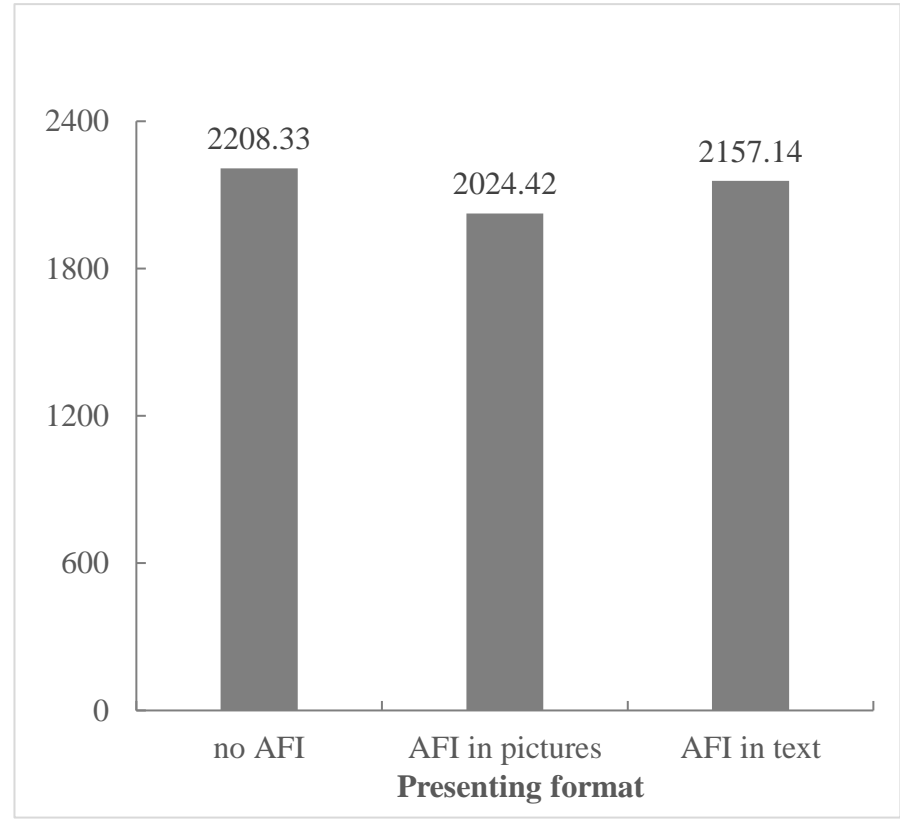


Figure 4 Results of calorie estimations of Study 4

Appendix 1. Experimental Stimuli in Study 1A -Unhealthy Base Food



Reference: origin homemade crisps



Unhealthy base food
without AFI



Unhealthy base food with
healthy AFI



Unhealthy base food with
unhealthy AFI

Appendix 1. Experimental Stimuli in Study 1A-Healthy Base Food



Reference: raw milk



Healthy base food without AFI



Healthy base food with healthy AFI



Healthy base food with unhealthy AFI

Appendix 2. Experimental Stimuli in Study 1B -Unhealthy Base Food



Reference: origin homemade crisps



Unhealthy base food
without AFI



Unhealthy base food with
healthy AFI



Unhealthy base food with
unhealthy AFI

Appendix 2. Experimental Stimuli in Study 1B-Healthy Base Food



Reference: homemade apple chips



Healthy base food without AFI



Healthy base food with healthy AFI



Healthy base food with unhealthy AFI

Appendix 3. Experimental Stimuli in Study 2



Reference: origin homemade crisps



Unhealthy base food without AFI



Unhealthy base food with healthy AFI

Appendix 4. Experimental Stimuli in Study 3



Reference: homemade crisps



Unhealthy base food
without AFI



Unhealthy base food with
one healthy AFI



Unhealthy base food
with multiple healthy
AFIs

Appendix 5. Experimental Stimuli in Study 4



Reference: handmade cookies



Unhealthy base food
without AFI

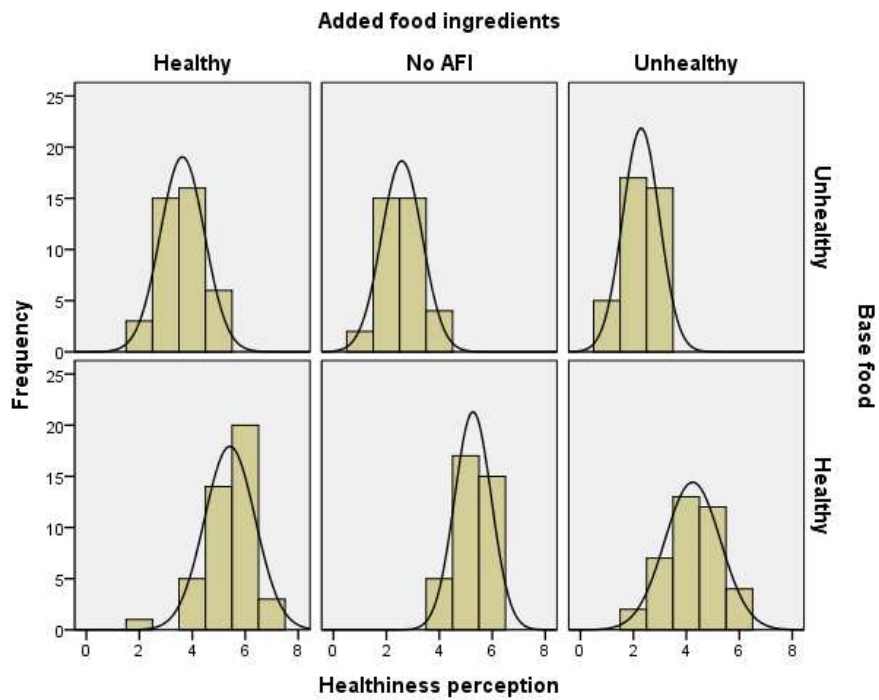
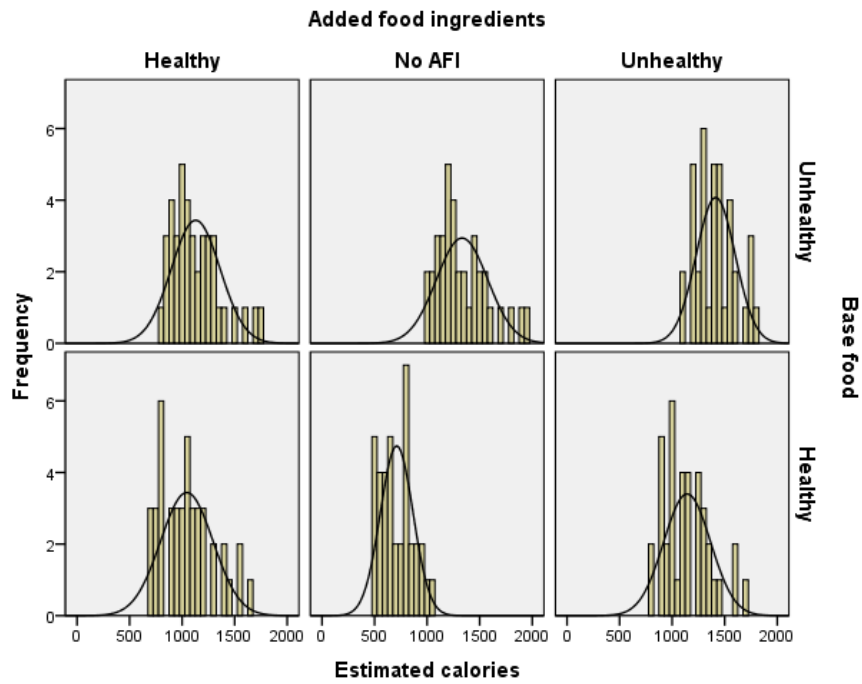


Unhealthy base food with
healthy AFI in picture

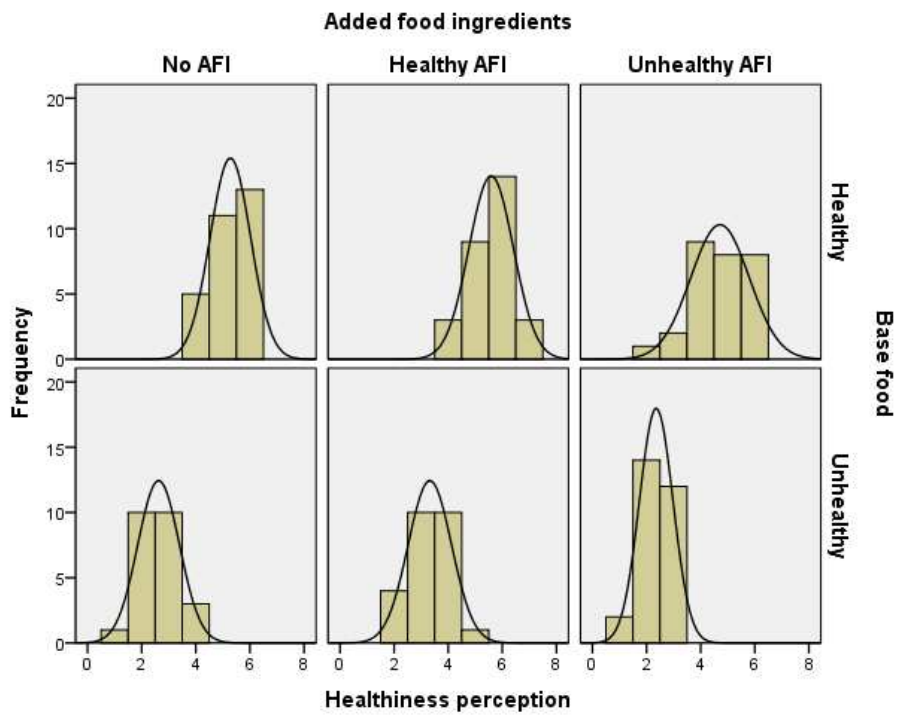
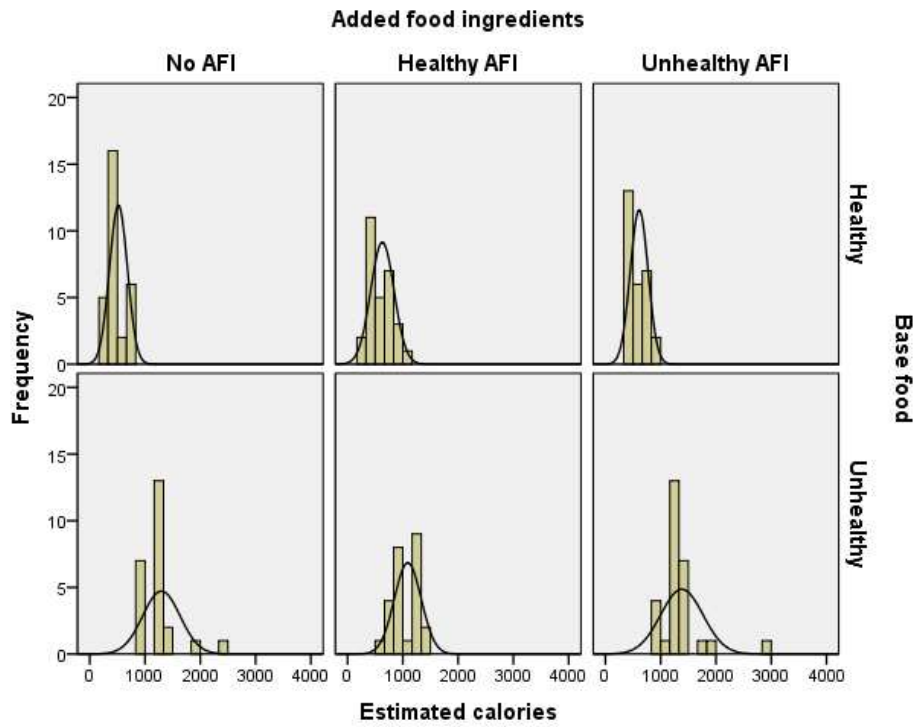


Unhealthy base food with
healthy AFI in words

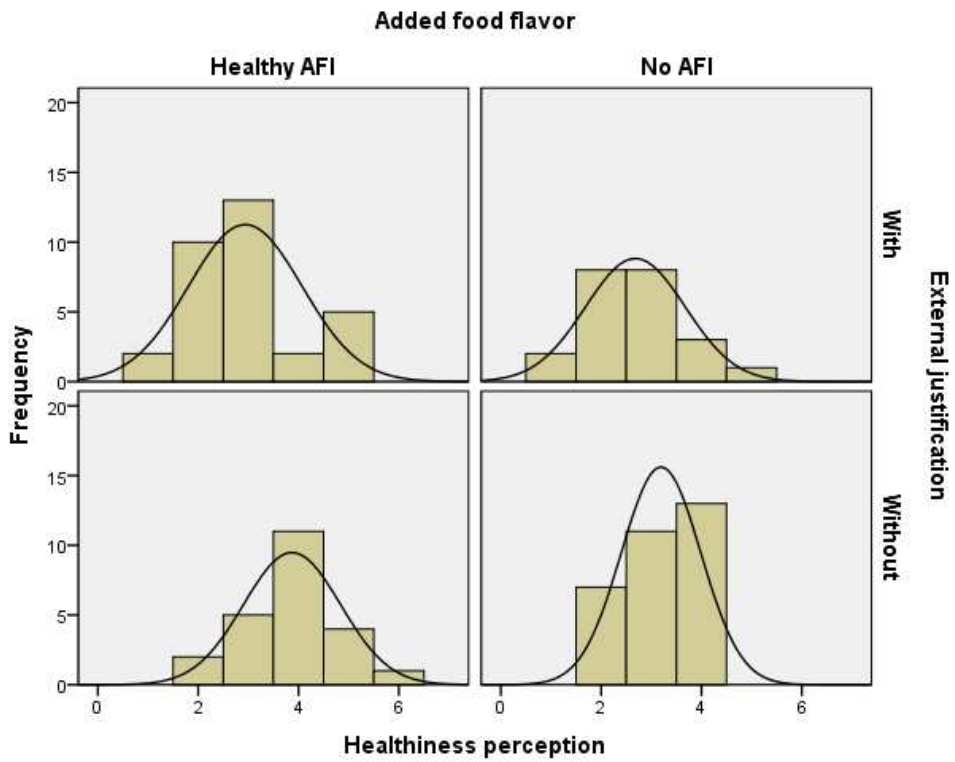
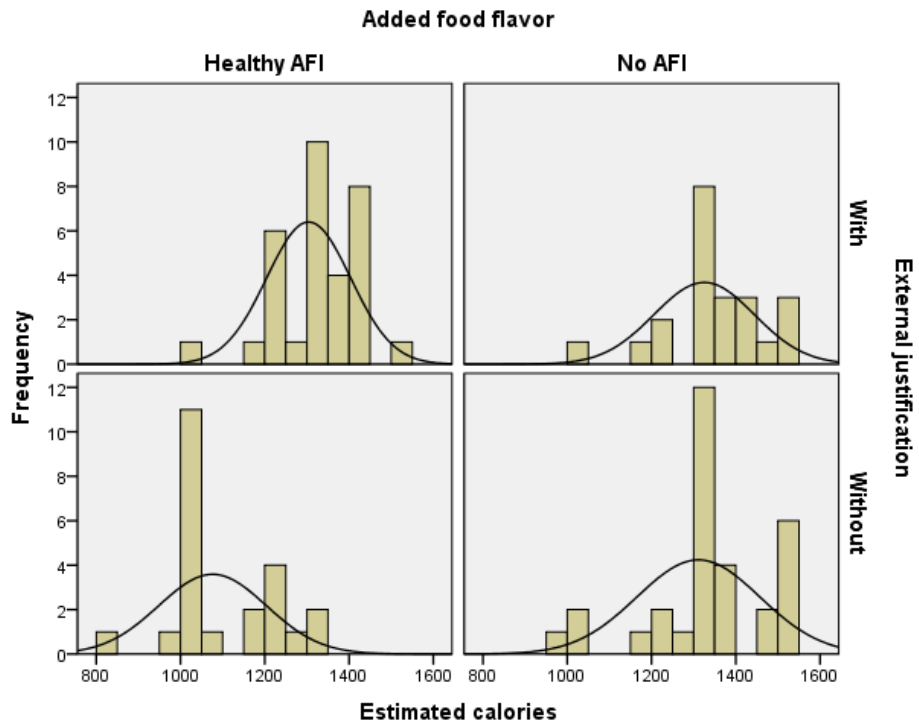
Appendix 6. Distribution of Responses



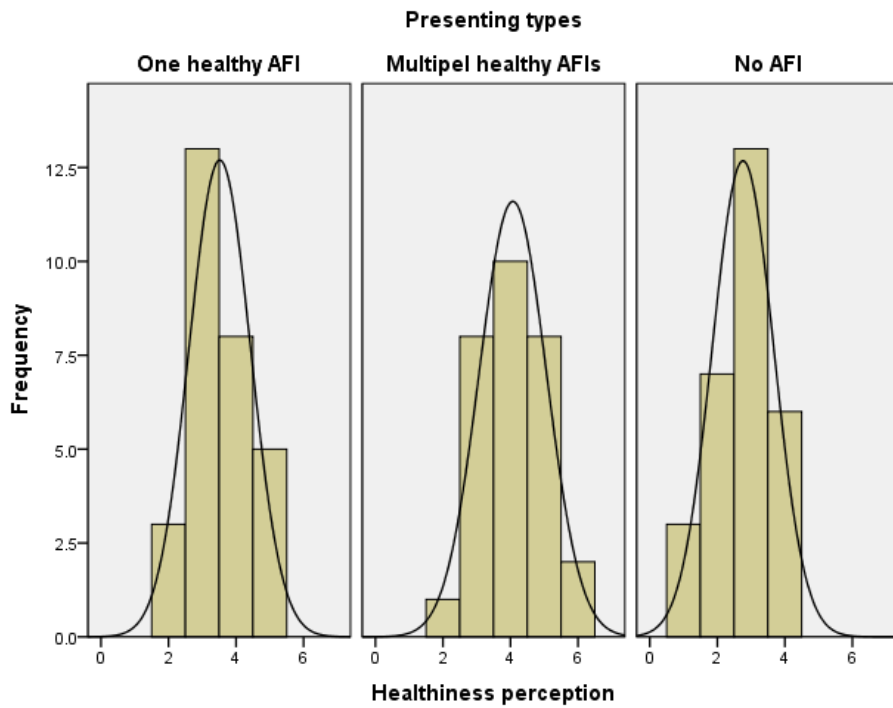
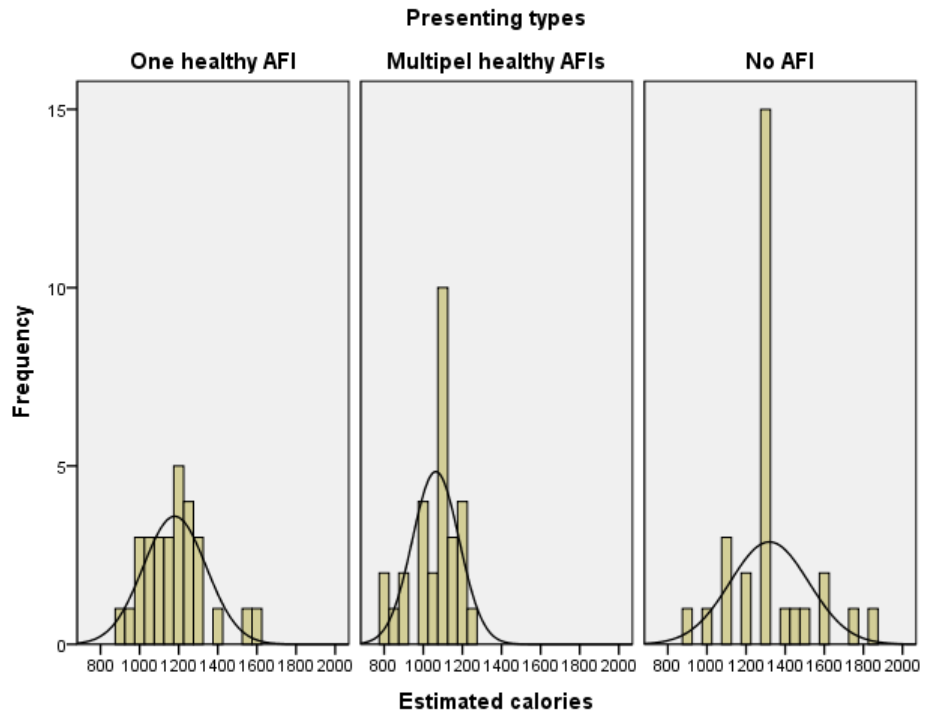
Study 1a



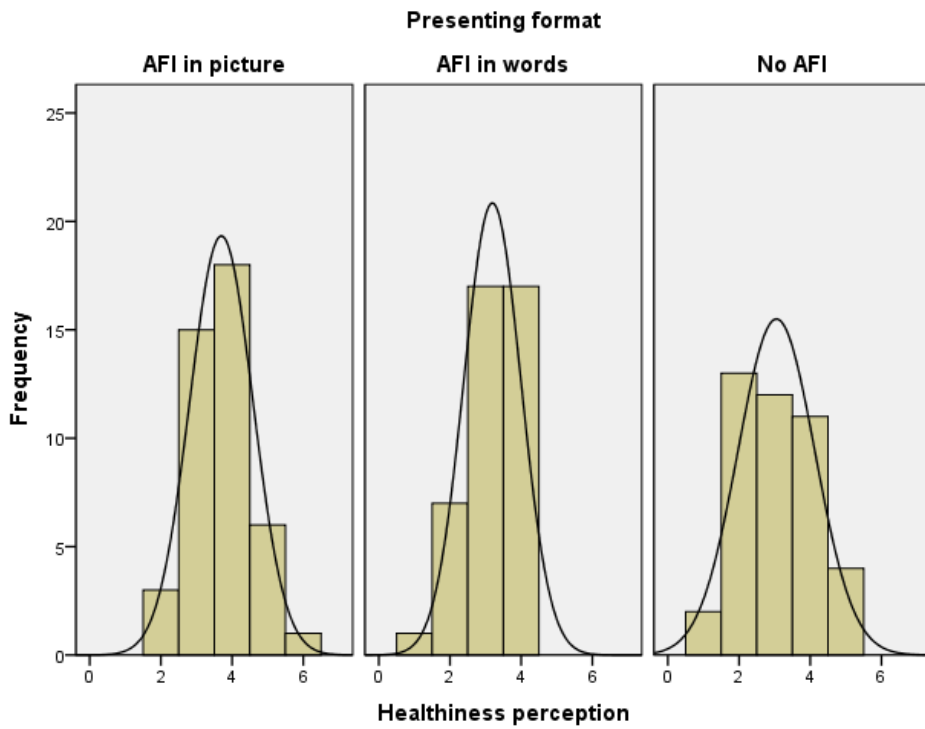
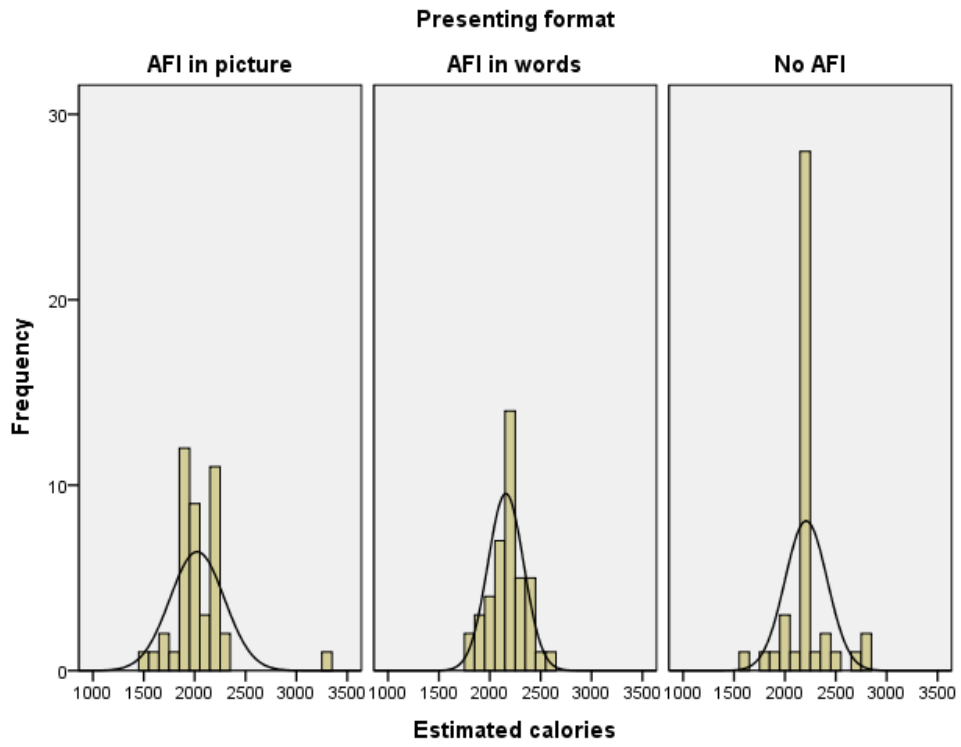
Study 1b



Study 2



Study 3



Study 4