

**The impact of menu label design on visual attention, food choice and recognition: an eye tracking study**

REALE, Sophie and FLINT, Stuart

Available from Sheffield Hallam University Research Archive (SHURA) at:

<http://shura.shu.ac.uk/12714/>

---

This document is the author deposited version. You are advised to consult the publisher's version if you wish to cite from it.

**Published version**

REALE, Sophie and FLINT, Stuart (2016). The impact of menu label design on visual attention, food choice and recognition: an eye tracking study. *Journal of Sensory Studies*, 31 (4), 328-340.

---

**Copyright and re-use policy**

See <http://shura.shu.ac.uk/information.html>

1     **The impact of menu label design on visual attention, food choice and recognition: An**  
2   **eye tracking study**

3

4     **Sophie Reale,<sup>1</sup> Stuart William Flint<sup>2,3</sup>**

5

6     <sup>1</sup> School of Health and Related Research, University of Sheffield, United Kingdom

7     <sup>2</sup> Academy of Sport and Physical Activity, Sheffield Hallam University, United Kingdom

8     <sup>3</sup> Centre for Sport and Exercise Science, Sheffield Hallam University, United Kingdom

9

10

11     \*Requests for reprints should be addressed to Sophie Reale, School of Health and Related  
12     Research, Regent Court, Sheffield, S1 4DA, United Kingdom, email:  
13     slreale1@sheffield.ac.uk

14

15

16

17

18

19

20

21

22

23

24

25

26 **Abstract**

27 Nutritional labelling on menus has been found to promote informed food choices and reduce  
28 information asymmetry between manufacturers and consumers. However, lack of attention to  
29 nutritional labels limits their effectiveness. This study manipulated the way in which  
30 nutritional information was provided on menus in aim of enhancing visual attention to the  
31 most health relevant information. A between-subject design was implemented with three  
32 experimental conditions (*non-directive label; directive label; semi-directive label*). A total of  
33 84 participants chose meals off a starter, main and desert menu whilst their eye movements  
34 were tracked using Tobii eye tracking software. Results showed that the menu labels did not  
35 significantly differ in their attentional gaining properties however the use of colour and health  
36 logos led participants to choose meals containing significantly less calories compared to  
37 when nutritional information was presented in black text alone. These findings indicate that  
38 nutritional information should be provided in colour or as health logos as this has the largest  
39 impact on food choice.

40 **Practical Applications**

41 A factor contributing to the rise in obesity prevalence is the obesogenic environment that we  
42 live in. The population has become increasingly reliant on convenience foods and dining out  
43 which has led to excess calorie consumption. Menu labelling has been identified as a possible  
44 intervention that could be employed by policy makers to guide informed food choices.  
45 However, there are calls for further actions and intervention to improve food choice as menu  
46 labelling has had mixed effects upon consumer choice and consumption. This study suggests  
47 that menu labelling is a viable option when the nutritional information is presented in a  
48 visually salient way. The use of colours and health logos attracts consumer's attention to the  
49 most health relevant information which could contribute to efforts in reducing obesity and  
50 other illnesses linked to unhealthy consumption.

51 *Keywords: menu labelling; food choice; eye tracking; visual attention; obesity*

52

53

54

55

56

## 57 **Introduction**

58           Obesity is a nutrition related disease that has more than doubled in the UK in the past  
59 25 years. Currently 24.8% of adults and 15% of children in the UK are classified as obese;  
60 therefore it is considered a significant health problem (National Health Service 2013).  
61 Nutrition plays a key role in achieving and maintaining a healthy body weight. However,  
62 there has been a concomitant increase in the marketing of unhealthy food, poor dietary  
63 choices in the British population, and increased prevalence of obesity and associated chronic  
64 illness (Fung *et al.* 2015; Huang *et al.* 2015). Efforts to reduce the continuing prevalence of  
65 obesity have steered towards focusing primarily on reducing energy intake and promoting  
66 healthier consumption (Valaquez and Pasch 2014).

67           Factors that influence dietary intake are complex and varied, including taste  
68 preferences, beliefs and values about nutrition. Typically, consumers engage in automatic,  
69 intuitive decisions regarding food choice that are guided by heuristics (Milosavljevic and  
70 Cerf 2008). Health policy and nutritional-related initiatives such as labelling can impact  
71 consumers' knowledge of food, health and subsequent food choice (Grunert *et al.* 2010).  
72 Research examining the impact of labelling has primarily focused on food packaging, with  
73 increased attention in recent years to menu labelling whilst dining out. Meals eaten out of  
74 home are predominantly larger in portion size and contain larger quantities of saturated fat  
75 compared to traditional home cooked meals (Bassett *et al.* 2007). The presence of nutritional  
76 information on packaged foods does not act as a precursor for nutritional awareness when  
77 dining out (Grunert, Bolton and Raats 2012). Thus, a need for labelling on menus to increase  
78 consumer awareness in restaurant environments was evident, and in 2009 the Food Standards  
79 Agency (FSA) developed a voluntary menu labelling scheme for the UK catering industry to  
80 promote healthier consumption when dining out (Seiders and Petty 2004). A total of 450  
81 stores, from 21 well-known high street brands, agreed to display calorie information for their  
82 food and drink items, with an overall aim to reduce calorie intake such that it was  
83 significantly impactful on health at a population level (Morley *et al.* 2013).

84

### 85 *Menu labelling*

86           Menu labelling has been reported to significantly impact food choice in a UK obese  
87 population such that a reduction in calories selected was observed (Reale and Flint 2016).  
88 However, menu labelling research in the UK is sparse. A majority of menu labelling research

89 has been conducted in the USA (e.g., Pulos and Leng 2010) as catering establishments  
90 retailing at 20 or more outlets have to provide calorie information on menus as part of the  
91 Patient Protection and Affordable Care Act (ACA; Pizam 2011). Angell and Silver (2008)  
92 reported that nutritional information presented at the point-of-purchase led to a decrease in  
93 calorie intake by 15% in a fast-food outlet. In alignment, Chu, Frongillo, Jones and Kaye  
94 (2009) reported similar findings when examining the impact of nutritional values in a  
95 cafeteria setting. The average calories purchased significantly decreased from 839 kcal to 667  
96 kcal showing a 20% reduction. Importantly, there were no differences in the total number of  
97 entrees sold therefore the reduction in calories were resultant of consumers selecting less  
98 energy dense foods. However, in some cases menu labelling has been found to have no  
99 impact on food preference (Harnack *et al.* 2008; Finkelstein *et al.* 2011). This has questioned  
100 the cost effectiveness of such intervention as extensive time and precision is required to  
101 provide accurate nutritional information, especially when the catering industry is continually  
102 making changes to the foods on offer (Lazareva 2015).

103         One possible explanation for the contrasting evidence is menu label design. Harnack  
104 *et al.* (2008) provided four fast food restaurant menus to participants as part of a between  
105 subject design. The calorie information was presented between the food item and price which  
106 resulted in just over half of the participant's reporting that they had seen the calorie  
107 information (54%). However, Chu *et al.* (2009) provided nutritional information on larger  
108 labels measuring 5 x 3 inches (height and width) and guided participants towards the  
109 information using a space divider to ensure the information was read. In similar studies  
110 whereby menu labelling had been presented in large text (Cinciripini 1984) and coloured  
111 fonts (Milich, Anderson and Mills 1976) a significant impact on food choice has also been  
112 reported. This suggests that visual attention to nutritional information plays a key role in  
113 consumer use of information and may explain why menu labelling had no impact when  
114 provided on a drive-thru menu in Kings County (Finkelstein *et al.* 2011).

115         The health consciousness of the individual also plays a part in the use of nutritional  
116 information. Health conscious consumers tend to act in accord to their internal attitudes, and  
117 thus, are more sensitive to behavioural consequences. They will actively search for the  
118 nutritional information to guide their choices when menu labelling is present (Gould 1990;  
119 Visschers, Hess and Siegrist 2010). Alternatively, less health conscious consumers without  
120 nutrient specific goals are unlikely to have their attention drawn towards the most health  
121 relevant information. Instead it is likely that they are stimulus driven which is largely

122 determined by attention and the visual saliency of the information within the visual field.  
123 Label information salience is determined by characteristics of the label itself against the  
124 background of the micro and macro context suggesting that labels need to be presented in a  
125 way that will attract consumer's attention towards the most health relevant information  
126 (Bialkova and van Trijp 2010).

127

### 128 *Nutrition label manipulation*

129 Visual graphics have been reported as a powerful motivator for ordering behaviour  
130 (Hanks *et al.* 2012). When used on coloured advertisements they captured participants'  
131 attention quicker and for a longer duration of time than black and white advertisements, in an  
132 eye tracking study of the yellow pages (Lohse 1997). Similar findings have been reported  
133 when consumers were presented with nutritional information on labels that had been made  
134 more salient within the visual field (Bialkova and van Trijp 2010). The crucial factors in  
135 determining visual attention to labels and the initial phase of searching include shape,  
136 contrast (Clement *et al.* 2013) and colour, especially when nutritional labels are affected by  
137 competing clutter dimensions (Bialkova *et al.* 2013). Even though the debate remains  
138 regarding how nutritional information should be presented (Feunekes *et al.* 2008), these  
139 studies support the notion that colours, font and logos can draw attention to stimuli by  
140 separating specific items from one another (Kershaw 2009). Based on these findings, a  
141 typology of labelling formats was recently suggested (Hodgkins *et al.* 2012) in relation to the  
142 degree to which they allow consumers to draw conclusions about the healthfulness of a  
143 product (Grunert and Wills 2007). Three designs were constructed: namely non-directive,  
144 semi-directive and directive.

145 Non-directive labels are currently being used on menus as part of the ACA (Pizam  
146 2011). They provide no information of the products healthiness, other than stating the  
147 calorific values of food items on the menu. Semi-directive labels include a partial evaluation  
148 of nutritional content through colour. For example, the traffic light labelling system  
149 encourages consumers to consider the foods they select based on the evaluation of nutritional  
150 content (Borgmeier and Westenhoefer 2009). Finally, directive labels use health logos to  
151 guide consumers' attention to the healthiest items in an all or nothing format (van Herpen and  
152 van Trijp 2011). Logos reduce cognitive effort thus they are beneficial in promoting healthier  
153 consumption to low health conscious people as they are less likely to search for nutritional

154 information to guide their decisions (Russo *et al.* 1986). Health consciousness can be  
155 measured using inventories such as the health and nutritional awareness questionnaire which  
156 is a validated tool (Kempen *et al.* 2012). However, Hodgkins *et al.* (2012) typology of  
157 labelling formats have not been utilised on menus, and whilst previous research (e.g.,  
158 Bialkova *et al.* 2014) demonstrates that they may be effective in improving food choice when  
159 purchasing packaged foods, the impact on food choice from a menu is yet to be understood.

160 Traditional approaches measuring nutritional label used have relied upon self-report  
161 methods (Cowburn and Stockley 2005; Higginson *et al.* 2002; Kelly *et el.* 2009), surveys and  
162 questionnaires (Roberto *et al.* 2012; Steenhuis *et al.* 2010). These processes are limited as two  
163 assumptions are made regarding the level of awareness in the processing of nutrition  
164 information and the level of introspection in reporting information processing (van Trijp  
165 2009). These limitations have stimulated methodological innovation including approaches  
166 based on the visual search methodology (Bialkova and van Trijp 2010; Bialkvoa Grunert and  
167 van Trijp 2013) and eye tracking measurements (Graham *et al.* 2012).

168 When visual search methodologies were enforced (Bialkova and van Trijp 2010;  
169 Bialkvoa Grunert and van Trijp 2013), attention, as indicated by performance, was better with  
170 monochromatic than polychromatic colouring, in particular GDA's. Neuroscience research  
171 has demonstrated that this is resultant of the extra brain regions involved in processing colour  
172 (Zeki and Marini 1998). However, these findings contradict consumer studies which may be  
173 due to the paradigms and measures used. Jones and Richardson (2006) examined the impact  
174 of labelling on attention and food choice in a supermarket using eye tracking technology. The  
175 use of eye tracking in menu labelling research is sparse; however it is suggested as a useful  
176 tool as it is less susceptible to social desirability than participant recall methods (Graham,  
177 Orquin and Visschers 2012). It is also well established and widely used in psychology for  
178 capturing attention (e.g. Rayner 1998; 2009). The study found that the semi-directive label  
179 captured consumers' attention quickly which made it easier for consumers to evaluate the  
180 healthfulness of the item compared to the non-directive labelling design.

181 Similarly, Bialkova *et al.* (2014) reported that label design was found to significantly  
182 impact both the number and duration of fixations, such that participants' attention was drawn  
183 to the semi-directive labelling system significantly more than the non-directive label. This  
184 increased the products likelihood of being selected, providing further evidence that attention  
185 is drawn to semi-directive labels. However, both of these studies only compared two of the  
186 three label designs. Therefore, it is not surprising that Van Herpen and van Trijp (2011)

187 found contrasting results when comparing all three labelling designs. The semi-directive label  
188 impacted food preferences, but its attention gaining properties and abilities to enhance  
189 selection beyond the level achieved in the directive labelling condition was not significant. It  
190 was the directive labelling system using health logos that enhanced attention resulting in  
191 participants making informed food choices. However, 30% of consumers reported that taste  
192 preference was the main reason for food choice, and therefore irrespective of health logos,  
193 remained a considerable factor in the decision making process as continuously found in the  
194 literature (Grunert, Wills and Fernandez-Celemin 2010). These studies provide some  
195 indication as to how labelling design impacts attentional capture and food choice, but they are  
196 not without limitation. The results represent the impact of nutritional labels on pre-packaged  
197 foods and therefore cannot be generalised to a dining out occasion where no time constraint  
198 applies (Drichoutis, Lazaridis and Nayga 2006).

199           Labelling appears to be an effective method of promoting informed food choices.  
200 However, despite concerns raised regarding food choice when dining out, there is a lack of  
201 research examining the effectiveness of menu labelling and thus, warrants investigation.  
202 Research to date has predominantly focused on consumers' comprehension of the information  
203 (e.g., Roberto *et al.* 2012) with only a handful of studies examining the effect of nutritional  
204 labelling on visual attention and these were limited to pre-packaged foods (Jones and  
205 Richardson 2006). A general concern emerging from this line of research is whether  
206 consumers notice and use the nutrition information in their final food choice decisions  
207 (Bialkova Grunert and van Trijp 2013). It is important to know what attracts consumers  
208 attention to nutrition labels and whether these labels have any influence on consumer  
209 purchase decisions (Bialkova and van Trijp 2010). It is still unknown how nutritional  
210 information on menus is absorbed and retrieved as no research to date has examined what  
211 consumers attention is drawn to throughout exposure of menu labelling (i.e., from first  
212 fixation during initial exposure, during final food choice and in retrieval). Therefore, the  
213 current study examined the impact of menu labelling design on visual attention, food choice  
214 and recognition of information.

215           Based on current evidence relating to the impact of labelling four hypotheses were  
216 offered:

- 217           1. In line with Jones and Richardson (2006), the semi-directive and directive  
218           labelling design were expected to attract participants attention quicker  
219           (shortest time to first fixation) than the non-directive label.



- 220 2. In line with Bialkova *et al.* (2014), the semi-directive and directive labelling  
221 design were expected to draw participant's attention to the information  
222 significantly more thus resulting in more frequent observations than the non-  
223 directive label (visit count; fixation count; fixation duration).
- 224 3. Participants will select food items containing the lowest calorie content in the  
225 semi-directive and directive labelling conditions in accordance to previous  
226 literature (Van Herpen and Van Trijp 2011).
- 227 4. Greater recognition of nutritional information is hypothesised in the directive  
228 and semi-directive condition as it will be attended to more, thus will be  
229 processed more effectively (and subsequently recognised) than the non-  
230 directive condition (Bialkova *et al* 2014).

## 231 **Methods**

### 232 *Participants*

233 A convenience sample of 84 participants were recruited from Sheffield Hallam  
234 University ensuring a small effect size ( $=.15$ ) and adequate level of power ( $=.77$ ). The sample  
235 included both university staff and students aged 18 years or above (mean =  $23.58 \pm 5.84$ )  
236 with a mean body mass index (BMI) of  $23.94 \pm 4.23 \text{ kg}\cdot\text{m}^2$ . Participants were excluded from  
237 the study if classified as blind or colour blind to prevent invalidating findings.

### 238 *Procedure*

239 Following ethical approval, a pilot study was conducted in 6 participants from  
240 Sheffield Hallam University (female = 50%) who were above the age of 18 ( $21.45 \pm 3.43$ )  
241 and had a mean BMI of  $22.95 \pm 5.72 \text{ kg}\cdot\text{m}^2$ . Based on the pilot study, an additional task was  
242 added to the eye tracking section of the study. It was determined that short term memory  
243 could not be measured validly in the recognition task. Therefore, long term memory would be  
244 measured. A maze was added for 120 seconds before the recognition task, to ensure that the  
245 time between tasks was controlled.

246 On entering the eye tracking studio, participants were provided with the information  
247 sheet and were offered the opportunity to ask questions about the study, before signing the  
248 informed consent form. Initially, participants completed a demographic form and the HNA  
249 (Kempen *et al.* 2012). Participants were then seated 65 cm in front of a 24 inch monitor with  
250 built in Tobii Studio software (Tobii T60) where they were randomly allocated to an  
251 experimental condition, as part of a between-subject design (1= non-directive labelling

252 system; 2= directive labelling system; 3= semi-directive labelling system; see Figures 1-3), to  
253 reduce practise effects in line with previous research (van Herpen and van Trijp 2011; Field  
254 2009). At this point the principal investigator left the room allowing participants to complete  
255 the eye tracking section of the study alone to prevent distractions and social desirability  
256 effects (Lohse and Johnson 1996).

257 On screen instructions firstly directed participants to fixate on a black dot presented in  
258 the centre of a red circle. Participants were asked to follow the dot as it moved around the  
259 screen for 10 seconds to calibrate the participant's eye movement to the eye tracking camera.  
260 Green lines were produced once the participant's eye movements were calibrated, indicating  
261 that the eye tracking element of the study could begin.

262 The first element of the eye tracking study required participants to select one food  
263 item off the starter, main and desert menu in accordance to the forced choice model. To  
264 replicate a natural restaurant setting no time restraint was implemented (Drichoutis *et al.*  
265 2006) and participants were asked to imagine that they were dining out for an evening meal  
266 (Brown 2014). Once participants selected their food items, they were directed to solve a maze  
267 presented on the screen simply with eye movements. The task was limited to 120 seconds to  
268 ensure that time between tasks was controlled. After 120 seconds, regardless of maze  
269 completion, the recognition task begun. A previously shown food item from each menu was  
270 displayed on the screen for 5 seconds. For each previously shown food item, three calorific  
271 values were presented. One of the values was presented previously on the menu and thus was  
272 the correct calorific value for that food item. The other two values were fictional but  
273 remained within a range of 25% to reduce participant's reliance on guesswork when  
274 instructed to select which value they thought was correct (Monroe, Powell and Choudhury  
275 1986). At this point, the eye tracking element of the study was complete and participants  
276 were instructed to complete the FCQ (Stephoe *et al.* 1995). The principal investigator then  
277 returned to provide a full verbal and written debrief to the participant.

## 278 *Measures*

279 *The Health and Nutritional Awareness Questionnaire (HNA; Kempen et al. 2012)* is a  
280 reliable measure of health consciousness relevant to two dimensions (Cronbach Alpha:  
281 Health awareness  $\alpha = 0.86$ , nutritional lifestyle behaviours  $\alpha = 0.84$ ). It consists of 21  
282 statements each rated on a 5 point Likert scale from 1-5 (strongly disagree to strongly agree).  
283 Scores range from 7- 35 and 14-70 for the health awareness and lifestyle scales respectively.

284 This measurement was included as there is evidence suggesting that health consciousness  
285 determines the effects of internal attitudes and external influences on consumer behaviour  
286 (Gould 1990).

287 *The Food Choice Questionnaire (FCQ; Steptoe, Pollard and Wardle 1995)* measures  
288 the motives that underpin food choice, pertinent to nine dimensions (Cronbach alpha: weight  
289 control  $\alpha = 0.79$ ; mood  $\alpha = 0.83$ ; convenience  $\alpha = 0.81$ , health  $\alpha = 0.87$ ; natural content  $\alpha =$   
290  $0.84$ ; price  $\alpha = 0.82$ ; familiarity  $\alpha = 0.70$ ; ethical concern  $\alpha = 0.70$ ; sensory appeal  $\alpha = 0.70$ ).  
291 A review of the FCQ suggested that an improved version should include less categories and  
292 items, to increase robustness (Fotopoulos *et al.* 2009). Therefore, the categories price,  
293 convenience and ethical concern were removed, as they were not relevant to the study. The  
294 modified FCQ contained 18 statements, rated on a 4 point Likert scale from 1-4 (not true to  
295 very true). Thus overall scores for each scale ranged from 3 to 12.

296 *Menu Design:* A starter, main and desert menu included 9 items randomly chosen from a  
297 well-known dining out establishment, where nutritional information is readily available. A  
298 menu from a sit-down service restaurant was chosen to address previous studies limitations  
299 that have predominantly used menus from fast-food outlets (e.g., Angell and Silver 2008).  
300 The menu contained three meals of low, medium and high calorie options to ensure there was  
301 no tendency towards high or low options. Price was removed in line with previous findings,  
302 as it is the most influential factor in the food choice process; therefore its inclusion may have  
303 invalidated findings (Roseman, Mathe-Soulek and Higgins 2013). Three designs were used as  
304 these are the three main labelling schemes currently used on packaged food in the EU:  
305 condition one presented calorie information in black text in accordance to the non-directive  
306 labelling design; condition two used health logos as part of the directive labelling design; and  
307 condition three employed a colour-coded traffic light labelling system as part of the semi-  
308 directive labelling design (Storcksdieck *et al.* 2010). For all experimental conditions the  
309 calorific value of meals selected was recorded.

310 *Visual Attention:* An area of interest (AOI) was created around the nutritional  
311 information presented on the menus. The AOI had five measures which were calculated using  
312 the Tobii eye tracker software (Tobii TX300): 1) *Time to first fixation* (time from the first  
313 menu display until the participant first fixated on the AOI); 2) *Total fixation duration* (total  
314 time of all fixations in the AOI); 3) *Fixation count* (the number of times a participant fixated  
315 on an AOI) and 4) *Visit count* (the number of times a participant visits an AOI including both  
316 saccades and fixations 5) *Percentage of fixations* (the percentage of nutritional information

317 that participants fixated on; Bialkova and van Trijp 2011). The software used a velocity  
318 threshold method to define saccades and fixations. When the velocity of the Fovea was  
319 higher than 30 visual degrees per second, the eye movement was defined as a saccade.  
320 Anything lower was defined as a fixation. The binocular sampling rate was set at 60 Hz and  
321 allowed for freedom of head movement in a 41 x 21 cm virtual box (TobiiPro 2015).

322 *Recognition Task:* To identify whether learning had taken place following the presentation of  
323 nutritional information, a recognition task based on the forced choice model was included  
324 (Brown 2014). The crucial feature was that participants were not asked to memorise anything  
325 and that under a false pretence, they were presented with calorific values, and thus learning  
326 was incidental in nature (Laureati *et al.* 2011). Visual short term memory was not measured  
327 as instructions had to be provided immediately before the task thus inhibiting immediate  
328 memory capture. Therefore, long term memory was measured following a 120 second task  
329 (Baddely and Hitch 1974). The task consisted of completing a maze, rather than popular  
330 counting tasks, to prevent numerical values interrupting memory retrieval of the calorific  
331 values (Ricker, Cowan and Morey 2010).

### 332 *Data Analysis*

333 A multivariate analysis of covariance (MANCOVA) was run in SPSS (Version, 21) to  
334 determine how menu labelling design impacts visual attention, food choice and recognition,  
335 when controlling for health consciousness. Health consciousness was used as a covariate due  
336 to individual differences in information processing (Gould 1990) and attentional capture  
337 (Visschers *et al.* 2010). All assumptions for the inferential test and the covariate were met  
338 following the calculation of descriptive statistics (Table 2). Where a main effect was  
339 established, pairwise comparisons were used to follow up significant effects. For all analyses  
340  $\alpha$  was set at .05. Internal consistency for the modified FCQ was determined by calculating  
341 Cronbach Alpha.

342

### 343 **Results**

344 The experimental groups consisted of near to equal sex distribution as shown in Table  
345 1. There was no significant difference for age ( $F(2,81) = .06, p > .05, \eta_p^2 = .01$ ) or BMI  
346 ( $F(2,81) = 2.63, p > .05, \eta_p^2 = .06$ ).

347 *Visual Attention*

348           The directive labelling (*Condition 2*) design captured participant's visual attention  
349 more quickly than the semi-directive (*Condition 3*) and non-directive (*Condition 1*) labelling  
350 design. This resulted in participants fixating on the nutritional information in the directive  
351 labelling condition for the longest length of time, as shown by the largest fixation duration  
352 and count (See Table 2). Participants also returned to the information during the decision  
353 making process in the directive labelling condition, but this was more frequent when the  
354 information was provided with colours in the semi-directive condition. There was no main  
355 effect for time to first fixation ( $F(2,81) = .30, p > .05, \eta_p^2 = .01$ ), fixation duration ( $F(2, 81) =$   
356  $2.08, p > .05, \eta_p^2 = .05$ ), fixation count ( $F(2,81) = 2.28, p > .05, \eta_p^2 = .05$ ) or visit count  
357 ( $F(2,81) = 2.31, p > .05, \eta_p^2 = .05$ ) for menu labelling design. However, there was a  
358 significant difference in the amount of nutrition information that was fixated upon ( $F(2, 81) =$   
359  $150.84, p > .001, \eta_p^2 = .79$ ). Participants in the semi-directive and directive labelling  
360 condition fixated upon all the nutritional information, whereas participants in the non-  
361 directive conditions fixated on  $41.93 \pm 4.73\%$  of the nutritional information provided.

362           When controlling for health consciousness there was also no main effect for time to  
363 first fixation ( $F(2, 81) = .23, p > .05, \eta_p^2 = .01$ ), fixation duration ( $F(2,81) = 1.75, p > .05, \eta_p^2$   
364  $= .04$ ), fixation count ( $F(2,81) = 1.96, p > .05, \eta_p^2 = .05$ ) or visit count ( $F(2,81) = 2.54,$   
365  $p > .05, \eta_p^2 = .06$ ) for menu labelling design. However, there was a significant difference in  
366 the amount of nutrition information that was fixated upon ( $F(2, 81) = 110.08, p > .001, \eta_p^2$   
367  $= .81$ ). Participants in the semi-directive and directive labelling condition fixated upon all the  
368 nutritional information, whereas participants in the non-directive conditions fixated on  $41.93$   
369  $\pm 4.73\%$  of the nutritional information provided.

370 *Food Choice*

371           Participants in the non-directive labelling system chose meals containing the highest  
372 mean energy content compared to when a partial evaluation of overall healthiness was  
373 provided with semi-directive and directive labels (see Table 2). The MANOVA showed that  
374 there was a main effect for content of meals selected based on the menu labelling condition  
375 ( $F(2,81) = 7.31, p < .01, \eta_p^2 = .15$ ). This was also shown in the MANCOVA when controlling

376 for health consciousness ( $F(2,81) = 6.95, p < .01, \eta_p^2 = .15$ ). Pairwise comparisons identified  
377 that the food selected was significantly lower in calories in the directive ( $p < .05$ ) and semi-  
378 directive ( $p < .05$ ) conditions in comparison to the non-directive condition.

### 379 *Recognition*

380 As show in Figure 1, the largest proportion of participants to accurately recognise all  
381 three calorific values were those that chose meals in the directive (N=5) and semi-directive  
382 condition (N=5). Participants who observed the nutritional information in the non-directive  
383 condition recorded the most incorrect answers (N=4; Figure 1). However, in all three  
384 conditions the mean accuracy score and time taken was similar (see Table 2), resulting in no  
385 main effect for recognition accuracy ( $F(2, 81) = .75, p > .05, \eta_p^2 = .02$ ) or time taken ( $F(2, 81)$   
386  $= 2.13, p > .05, \eta_p^2 = .05$ ) for menu labelling design. This was also observed when controlling  
387 for health consciousness: recognition accuracy ( $F(2, 81) = .66, p > .05, \eta_p^2 = .02$ ) and time  
388 taken ( $F(2, 81) = .73, P > .05, \eta_p^2 = .02$ ).

### 389 *Reason for Food Choice*

390 In all three conditions the most influential factor of food choice was sensory appeal.  
391 However, participants were more concerned about their personal health and weight, as well  
392 as the food item's natural content, when nutritional information was presented in the directive  
393 and semi-directive conditions compared to the non-directive condition. Yet, there was no  
394 main effect for food choice based on natural content ( $F(2,81) = 1.09, p > .05, \eta_p^2 = .02$ ),  
395 weight control ( $F(2,81) = 1.25, p > .05, \eta_p^2 = .03$ ), health concern ( $F(2,81) = 1.71, p > .05,$   
396  $\eta_p^2 = .04$ ), sensory appeal ( $F(2,81) = .85, p > .05, \eta_p^2 = .02$ ), mood ( $F(2,81) = 1.05, p > .05,$   
397  $\eta_p^2 = .03$ ) or familiarity ( $F(2,81) = 2.26, p > .05, \eta_p^2 = .05$ ) in the three menu labelling  
398 conditions. This was also observed when controlling for health consciousness: natural content  
399 ( $F(2,81) = .75, p > .05, \eta_p^2 = .02$ ), weight control ( $F(2,81) = 1.25, p > .05, \eta_p^2 = .03$ ), health  
400 concern ( $F(2,81) = 2.27, p > .05, \eta_p^2 = .05$ ), sensory appeal ( $F(2,81) = .86, p > .05, \eta_p^2 = .02$ ),  
401 mood ( $F(2,81) = .90, p > .05, \eta_p^2 = .02$ ) and familiarity ( $F(2,81) = 2.35, p > .05, \eta_p^2 = .06$ ).

402

### 403 **Discussion**

404 Eye tracking technology was used to examine the impact of menu labelling design on  
405 attention gaining properties and establish whether and how label design impacts food choice  
406 and recognition. Three labelling designs were employed that differed in their ‘directiveness’,  
407 referring to the degree to which they allow consumers to draw conclusions about the  
408 healthfulness of a food item (Grunert and Wills 2007). This study found that visual attention  
409 and recognition of the nutritional information did not significantly vary by label design,  
410 however label design did significantly impact food choice.

#### 411 *Visual Attention*

412 When participants were presented with nutritional information on menus, time to first  
413 fixation did not significantly vary by menu labelling design in contrast with previous research  
414 research (Bialkova *et al* 2014). Therefore, hypothesis 1 was not met. However, the directive  
415 and non-directive label, employing a monochromatic colour scheme, showed slightly higher  
416 attentional capture than the semi-directive label, which employed a traffic light colour  
417 scheme. These findings are in line with previous literature that compared the attentional  
418 gaining properties of monochromatic and polychromatic colouring on nutritional labels  
419 (Bialkova and van Trijp 2010, Bialkova Grunert and van Trijp 2013) whereby it has been  
420 demonstrated that processing colour coded information takes extra time, as more brain  
421 regions are involved in processing this information (Zeki and Marini 1998). This outcome  
422 contrasts consumer preference for coloured labels (Kelly *et al* 2009). Consumers have been  
423 reported to understand and interpret colour more efficiently at high levels of cognitive  
424 processing than when provided with monochromatic labels. Therefore, suggesting that colour  
425 coding effects may vary by level of information processing (Bialkova and van Trijp 2010).

426 During the decision making process, participant’s observed less than half of the  
427 nutritional information when it was presented in black text. This finding is in line with  
428 research that recorded participants self-reported observations of nutritional information on  
429 menus (Harnack *et al* 2008). When nutritional information has been provided in a visual  
430 salient way and received initial attention, an impact on food choice has been reported (Chu *et*  
431 *al* 2009; Cinciripini 1984; Milich, Anderson and Mills 1976). This finding was replicated in  
432 the current study whereby participants in the directive and semi-directive labelling condition  
433 who fixated upon significantly more nutritional information provided on the menus had  
434 slightly larger fixation durations in comparison to the non-directive label. However, fixation  
435 duration was not significantly related to labelling design therefore hypothesis 2 was not met.

436 Furthermore, nutritional information was viewed slightly less frequently, as indicated  
437 by visit and fixation count, when presented in black text compared to the logo and traffic  
438 light colour scheme. This difference was not significant and contradicts previous research  
439 (Bialkova *et al* 2014; Jones and Richardson 2006). This may be resultant of participant  
440 familiarity. Repeated exposure over time has been shown to enhance consumers learning and  
441 familiarity to the nutritional information which subsequently affects attention processes with  
442 consumers requiring less time to process information they are familiar with. This concept was  
443 supported in Bialkova and van Trijp (2011) study that reported a decrease in the fixation  
444 count when consumers were familiar with the label format. Therefore, participant's fixation  
445 and visit count may not have been significantly different due to prior familiarity with the  
446 labels provided as they are currently employed on packaged foods in the UK and on some  
447 restaurant menus as part of a voluntary menu labelling scheme (FSA 2009).

448 Alternatively, no significant differences in attentional data may have been reported  
449 due to the subtle changes enforced to the label design, such that the visually manipulated  
450 labels were unable to significantly shift participants' attention towards the lowest calorie food  
451 items (Wansink, Shimizu and Camps 2012). Label design represents an important  
452 opportunity for enhancing visual attention (Graham *et al.* 2012). Hodgkins *et al.* (2012)  
453 typology of labels were derived from a consumer sorting task thus using a typology that aims  
454 to make a distinction based on processing requirements for attentional gaining properties may  
455 explain why no significant differences were found. Furthermore, label design is not the only  
456 factor in which can be manipulated. Consumers have been found to exhibit a bias towards  
457 items within a certain location on a menu, also known as the sweet spot. This generally tends  
458 to be in the centre of the display which increases the likelihood of that item being selected by  
459 60% (Reutskaja *et al.* 2011). The label design therefore may have been competing for visual  
460 attention against a predominant location that the participants were observing. With this in  
461 mind it is possible that placing the lowest calorie food items in the centre of the menu could  
462 enhance visual attention and steer consumers towards informed food choices. However,  
463 further study is required before drawing such conclusion.

#### 464 *Food Choice*

465 The current study found that label design significantly impacted food choice in the  
466 decision making process. Participants chose menu items containing significantly less calories  
467 in the directive and semi-directive labelling condition compared to the non-directive  
468 condition, in line with hypothesis three and previous research (Van Herpen and van Trijp,



469 2011). This may have been a resultant effect of time to first fixation. Even though time to  
470 first fixation was not significantly different between conditions, it was slightly quicker in the  
471 directive and semi-directive labelling conditions. Evidence suggests that processing of  
472 attended information occurs ‘as soon as possible’ (Just and Carpenter, 1980) and acts as a  
473 determining factor to elaborate a decision. Therefore, if the attended information is relevant  
474 for the intentional decision to be made, then the likelihood of choosing that particular food  
475 item increases (Reutskaja *et al* 2011; Bialkova and van Trijp 2011). These food items are  
476 known as trigger foods which once exposed to, can set the tone for the entire meal such that  
477 exposure to a low calorie appetiser is 8 times more likely to encourage low calorie  
478 consumption for the rest of the meal (Hanks *et al.* 2012; Wansink and Love 2014).

479 A 17-25% reduction was observed in the directive and semi-directive labelling  
480 condition in comparison to the non-directive condition, in line with previous menu labelling  
481 studies (Chu *et al.* 2009; Liu *et al.* 2012). This reduction equates to a 368 to 528 calorie  
482 deficit (semi-directive and directive labelling conditions respectively) which if consumed in  
483 excess is equivalent to gaining approximately 8 pounds a year (Cutler, Glaeser and Shapiro  
484 2003). Therefore, menu labelling appears to be a particularly relevant intervention to employ  
485 in the UK given that consumers reportedly eat out at least once in every six dining occasions  
486 (FSA, 2009).

487 Menu label design did not significantly impact motives for food choice; however the  
488 current study indicated that participants became slightly more concerned about their weight  
489 and health when nutritional information was presented with health logos and colours.  
490 Consumers appear to have low awareness of the high calorific content of meals when dining  
491 out (Berman and Lavizzo-Mourey 2008). The level of comprehension required to understand  
492 nutritional information is easily reduced when attentional capturing properties are enhanced.  
493 This has been found to have the largest impact on positive lifestyle changes such as a clearer  
494 association between consumption and health (Fogg 2009). However, in accordance to  
495 previous studies (e.g., Grunert *et al.* 2010), sensory appeal remained to be the most influential  
496 factor in the decision making process. This finding may appear to be concerning given that  
497 menu labelling aims to encourage informed food choices. However, menu labelling must be  
498 done in a way to prevent negative perceptions of taste. Low calorie foods are often associated  
499 with low sensory appeal (Wansink and Hanks 2013) which can lead to compensatory  
500 behaviours, such as overeating (Chandon and Wansink 2007). With this in mind it has been  
501 suggested that priming and expectation building is required before presenting low calorie

502 foods to enhance consumer taste expectations (Wansink and Love 2014). However, the  
503 current study indicates that this may not be needed, as directive and semi-directive labels  
504 were found to maintain perceived sensory appeal which could subsequently reduce  
505 compensatory behaviours.

#### 506 *Recognition*

507         The outcome of the recognition task appears to be closely related to the visual  
508 attention data. There was no significant difference in the accuracy of the recognition task  
509 which opposes hypothesis 4. Eye movements are associated with information processing  
510 (Rayner and Castelhana 2008) and the deeper the information is processed the easier it is to  
511 be retrieved. However, attentional capture does not imply that comprehension will be  
512 improved. Instead, recognition relies on memory and further processing of nutritional  
513 information, rather than being a pure measure of attention which may explain why no  
514 differences were found between labelling conditions (Bialkova and van Trijp 2010).  
515 Furthermore, when the number of alternatives increases consumers often become more  
516 selective in the information they encode through heuristics strategies (Payne, Bettman and  
517 Johnson 1993). Therefore, deep encoding may not always be possible as the brains  
518 information capacity is limited.

#### 519 *Implications*

520         The implications of the current study are that menu labelling can improve consumer  
521 food choice when dining out, and thus should be considered by policy makers. There are calls  
522 for further actions and intervention to improve food choice and this study suggests that menu  
523 labelling is a viable option that can be enforced. Enforcement of menu labelling could  
524 contribute to efforts in reducing obesity and other illnesses linked to overconsumption of high  
525 energy dense foods (Bezerra *et al.* 2012). More specifically, when nutritional information is  
526 displayed as health logos or in accordance to the traffic light system, it appears to capture  
527 visual attention and encourage consumers to spend a longer duration processing the  
528 nutritional information. Repeated exposure to menu labelling may lead to an improved  
529 awareness of calorie content when dining out (Bettman 1979) which could consequently  
530 enhance informed daily food choices. Restaurants may consider providing lower calorie  
531 options to meet the consumer demand as these foods are generally more profitable (Wansink  
532 and Chandon 2014).

#### 533 *Limitations and Future Research*

534           This study makes an important contribution to the menu labelling literature; however,  
535 it is not without limitations. First, the study was conducted in an eye tracking laboratory thus  
536 hypothetical choices were observed rather than actual food choices. This increases the  
537 likelihood of social desirability biases and does not allow conclusions to be drawn on energy  
538 consumption (Morley *et al.* 2013). Second, food choices were based on the forced choice task  
539 which mandated participants to choose a starter, main and desert item, whereas in reality they  
540 may have chosen a different amount (Brown 2014). Third, participants chose food items after  
541 completing the HNA and the menu items were presented in a fixed order which may have  
542 created a priming or order effect (Dayan and Bar-Hillel 2011). Furthermore, the current  
543 sample were relatively young which reduces the generalisability of the findings given that  
544 nutritional label use is influenced by demographic factors such as gender, age, education  
545 level and income (Sarink *et al.* 2016). A larger sample may have increased the statistical  
546 power ensuring the study was not exploratory in nature. Having said this, the current study's  
547 findings were similar to previous research conducted in a natural setting, implying that  
548 environmental and social influences may not impact food choice to the extent that attentional  
549 capture does (Chu *et al.* 2009). Irrespective, future research should test the impact of menu  
550 labelling in a real life setting to accurately examine consumer visual attention to menu  
551 labelling and its subsequent effect on food choice and consumption.

552

### 553 **Conclusion**

554           The current study is a useful addition to consumer psychology and menu labelling  
555 research examining the impact of menu label design on visual attention, food choice and  
556 recognition by using eye tracking technology. The findings suggest that presenting nutritional  
557 information in health logos or colour captures and maintains visual attention such that it has a  
558 significant impact on food choice. Consumers became more concerned about their health and  
559 weight management which reduced the calorie content of food selected. The UK should  
560 therefore consider implementing menu labelling nationwide to enhance informed food  
561 choices and reduce the prevalence of obesity and associated ill health.

562

563

564 **References**

- 565 ANGELL, S. and SILVER, L. 200). Calorie Labeling in New York City Restaurants: An  
566 Approach to Inform Consumers. Retrieved August 22, 2015, from  
567 <http://www.cspinet.org/reports/generationexcess/nycdh.pdf>
- 568 ARES, G., GIMENEZ, A., BRUZZONE, F., VIDAL, L., ANTUNEZ, L. And MAICHE, A.  
569 2013. Consumer Visual Processing of Food Labels: Results from an Eye-Tracking  
570 Study. *J. Sensory Stud.* 28, 138-153.
- 571 BADDELEY, A. and HITCH, G. 1974. Working memory. *Psychol Learn. Motiv.* 8(1), 47-89.
- 572 BASSETT, M., DUMANOVSKY, T., HUANG, C., SILVER, L., YOUNG, C., NONAS, C.  
573 And FRIEDEN, T. 2008. Purchasing behavior and calorie information at fast-food  
574 chains in New York City, 2007. *Am. J. Public Health.* 98(8), 1457-1459.
- 575 BERMAN, M. and LAVIZZO-MOUREY, R. 2008. Obesity prevention in the information  
576 age: caloric information at the point of purchase. *J. Am. Med. Assoc.* 300(4), 433-435.
- 577 BEZERRA, I., CURIONI, C. and SICHIERI, R. 2012. Association between eating out of  
578 home and body weight. *Nutr. Rev.* 70(2), 65-79.
- 579 BETTMANN, J. 1979. Memory factors in consumer choice: A review. *J. Marketing.* 43(2),  
580 37-53.
- 581 BIALKOVA, S., GRUNERT, K. and VAN TRIJP, H. 2013 Standing out in the crowd: The  
582 effect of information clutter on consumer attention for front-of-pack nutrition labels.  
583 *Food Policy.* 41, 65-74.
- 584 BIALKOVA, S. and VAN TRIJP, H. 2010. What determines consumer attention to nutrition  
585 labels? *Food Quality and Preference.* 21(8), 1042-1051.
- 586 BIALKOVA, S. and VAN TRIJP, H. 2011. An efficient methodology for assessing attention  
587 to and effect of nutrition information displayed front-of-pack. *Food Qual. Prefer.* 22(6),  
588 592-601.
- 589 BIALKOVA, S., GRUNERT, K., JUHL, H., WASOWICZ-KIRYLO, G., STYSKO-  
590 KUNKOWSKA, M. and VAN TRIJP, H. 2014. Attention mediates the effect of  
591 nutrition label information on consumers' choice. Evidence from a choice experiment  
592 involving eye-tracking. *Appetite.* 76(1), 66-75.
- 593 BORGMEIER, I. and WESTENHOEFER, J. 2009. Impact of different food label formats on  
594 healthiness evaluation and food choice of consumers: a randomized-controlled study.  
595 *BMC public health.* 9(1), 184.
- 596 BROWN, A. 2014. Item response models for forced-choice questionnaires: A common  
597 framework. *Psychometrika.* 1-26.

598 CHANDON, P. and WANSINK, B. 2007. The biasing health halos of fast-food restaurant  
599 health claims: lower calorie estimates and higher side-dish consumption intentions. *J.*  
600 *Consum. Res.* 34(3), 301-314.

601 CHU, Y., FRONGILLO, E., JONES, S. and KAYE, G. 2009. Improving patrons' meal  
602 selections through the use of point-of-selection nutrition labels. *Am. J. Public Health.*  
603 99(11), 2001.

604 CINCIRIPINI, P. 1984. Changing food selection in a public cafeteria: An applied behaviour  
605 analysis. *Behav. Modif.* 8, 520-539.

606 CLEMENT, J., KRISTENSEN, T. and GRØNHAUG, K. 2013. Understanding consumers'  
607 in- store visual perception: The influence of package design features on visual  
608 attention. *Journal of Retailing and Consumer Services*.XXXXX

609 COWBURN, G. and STOCKLEY, L. 2005. Consumer understanding and use of nutrition  
610 labelling: a systematic review. *Public Health Nutrition*, 8(1), 21-28.

611 CUTLER, D., GLAESER, E. and SHAPIRO, J. 2003. Why have Americans become more  
612 obese? *J. Econ. Perspect.* 17(3), 93-118.

613 DAYAN, E. and BAR-HILLELI, M. 2011. Nudge to nobesity II: Menu positions influence  
614 food orders. *Judgm. Decis. Mak.* 6(4), 333-342.

615 DRICHOUTIS, A., LAZARIDIS, P. and NAYGA, R. 2006. Consumers' use of nutritional  
616 labels: a review of research studies and issues. *Acad. Market. Science Rev.* 9(9), 1-22.

617 FEUNEKES, G., GORTEMAKER, I., WILLEMS, A., LION, R. and VAN DEN KOMMER,  
618 M. 2008. Front-of-pack nutrition labelling: testing effectiveness of different nutrition  
619 labelling formats front-of-pack in four European countries. *Appetite.* 50(1), 57-70.

620 FIELD, A. 2009. *Discovering statistics using SPSS: And sex and drugs and rock 'n' roll.*  
621 London: SAGE.

622 FINKELSTEIN, E., STROMBOTNE, K., CHAN, N. and KRIEGER, J. 2011. Mandatory  
623 menu labeling in one fast-food chain in King County, Washington. *Am. J. Prev. Med.*  
624 40(2), 122-127.

625 FOGG, B. 2009.. A behavior model for persuasive design. In *Proceedings of the 4th*  
626 *international Conference on Persuasive Technology* (p. 40). ACM.

627 FOOD STANDARDS AGENCY. 2009. Calorie Labelling and Nutrition Information in  
628 Catering. Retrieved August 22, 2015, from  
629 <http://collections.europarchive.org/tna/20100927130941/http://food.gov.uk/healthierat>  
630 [ing/healthycatering/cateringbusiness/calorie](http://collections.europarchive.org/tna/20100927130941/http://food.gov.uk/healthierat/healthycatering/cateringbusiness/calorie)

631 FOTOPOULOS, C., KRYSTALLIS, A., VASSALLO, M and PAGIALIA, A. 2009. Food  
632 Choice Questionnaire (FCQ) revisited. Suggestions for the development of an enhanced  
633 general food motivation model. *Appetite*, 52(1), 199-208.

634 FUNG, T., PAN, A., HOU, T., CHIUVE, S., TOBIA, D., MOZAFFARIAN, D and HU, F.  
635 2015. Long-Term Change in Diet Quality Is Associated with Body Weight Change in  
636 Men and Women. *J. Nutr.* 145(8), 1850-1856.

637 GOULD, S. 1990. Health consciousness and health behavior: The application of a new health  
638 consciousness scale. *Am. J. Prev. Med.* 6(4), 228-237.

639 GRAHAM, D., ORQUIN, J. and VISSCHERS, V. 2012. Eye tracking and nutrition label use:  
640 A review of the literature and recommendations for label enhancement. *Food Policy*.  
641 37(4), 378–382.

642 GRUNERT, K., BOLTON, L. and RAATS, M. 2012. Processing and acting on nutrition  
643 labeling on food. Florida: Routledge Academic.

644 GRUNERT, K., FERNANDEZ-CELEMIN, L., WILLS, J., GENANNT BONSMANN, S.  
645 and NUREEVA, L. (2010). Use and understanding of nutrition information on food  
646 labels in six European countries. *J. Public Health.* 18(3), 261-277.

647 GRUNERT, K. and WILLS, J. 2007. A review of European research on consumer response  
648 to nutrition information on food labels. *J. Public Health.* 15(5), 385-399.

649 GRUNERT, K., WILLS, J. and FERNANDEZ-CELEMIN, L. 2010. Nutrition knowledge,  
650 and use and understanding of nutrition information on food labels among consumers in  
651 the UK. *Appetite.* 55(2), 177-189.

652 HANKS, A., JUST, D., SMITH, L., WANSINK, B. and DYSON, J. 2012. Healthy  
653 convenience: nudging students toward healthier choices in the lunchroom. *J. Public  
654 Health.* 34(3), 370-376.

655 HARNACK, L., FRENCH, S., OAKES, J., STORY, M., JEFFERY, R. and RYDELL, S.  
656 (2008). Effects of calorie labeling and value size pricing on fast food meal choices:  
657 results from an experimental trial. *Int. J. Behav. Nutr. Phys.* 5(1), 63.

658 HIGGINSON, C. S., KIRK, T. R., RAYNER, M. J. and DRAPER, S. 2002. How do  
659 consumers use nutrition label information? *Nutrition & Food Science.* 32(4), 145-152.

660 HODGKINS, C., BARNETT, J., WASOWICZ-KIRYLO, G., STYSKO-KUNOWSKA, M.,  
661 GULCAN, Y., KUSTEPLI, Y. and RAATS, M. 2012. Understanding how consumers  
662 categorise nutritional labels. A consumer derived typology for front-of-pack nutrition  
663 labelling. *Appetite.* 59(3), 806-817.

664 HUANG, T., QI, Q., ZHENG, Y., LEY, S., MANSON, J., HU, F. and QI, L. 2015. Genetic  
665 Predisposition to Central Obesity and Risk of Type 2 Diabetes: Two Independent  
666 Cohort Studies. *Diabetes care*. 38(7), 1306-1311.

667 JONES, G. and RICHARDSON, M. 2006. An objective examination of consumer perception  
668 of nutrition information based on healthiness ratings and eye movements. *Public Health*  
669 *Nutr.* 10(3), 238–244.

670 KELLY, B., HUGHES, C., CHAPMAN, K., LOUIE, J. C.-Y., DIXON, H., CRAWFORD, J.,  
671 KING, L., DAUBE, M. and SLEVIN, T. 2009. Consumer testing of the acceptability  
672 and effectiveness of front-of-pack food labelling systems for the Australian grocery  
673 market. *Health Promotion International*. 24(2), 120-129.

674 KEMPEN, E., MULLER, H., SYMINGTON, E. and VAN EEDEN, T. 2012. A study of the  
675 relationship between health awareness, lifestyle behaviour and food label usage in  
676 Gauteng. *S.Afr. J. Clin. Nutr.* 25(1), 15-21.

677 KERSHAW, S. 2009. Using menu psychology to entice diners. Retrieved August 22, 2015,  
678 from [http://www.nytimes.com/2009/12/23/dining/23menus.html?pagewanted=all&\\_r=0](http://www.nytimes.com/2009/12/23/dining/23menus.html?pagewanted=all&_r=0)

679 LAUREATI, M., PAGLIARINI, E., MOJET, J. and KOSTER, E. 2011. Incidental learning  
680 and memory for food varied in sweet taste in children. *Food Qual. Prefer.* 22(3), 264-  
681 270.

682 LAZAREVA, Y. 2015. Can nutrition menu labelling positively influence consumer food  
683 choices? A review of the literature. *Surrey Undergraduate Research Journal*. 1(1) 1-8.

684 LIU, P., ROBERTO, C., LIU, L. And BROWNELL, K. 2012. A test of different menu  
685 labeling presentations. *Appetite*. 59(3), 770-777.

686 LOHSE, G. and JOHNSON, E. 1996. A comparison of two process tracing methods for  
687 choice tasks. In *Proceedings of the Twenty-Ninth Hawaii International Conference on*  
688 *System Sciences* (Vol. 4, pp. 86-97). IEEE.

689 MILICH, R., ADERSON, J. and MILLS, M. 1976. Effects of visual presentation of caloric  
690 values on food buying by normal and obese persons. *Percept. motor skill*. 42, 155-162.

691 MILOSAVLJEVIC, M. and CERF, M. 2008. First attention then intention: Insights from  
692 computational neuroscience of vision. *Int. J. Advert.* 27(3), 381-398.

693 MONROE, K., POWELL, C. and CHOUDHURY, P. 1986. Recall versus recognition as a  
694 measure of price awareness. *Adv. Consum. Res.* 13(1), 594-599.

695 MORLEY, B., SCULLY, M., MARTIN, J., NIVEN, P., DIXON, H. and WAKEFIELD, M.  
696 2013. What types of nutrition menu labelling lead consumers to select less energy-  
697 dense fast food? An experimental study. *Appetite*. 67(1), 8-15.

698 NATIONAL HEALTH SERVICE 2013. Britain: ‘the fat man of Europe’. Retrieved August  
699 22, 2015, from [http://www.nhs.uk/livewell/loseweight/pages/statistics-and-causes-of-](http://www.nhs.uk/livewell/loseweight/pages/statistics-and-causes-of-the-obesity-epidemic-in-the-uk.aspx)  
700 [the-obesity-epidemic-in-the-uk.aspx](http://www.nhs.uk/livewell/loseweight/pages/statistics-and-causes-of-the-obesity-epidemic-in-the-uk.aspx)

701 PAYNE, J., BETTMAN, J., & JOHNSON, E. 1993. *The adaptive decision maker.*  
702 Cambridge: University Press.

703 PIZAM, A. 2011. Menu labeling: the new trend. *Int J. Hosp. Manag.* 30(2), 221-224.

704 PULOS, E. and LENG, K. 2010. Evaluation of a voluntary menu-labeling program in full-  
705 service restaurants. *Am. J. Public Health.* 100(6), 1035.

706 RAYNER, K. 1998. Eye movements in reading and information processing. *Psychological*  
707 *Bulletin.* 85(3), 618-660.

708 RAYNER, K. 2009. Eye movements and attention in reading, scene perception, and visual  
709 search. *The Quarterly Journal of Experimental Psychology.* 62(8), 1457-1506.

710 RAYNER, K. and CASTELHANO, M. S. 2008. Eye movements during reading, scene  
711 perception, visual search, and while looking at print advertisements. *Visual marketing:*  
712 *From attention to action.* 1(1), 9-42.

713 REALE, S., and FLINT, S. W. (2016). Menu labelling and food choice in obese adults: a  
714 feasibility study. *BMC obesity.* 3, 17.

715 REUTSKAJA, E., NAGEL, R., CAMERER, C. And RANGEL, A. 2011. Search dynamics in  
716 consumer choice under time pressure: An eye-tracking study. *Am. Econ. Rev.* 101(2),  
717 900-926.

718 RICKER, T., COWAN, N., & MOREY, C. 2010. Visual working memory is disrupted by  
719 covert verbal retrieval. *Psychon. Bulletin & Review.* 17(4), 516-521.

720 ROBERTO, C., BRAGG, M., SEAMANS, M., MECHULAN, R., NOVAK, N. and  
721 BROWNELL, K. 2012. Evaluation of consumer understanding of difference front-of-  
722 package nutrition labels, 2010-2011. *Prev. chron. dis.* 9(1), 149-161.

723 ROSEMAN, M., MATHE-SOULEK, K. and HIGGINGS, J. 2013. Relationships among  
724 grocery nutrition label users and consumers’ attitudes and behavior toward restaurant  
725 menu labeling. *Appetite.* 71(1), 274-278.

726 RUSSO, J., STAELIN, R., NOLAN, C., RUSSELL, G. and METCALF, B. 1986. Nutrition  
727 information in the supermarket. *J. Consum. Res.* 13(1), 48-70.

728 SARINK, D., PEETERS, A., FREAK-POLI, R., BEAUCHAMP, A., WOODS, J., BALL, K.  
729 & BACKHOLER, K. 2016. The impact of menu energy labelling across  
730 socioeconomic groups: A systematic review. *Appetite.* 99(1), 59-75.



- 731 SEIDERS, K. and PETTY, R. 2004. Obesity and the role of food marketing: A policy  
732 analysis of issues and remedies. *J. Public Policy Mark.* 23(2), 153-169.
- 733 STEENHUIS, I. H. M., KROEZE, W., VYTH, E. L., VALK, S., VERBAUWEN, R. &  
734 SEIDELL, J. C. 2010. The effects of using a nutrition logo on consumption and  
735 product evaluation of a sweet pastry. *Appetite.* 55(3), 707-709.
- 736 STEPTOE, A., POLLARD, T. and WARDLE, J. 1995. Development of a measure of the  
737 motives underlying the selection of food: the food choice questionnaire. *Appetite.*  
738 25(3), 267-284.
- 739 STORCKSDIECK, S., FERNANDEZ, L., LARRANAGA, A., EGGER, S., WILLS, J.M.,  
740 HODGKINS, C. & RAATS, M. 2010. Penetration of nutrition information on food  
741 labels across the EU-27 plus Turkey. *Eur. J. Clin. Nutr.* 64, 1379-1385.
- 742 TOBIIPRO. 2015. Eye Tracking Software: Tobii Studio. Retrieved August 22, 2015, from  
743 [http://www.tobii.com/eye-tracking-research/global/products/software/tobii-studio-](http://www.tobii.com/eye-tracking-research/global/products/software/tobii-studio-analysis-software/)  
744 [analysis-software/](http://www.tobii.com/eye-tracking-research/global/products/software/tobii-studio-analysis-software/)
- 745 VAN HERPEN, E. And VAN TRIJP, H. 2011. Front-of-pack nutrition labels. Their effect on  
746 attention and choices when consumers have varying goals and time constraints.  
747 *Appetite.* 57(1), 148-160.
- 748 VAN TRIJP, H. C. M. 2009. Consumer understanding and nutritional communication: Key  
749 issues in the context of the new EU legislation. 48(1), 41-48.
- 750 VALAZQUEZ, C. and PASCH, K. 2014. Attention to food and beverage advertisements as  
751 measured by eye-tracking technology and the food preferences and choices of youth. *J.*  
752 *Acad. Nutr. Diet.* 114(4), 578-582.
- 753 VISSCHERS, V., HESS, R., & SIEGRIST, M. 2010. Health motivation and product design  
754 determine consumers' visual attention to nutrition information on food products. *Public*  
755 *health nutr.* 13(7), 1099-1106.
- 756 VON RESTORFF, H. 1933. Ober die wirkung von bereichsbildungen im spurenfeld.  
757 *Psychologische Forschung*, 18(1), 299-342.
- 758 WANSINK, B. and CHANDON, P. 2014. Slim by design: Redirecting the accidental drivers  
759 of mindless overeating. *J. consum. psychol.* 24(3), 413-431.
- 760 WANSINK, B. and HANKS, A. S. 2013. Slim by design: serving healthy foods first in buffet  
761 lines improves overall meal selection. *PloS one.* 8(10), e77055- e77059.
- 762 WANSINK, B. and LOVE, K. 2014. Slim by design: Menu strategies for promoting high-  
763 margin, healthy foods. *Int J. Hosp. Manag.* 42(2), 137-143.

- 764 WANSINK, B., SHIMIZU, M. and CAMPS, G. 2012. What would Batman eat?: Priming  
765 children to make healthier fast food choices. *Pediatr. Obes.* 7(2), 121-123.
- 766 ZEKI, S. & MARINI, L. 1998. Three cortical stages of colour processing in the human brain.  
767 *Brain.* 121, 1669-1685.

768 **Table 1** Participants' demographic information for each experimental condition (mean and  
 769 standard deviation)

	<b>Non-Directive</b>	<b>Directive</b>	<b>Semi-Directive</b>
	<b>(Condition 1)</b>	<b>(Condition 2)</b>	<b>(Condition 3)</b>
	<b>N=28</b>	<b>N=28</b>	<b>N=28</b>
<b>Number of males</b>	N= 15	N= 14	N= 14
<b>Number of females</b>	N= 13	N= 14	N= 14
<b>Age (years)</b>	23.29 ± 4.44	23.68 ± 6.86	23.79 ± 6.16
<b>BMI (kg·m<sup>2</sup>)</b>	25.34 ± 3.52	23.62 ± 6.86	22.86 ± 3.41

770

771 **Table 2** Visual attention, food choice, reason for food choice and recognition of nutritional  
 772 information (mean and standard deviation) following the provision of menu labelling

	<b>Non-Directive (Condition 1) N=28</b>	<b>Directive (Condition 2) N=28</b>	<b>Semi-Directive (Condition 3) N=28</b>
<b><i>Visual Attention</i></b>			
Time to First Fixation (s)	2.65 ± 2.41	2.28 ± 1.98	2.73 ± 2.50
Total Fixation duration (s)	1.63 ± 1.34	2.51 ± 1.91	2.1 ± 1.60
Total Fixation Count (s)	7.81 ± 5.99	11.85 ± 8.40	10.20 ± 6.71
Total Visit Count (s)	3.75 ± 2.39	4.94 ± 3.28	5.55 ± 3.73
<b><i>Food Choice</i></b>			
Calories Selected (kcal)*	2147.07 ± 65.31	1619.36 ± 487.04	1779.93 ± 411.85
<b><i>Reason for food Choice</i></b>			
Natural Content	4.21 ± 1.64	4.96 ± 2.36	4.54 ± 1.62
Weight Control	6.14 ± 1.88	6.86 ± 2.24	6.86 ± 1.69
Health Concern	5.04 ± 2.24	5.68 ± 2.48	6.18 ± 1.69
Sensory Appeal	10.32 ± 1.91	9.82 ± 1.79	9.71 ± 1.90
Mood	7.39 ± 2.39	6.50 ± 2.47	6.79 ± 2.20
Familiarity	8.68 ± 1.54	7.96 ± 2.44	7.57 ± 1.83
<b><i>Recognition Task</i></b>			
Accuracy	.50 ± .31	.58 ± .27	.50 ± .31
Time (s)	5.59 ± 1.87	5.49 ± 2.44	6.79 ± 3.32

773 \* Indicates a main effect ( $P < .05$ )



774

775 **Figure 1** Non-directive labelling (Condition 1)

776

777

778

779

780

781



782 **Figure 2** Directive labelling (Condition 2)



789 **Figure 3** Semi-directive labelling (Condition 3)