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1        **The Effect of Priming on Food Choice: A Field and Laboratory Study**

2    Stephanie T. Farrar<sup>a1</sup> • Anke C. Plagnol<sup>a</sup> • Katy Tapper<sup>a</sup>

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4    <sup>a</sup>Department of Psychology, City, University of London, London, UK

5    *Email addresses:* stephanie.farrar@city.ac.uk (S.T. Farrar), anke.plagnol.1@city.ac.uk

6    (A. C. Plagnol), katy.tapper.1@city.ac.uk (K. Tapper)

7  
8    *Corresponding author:* Stephanie. T. Farrar

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32    <sup>1</sup>*Present address:* School of Psychology, 62 Hillhead Street, University of Glasgow,  
33    Glasgow, UK. *Email:* stephanie.farrar@glasgow.ac.uk

# 1. Introduction

## 1.1 Research Overview

The high prevalence of overweight and obesity means it is now recognised as a global epidemic, having severe consequences at both the societal and individual level (Dobbs & Manyika, 2015; World Health Organisation, n.d.-a). One of the main contributing factors is the excessive consumption of high-calorie foods, which reinforce further consumption through the rewarding effects on the brain (Fletcher & Kenny, 2018; Kenny, 2011; Mendoza et al., 2007). Consequently, it is important to recognise aspects of the environment that may contribute to unhealthy food and beverage choices, so they can either be modified or removed altogether. In this paper, we look at whether exposure to brand logos that promote unhealthy foods increases the selection of unhealthy foods. Study one examined this effect in the field while study two examined this effect in the laboratory. Study two also measured trait mindfulness to examine whether this moderated any priming effects found and to determine whether increasing mindfulness has the potential to reduce the influence of exposure to unhealthy food-related logos on food choice.

The paper argues that unhealthy food choices may be elicited through behavioural priming effects, where exposure to unhealthy food-related stimuli activates related concepts in memory, promoting behaviour that is in line with these concepts. Although there is much evidence to support the effect of prime stimuli on eating and drinking behaviour (Brunner & Siegrist, 2012; Chiou et al., 2013), no research to date has examined the effect of food-related logos on subsequent food choice. As unhealthy food-related logos are highly prevalent in the environment, it is important to establish the effect they are having on the choices made on a daily basis, particularly if they encourage the consumption of unhealthy foods. It is also argued that mindfulness may moderate the effect of unhealthy food-related primes on food choice, whereby individuals higher in trait mindfulness will be less influenced than individuals lower in trait mindfulness. Specifically, it is argued that individuals higher in trait mindfulness may have a greater awareness of how the prime stimuli are influencing behaviour, resulting in a greater capacity to offset this effect.

## 1.2 Behavioural Priming

66 Behavioural priming refers to ‘the activation of social representations by exposure to  
67 different types of information, and the application of these activated representations in social  
68 judgments and behaviours’ (Molden, 2014, p. 3). The first study to show behavioural priming  
69 effects was by Bargh et al. (1996) who found that priming participants with either the concept  
70 of rudeness or politeness increased behaviour that was in line with the active concept. This  
71 was just one in a series of studies showing that incidentally presented words could have  
72 downstream effects on behaviour; this proved to be an important finding in the history of  
73 psychology as it provided evidence that behaviour can be influenced by unconscious  
74 processes as well as conscious ones (Payne et al., 2016). These findings subsequently led to  
75 the introduction of the term ‘behavioural priming’, followed by multiple studies examining  
76 the various behaviours that could be primed. For example, one study found that subliminal  
77 exposure to the Apple computer logo, compared to the IBM logo, increased creativity as  
78 measured through the unusual uses test (Fitzsimons et al., 2008). According to the authors,  
79 this implies that brand associations exist at a basic cognitive level and have the capacity to  
80 influence behaviour outside of awareness. Furthermore, a recent meta-analysis by  
81 Weingarten et al. (2016) found a small positive effect of incidentally presented words on  
82 different behavioural outcomes, an effect that was consistent across a variety of priming  
83 paradigms.

84

85 Since the first studies on behavioural priming, the variety of behaviours that can be primed  
86 has been closely examined by researchers, with several studies concerning the influence of  
87 prime stimuli on food and beverage choice. One study by Fishbach and Dhar (2005)  
88 examined the effect of priming either high or low progress towards ideal weight on  
89 subsequent snack choice. The participants were initially asked to colour either a wide-scale or  
90 a narrow-scale as a means of priming high and low progress respectively, before being asked  
91 to select either an apple or a chocolate bar as a parting gift. The results showed a significant  
92 difference between the conditions as 85% of participants primed with high progress selected  
93 the chocolate bar compared to just 58% of participants primed with low progress. Another  
94 study by Chiou et al. (2013) examined whether priming the concept of masculinity through a  
95 scrambled sentence task could influence drink choice among men. On completion of the  
96 scrambled sentence task, all participants were asked to select either a can of Red Bull or a  
97 bottle of Perrier mineral water as a reward for participating in the study. The results showed  
98 that participants in the prime condition were significantly more likely to select Red Bull than  
99 participants in the control condition, implying that priming the concept of masculinity

100 promoted behaviour that was consistent with the prime. The unconscious effect of primes on  
101 behaviour is further reinforced by several studies that have employed subliminal priming  
102 techniques. For example, a study by Karremans et al. (2006) compared the intentions of a  
103 prime condition and a control condition to consume Lipton Ice following subliminal exposure  
104 to the words 'Lipton Ice' (prime condition) or 'Npeic Tol' (control condition). The result  
105 showed that participants exposed to the Lipton Ice prime had a higher intention to consume  
106 Lipton Ice, although further analyses showed that this effect was moderated by degree of  
107 thirst.

108

### 109 **1.3 Brand Logos as Prime Stimuli**

110 Although there is little research examining the potential for brand logos to influence  
111 behaviour, there is evidence that exposure to brand logos can activate a corresponding mental  
112 concept in memory (Muscarella et al., 2013). This study compared an unconscious prime  
113 condition with a conscious prime condition where both involved exposing participants to five  
114 brand logos, previously confirmed as highly familiar and recognisable during a pilot study;  
115 these logos had also elicited the strongest unconscious and conscious priming effects in a  
116 study that exposed the participants to ten different brand logos. The participants in the  
117 unconscious prime condition were exposed to each prime for 17ms, whereas those in the  
118 conscious condition were exposed to each prime for 34ms. The participants then completed a  
119 lexical decision task where the words presented were from one of four target word categories:  
120 (1) a related brand condition (e.g. the McDonald's logo followed by the word  
121 "MCDONALDS"); (2) a related non-brand condition (e.g. the McDonald's logo followed by  
122 the word "HAMBURGER"); (3) an unrelated brand condition (e.g. the McDonald's logo  
123 followed by the word "LACOSTE"); (3) and an unrelated non-brand condition (e.g. the  
124 McDonald's logo followed by the word "TIRES"). The results showed that participants  
125 responded significantly faster on both brand and non-brand trials where the prime and target  
126 word were related as opposed to unrelated. Furthermore, a significant interaction was  
127 observed where participants responded faster in the related brand condition than the related  
128 non-brand condition. Based on these findings, it was concluded that exposure to brand logos  
129 can activate a corresponding mental concept in memory, which has the potential to have  
130 downstream effects on behaviour.

131

### 132 **1.4 The Situated Inference Model**

133 The increase in the accessibility of a mental concept following exposure to prime stimuli has  
134 been well established in the literature (Förster & Liberman, 2007), although the mechanisms  
135 that translate this increased accessibility into behaviour are less well understood. One model  
136 that attempts to explain the mechanism that underlies behavioural priming effects is the  
137 Situated Inference Model by Loersch and Payne (2011), which proposes that the effect of  
138 prime stimuli on judgments, decisions, and/or behaviour can be accounted for by a single  
139 process that has three discrete stages. The first stage involves exposure to the prime stimulus  
140 which increases the accessibility of any mental content that is experientially, semantically, or  
141 evaluatively related to the prime. Importantly, this stage only reflects an increase in the  
142 readiness to use the activated concept during information processing, as opposed to having a  
143 direct effect on judgments, decisions, and/or behaviour. During the second stage, the  
144 individual misattributes the increased accessibility of the mental concept to their own natural  
145 response toward a specific element of the environment; more precisely, the accessibility of  
146 the primed concept is misattributed to the natural thoughts and feelings experienced by the  
147 individual and is therefore more likely to be taken into account during subsequent cognitive  
148 processing. The third stage relates to the specific questions afforded by the present situation;  
149 in other words, the situation determines the different ways in which an individual may  
150 respond. As the priming effect obtained depends on the specific questions asked, it is argued  
151 that questions related to behavioural responses will subsequently result in behavioural  
152 priming effects.

153

### 154 **1.5 Priming and Mindfulness**

155 One of the main concerns over priming effects is that they occur automatically outside of  
156 conscious awareness and are therefore outside the control of the individual. This point is  
157 reiterated by Bargh (1994, p. 13) who states that ‘a lack of awareness of the prime on  
158 subsequent judgements, decisions, and behaviour is important as it means the individual has  
159 no control over the effect of the prime’. The importance of awareness has also been  
160 acknowledged by Wegener and Petty (1997) who proposed that corrective processes can only  
161 take place when individuals are aware of a potential bias. Interestingly, it has recently been  
162 proposed that cultivating mindfulness may reduce the influence of automatic processes on  
163 behaviour, while increasing the influence of conscious processes (Kang et al., 2013).  
164 Mindfulness originates from the teachings of the Buddha and has been defined as ‘paying  
165 attention in a particular way: on purpose, in the present moment, and non-judgementally  
166 (Cantwell, 2010; Kabat-Zinn, 1994, p. 4). Kang et al. (2013) argue that mindfulness increases

167 the activation of conscious processes through improvements in awareness, attention, ability to  
168 focus on the present moment, and non-judgemental acceptance. These lead to the realisation  
169 that thoughts are transient mental events that are often far removed from reality, allowing  
170 individuals to create mental distance from thoughts (termed cognitive decoupling or  
171 decentring) and increasing awareness of the intuitive reactions elicited by internal and  
172 external events. This awareness allows individuals to override their intuitive reactions to  
173 these events and respond from a conscious rather than an unconscious level. Based on this  
174 theory, it is expected that individuals high in trait mindfulness will be less influenced by  
175 prime stimuli than individuals low in trait mindfulness.

176

## 177 **1.6 Overview of Studies**

178 Study one examined whether unobtrusive exposure to specific food logos (primes) could  
179 influence choice of snack in a natural setting. This study aimed to build on previous research  
180 in two ways. Firstly, no previous studies to date have used food logos as a means of priming  
181 eating behaviour; one of the reasons for using logos is that they are highly prevalent in the  
182 social environment and are therefore likely to be highly familiar and easily recognisable. This  
183 is partly due to recent advances in technology which have increased the number of ways in  
184 which companies can advertise specific brands to potential consumers. Furthermore, the high  
185 prevalence of logos in the social environment means that any effects found are likely to  
186 reflect how food logos influence eating behaviour on a daily basis. Secondly, the logos were  
187 presented in the background of an image rather than in isolation; the main reason for taking  
188 this approach was to emulate the presentation of prime stimuli in the natural environment.  
189 The importance of brand awareness on product choice has led to the proliferation of stimuli  
190 in the social environment as companies compete for consumer attention; as a result, brand  
191 logos are usually perceived in the presence of other stimuli.

192

193 Study two was a laboratory-based study that examined whether exposure to specific food  
194 logos (primes) could influence food choice, building on study one in three ways. Firstly, each  
195 logo was presented in isolation to prevent the effect of the prime stimuli from being  
196 compromised due to exposure to several different concepts at the same time. This also  
197 allowed for a larger image of each logo to be presented, increasing the intensity of the prime  
198 stimuli and the resulting concept activation (Bargh & Chartrand, 2000). Secondly, the nature  
199 of the priming task meant that all the participants were exposed to the prime stimuli for a  
200 fairly long duration. As the logos formed an integral part of the priming task, this maximised

201 the conscious processing of the primes and further increased the resulting concept activation.  
202 Specifically, the priming task involved distinguishing between an original and a modified  
203 version of various brand logos and was designed to be fairly difficult for two reasons: (1) to  
204 increase the amount of time participants were exposed to the logos; and (2) to reduce the  
205 likelihood that participants would become aware of the true aim of the study. Thirdly, the  
206 food selection task included a large variety of healthy and unhealthy food items in order to  
207 increase the sensitivity of the outcome measure. Consequently, this increased the likelihood  
208 of detecting a significant priming effect and also reflected the large variety of foods presently  
209 available in the UK (Thornton et al., 2013).

210

## 211 **2. Study One**

212

### 213 **2.1 Study One Overview**

214 In order to examine the effect of specific food logos on subsequent snack choice, participants  
215 were primed through the completion of a World Cup Quiz that contained an image with  
216 either the Marks & Spencer logo (British retail company that sells food products), the Mars  
217 logo, or logos that were unrelated to food visible in the background. Following this,  
218 participants were asked to select either an M&S fruit and nut assortment (M&S snack) or a  
219 Mars bar as a thank you for taking part. The first confirmatory hypothesis (H1) stated that  
220 participants exposed to the M&S logo would be more likely to select the M&S snack  
221 compared to participants exposed to the Mars logo or logos unrelated to food. The second  
222 confirmatory hypothesis (H2) stated that participants exposed to the Mars logo would be  
223 more likely to select the Mars bar compared to participants exposed to the M&S logo or  
224 logos unrelated to food. The data analysis also explored whether any effect of the prime  
225 stimuli on snack choice was moderated by conscious effort to eat healthily, hunger, tiredness,  
226 or BMI. These variables were examined based on previous research findings which have  
227 shown them to influence food choice (Ghvanidze et al., 2017; Hoefling & Strack, 2010;  
228 Wells & Cruess, 2006; Cohen et al., 2011), although none have been examined in this  
229 specific context. This study was pre-registered on the Open Science Framework prior to the  
230 start of the data collection period ([osf.io/vyter](https://osf.io/vyter)).

231

### 232 **2.2 Participants**

233 An a priori power calculation was conducted for a logistic regression analysis using the  
234 software G\*Power (Faul et al., 2009). This showed that 167 participants would be required to  
235 detect a small main effect of priming on food choice (0.25) and achieve a 0.8 level of power  
236 with alpha at 0.05. Therefore, a total of 205 participants (before exclusions) were recruited by  
237 the first author and a psychology graduate who was briefed on the study procedure. The  
238 inclusion criteria stated that participants must be at least 18 years of age; have no allergies or  
239 specific dietary needs that would prevent the selection of one or both snacks; be familiar with  
240 the M&S and Mars logos; and show no awareness of the true aim of the study during the  
241 funnelled debrief. Participants who did not meet these criteria were subsequently excluded  
242 from the data analysis. The data collection was due to take place over four sessions with the  
243 aim of recruiting a minimum of 167 participants and a maximum of 180 participants (after  
244 exclusions). It was explicitly stated in the pre-registration form that the data collection would  
245 be terminated as soon as 180 participants had completed the study. However, if less than 167  
246 participants took part over the four sessions scheduled, then extra sessions would take place  
247 until a minimum of 167 participants had been recruited. Ethical approval was granted by the  
248 City, University of London Psychology Department Research Ethics Committee.

249

## 250 **2.3 Measures**

### 251 *Demographic Information*

252 The demographic information questionnaire comprised measures of age, gender and  
253 education; participants stated the highest level of education attained at the time of the study.

254

### 255 *Funnelled Debrief*

256 Awareness of the link between the priming task and the snacks offered was checked by  
257 asking participants two questions: (1) whether they had any ideas about the aim of the present  
258 study; and (2) whether they thought anything they had completed during the study may have  
259 influenced their snack choice.

260

### 261 *Eating Behaviour Questionnaire*

262 Motivation to consume a healthy diet was measured by means of a single question;  
263 participants were asked to rate the statement 'I make a conscious effort to eat healthy foods'  
264 on a 7-point Likert scale from 'Strongly disagree' to 'Strongly agree'. Participants were also  
265 asked to specify whether they were currently dieting and whether they had any allergies  
266 and/or specific dietary needs that prevented them from taking one of the snacks offered.

267 Hunger was measured by asking participants to rate how hungry they felt at the time of the  
268 study on a 7-point Likert scale from “Extremely hungry” to ‘Extremely full’. Similarly,  
269 tiredness was measured by asking participants to rate how tired they felt at the time of the  
270 study using a 7-point Likert scale from ‘Extremely tired’ to ‘Extremely alert’. Recognition of  
271 both the M&S logo and the Mars logo was checked by asking participants to indicate whether  
272 they recognised each logo by ticking one of two boxes (corresponding to yes or no). Finally,  
273 each participant was asked to self-report their height and weight before indicating whether  
274 they chose the M&S fruit and nut assortment, the Mars bar, or declined to take a snack; the  
275 actual snack chosen was observed by the researcher in order to confirm that the response to  
276 this question was correct.

277

#### 278 **2.4 Priming Task**

279 Participants were primed through the completion of a quiz on the 2018 World Cup which was  
280 developed by the first author. The quiz was presented on an A4 sheet of paper and included  
281 an image of the England manager, Gareth Southgate, located at the top of the quiz sheet; the  
282 image was approximately 16cm x 8.6 cm in all three conditions. In the background of the  
283 image was an advertising board displaying the logos of various sponsors of the English  
284 Football Association (FA). The logos shown on the advertising board were modified so that  
285 the M&S logo was shown four times in the first experimental condition, the Mars logo was  
286 shown four times in the second experimental condition, and no food-related logos were  
287 shown in the control condition. These logos were used as both Mars and M&S are sponsors  
288 of the English FA and the use of different food logos could be considered false advertising.  
289 Furthermore, the M&S and Mars logos were presented alongside several logos that were  
290 unrelated to food to prevent participants from becoming aware of the true aim of the study.  
291 The last quiz question concerned the identity of the individual in the image (Gareth  
292 Southgate) to ensure all participants would look directly at the logos.

293

#### 294 **2.5 Procedure**

295 The study took place in one of the indoor walkways at the university. A stand was set up  
296 between 11am and 3pm on five weekdays over a two-week period and consisted of two  
297 display boards, two tables and two chairs. The display boards were arranged in a T shape  
298 with one table and one chair on either side of the vertical display board; this set-up allowed  
299 the researchers to recruit two participants at a time and prevented the participants from seeing  
300 each other's snack choice. The snacks were offered to participants in a small wicker basket

301 that was hidden behind the horizontal display board so participants were not aware that the  
302 study involved food. Posters were also attached to the display boards which advertised the  
303 study as a brief quiz on the 2018 World Cup, with two notifications informing the  
304 participants they could enter a prize draw for a £50 Amazon voucher on completion of the  
305 study. The participants included students, staff, and visitors to the university who were  
306 recruited as they walked past the stand. All participants were provided with basic information  
307 about the study and were required to give verbal consent prior to taking part.

308

309 The quiz sheets were randomly ordered by the third author who was not involved in the data  
310 collection. A restricted randomisation was used to ensure each condition was approximately  
311 the same size throughout the data collection period (Schulz & Grimes, 2002). The quiz sheets  
312 were randomised in blocks of nine using the website graphpad.com, where three quiz sheets  
313 from each of the three conditions were randomly ordered in each block. The quiz sheets were  
314 subsequently given to the participants in the order they were received, with the researchers  
315 collecting the data unaware of how the participants were allocated to conditions. The  
316 demographic information questionnaire was also attached to the quiz sheet and was  
317 intentionally placed over the image of Gareth Southgate to ensure each trial was double-  
318 blind. Once each participant had agreed to take part, they were seated at one of the tables and  
319 completed the demographic questionnaire followed by the World Cup Quiz. The quiz  
320 comprised five questions and took approximately 1-2 minutes to complete; however,  
321 participants were only required to look at the image to answer the fifth question. Once the  
322 quiz had been completed and returned to the researcher, each participant was asked if they  
323 would like to select either an M&S fruit and nut assortment or a Mars bar as a thank you for  
324 taking part; participants were also free to decline if they did not want to take either snack.  
325 Once a snack had been selected (or declined) each participant was taken through the  
326 funnelled debrief in order to check for awareness of the true aim of the study; this was done  
327 verbally by the researchers who wrote the responses on an A4 sheet of paper. Participants  
328 were then asked to fill in the eating behaviour questionnaire before being debriefed about the  
329 aims of the study. All participants who wished to enter the prize draw were asked to write  
330 down their email address before leaving.

331

## 332 **2.6 Data Analyses**

333 Both confirmatory hypotheses were specified before the first author began collecting the  
334 study data. The pre-registration form stated that the data would be analysed by means of a

335 multinomial regression analysis in order to compare the three levels of the dependent  
 336 variable: M&S snack chosen, Mars snack chosen, and no snack chosen. However, as it was  
 337 later decided to exclude the participants who declined to take a snack, both the confirmatory  
 338 and exploratory analyses were examined through a series of logistic regression models.

339

340

### 3. Results

341

#### 3.1 Data Screening and Participant Characteristics

342 A total of 35 participants did not meet the inclusion criteria and were therefore excluded from  
 343 the analysis. The first five participants were excluded as the participants may have guessed  
 344 the aim of the study due to procedural errors by the researcher; seventeen participants  
 345 reported having an allergy or specific dietary need that influenced their snack choice; five  
 346 participants failed to recognise at least one of the logos during the eating behaviour  
 347 questionnaire; and five participants guessed the aim of the study during the funnelled debrief.  
 348 A further three participants were excluded as two participants reported having a dislike for  
 349 one of the snacks (influencing snack choice) and one participant gave the snack back at the  
 350 end of the study, implying they had no intention to consume the snack selected. This resulted  
 351 in a final sample size of 170 participants. Table 1 shows the demographic and personal  
 352 characteristics as a function of condition.

353

354 **Table 1**

355 *Characteristics of Participants as a Function of Condition*

Characteristic <sup>a</sup>	Control ( <i>n</i> = 60)	M&S Prime ( <i>n</i> = 56)	Mars Prime ( <i>n</i> = 54)
Females (%) <sup>b</sup>	32	45	47
Age (Mean, SD) <sup>cd</sup>	25.1 (9.8)	24.0 (7.3)	27.8 (11.2)
Completed education level (%) <sup>e</sup>			
GCSE's	2	2	4
A-Levels	60	48	46
Bachelor's degree	22	27	26
Postgraduate degree	17	23	24

Conscious effort to eat healthily (Mean, SD)	5.0 (1.4)	5.4 (1.2)	5.3 (1.3)
Dieting (%) <sup>f</sup>	15	22	32
Hunger (Mean, SD)	3.8 (1.5)	3.9 (1.4)	3.8 (1.4)
Tiredness (Mean, SD)	4.2 (1.7)	3.8 (1.6)	3.7 (1.8)
BMI (Mean, SD) <sup>g</sup>	23.9 (3.4)	23.1 (3.5)	25.2 (4.7)

357 <sup>a</sup>Conscious effort to eat healthily, hunger, and tiredness were all measured on 7-point Likert  
358 scales: higher scores reflected higher agreement with each measure.

359 <sup>b</sup>Three missing values in the control condition and the Mars prime condition.

360 <sup>c</sup>One missing value in the control condition and the M&S prime condition.

361 <sup>d</sup>Significance based on Welch's F-test due to unequal homogeneity of variance.

362 <sup>e</sup>Percentages may not total 100 due to rounding.

363 <sup>f</sup>One missing value in the M&S prime condition.

364 <sup>g</sup>Number who declined to say: Control = 7, M&S prime = 3, Mars prime = 7.

365

### 366 **3.2 Confirmatory Analysis: The Effect of Condition on Snack Choice (H1 and H2)**

367 The data analysis was run with and without the participants who declined to take a snack;  
368 when these participants were included, the no snack choice and M&S snack choice were  
369 collapsed into one category as both choices can be interpreted as being healthier than  
370 selecting the Mars bar. Although the results were the same, the participants who took no  
371 snack ( $n = 11$ ) were excluded from the analysis. This decision was made as collapsing these  
372 categories is based on the assumption that the participants who took no snack had the same  
373 underlying motivation as the participants who chose the M&S snack. However, it may be the  
374 case that the participants who declined a snack did so as they disliked both of the snacks  
375 offered.

376

377 A logistic regression analysis was run to examine the effect of condition (M&S prime, Mars  
378 prime, or control) on snack choice (M&S snack or Mars bar), with the control condition  
379 entered as the reference category (see Table 2 below). The results showed that the  
380 participants assigned to either the M&S prime or the Mars prime condition were no more  
381 likely than those assigned to the control condition to select the M&S snack or the Mars bar.

382

383 **Table 2**

		<i>b</i> (S.E)	Sig.	Odds Ratio	95% CI for Odds Ratio	
					Lower	Upper
<b>Included</b>						
Constant		0.07 (0.27)	0.79	1.07		
Condition	M&S prime	-0.07 (0.39)	0.85	0.93	0.44	1.98
	Mars prime	-0.03 (0.39)	0.93	0.97	0.45	2.07

385 *Note.* The control condition served as the reference category.  
 386  $R^2 = 0.00$  (Hosmer-Lemeshow), 0.00 (Cox-Snell), 0.00 (Nagelkerke).  
 387 Model  $\chi^2(2) = 0.03, p = .98$ .  
 388

389 Another logistic regression analysis was run to compare the M&S prime condition with the  
 390 Mars prime condition. The analysis showed that there was no difference in the snack choices  
 391 made by either the M&S prime condition or the Mars prime condition ( $p = 0.92$ ). The main  
 392 findings are visually represented in Figure 1 which shows the percentage of M&S snacks and  
 393 Mars bars selected in each condition.

394

395 **Figure 1**

396 *The Percentage of M&S Snacks and Mars Bars Selected in Each Condition*

397

398 Insert Figure 1 here

399

400 The results showed that participants assigned to the M&S prime or the Mars prime condition  
 401 were no more likely than those assigned to the control condition to select the M&S snack or  
 402 the Mars bar. The model was a poor fit for the data observed ( $\chi^2(2) = 0.03, p = .98$ ).

403

404 **3.3 Exploratory Analysis: The Moderating Effect of Traits**

405 A series of logistic regressions were run to determine whether age (mean centred), gender,  
 406 and education level moderated the association between prime condition and snack choice. For  
 407 each moderator variable, three separate regressions were run to compare the three conditions.  
 408 Each analysis involved entering the moderating variable at step 1, condition at step 2, and the  
 409 interaction term at step 3. The M&S snack choice was coded as 0 and the Mars bar was coded  
 410 as 1 for each analysis. A significance cut-off point of  $p < 0.05$  was used despite the large  
 411 number of tests being performed. A stringent Bonferroni correction for seven moderators in  
 412 total – the three traits explored here (age, gender, and education level) and four states  
 413 considered below (effort to eat healthily, hunger, tiredness, and BMI) – and three regressions

414 per moderator (hence 21 tests) would imply a significance cut-off at  $p < 0.0024$  ( $0.05/21$ ).  
415 However, conscious of the limited sample size and therefore power of the current study, the  
416 findings are reported at the conventional 0.05 threshold.

417

### 418 ***The Moderating Effect of Age, Gender, and Education Level***

419 The results showed a significant main effect of age on snack choice whereby older  
420 participants were more likely to select the M&S snack than younger participants,  $b = -0.06$ ,  
421  $OR = 0.95$ ,  $p = 0.01$ ,  $R^2$  (Cox & Snell) = 0.05,  $R^2$  (Nagelkerke) = 0.07. A significant  
422 interaction between condition and age was found when the control condition (coded as 0) was  
423 compared with the M&S prime condition (coded as 1),  $b = -0.19$ ,  $OR = 0.82$ ,  $p = 0.04$ . A  
424 simple slopes analysis was run to explore the interaction between age and condition when  
425 comparing the control condition (coded as 0) with the M&S prime condition (coded as 1),  
426 although none of the simple slopes reached significance. The results showed there was no  
427 moderating effect of gender or education level.

428

### 429 **3.4 Exploratory Analysis: The Moderating Effect of States**

430 A series of logistic regressions were run to determine whether conscious effort to eat  
431 healthily, dieting status, hunger, tiredness, and/or self-reported BMI moderated the  
432 association between prime condition and snack choice; these were all mean centred before  
433 being entered into the regression models. For each moderator variable, three separate  
434 regressions were run to compare the three conditions. Each analysis involved entering the  
435 moderating variable at step 1, condition at step 2, and the interaction term at step 3. The  
436 M&S snack was coded as 0 and the Mars bar was coded as 1 for each analysis.

437

### 438 ***The Moderating Effect of Conscious Effort to Eat Healthily, Dieting Status, Hunger, 439 Tiredness, and Self-Reported BMI***

440 There was a significant main effect of conscious effort to eat healthily on snack choice  
441 whereby participants showing a greater effort to eat healthily were more likely to select the  
442 M&S snack,  $b = -0.54$ ,  $OR = 0.59$ ,  $p < 0.001$ . No significant interactions between condition  
443 and conscious effort to eat healthily were found. However, there was a significant interaction  
444 between condition and dieting status when the M&S prime condition (coded as 0) was  
445 compared to the Mars prime condition (coded as 1) ( $b = -2.72$ ,  $OR = 0.07$ ,  $p = 0.01$ ); a simple  
446 slopes analysis found that participants who were dieting were more likely to select the snack  
447 that corresponded with the prime stimuli presented,  $b = 2.20$ ,  $OR = 9.03$ ,  $p = 0.02$ . There was

448 also a main effect of hunger on snack choice whereby participants with higher levels of  
449 hunger were more likely to select the M&S snack than participants with lower levels of  
450 hunger,  $b = -0.29$ ,  $OR = 0.75$ ,  $p = 0.02$ . Furthermore, the results showed a significant  
451 interaction between condition and hunger when the M&S prime condition (coded as 0) was  
452 compared to the Mars prime condition (coded as 1),  $b = -0.71$ ,  $OR = 0.49$ ,  $p = 0.03$ ; however,  
453 none of the simple slopes reached significance. The findings indicated a significant  
454 interaction between condition and tiredness when the control condition (coded as 0) was  
455 compared to the M&S prime condition (coded as 1),  $b = 1.92$ ,  $OR = 6.85$ ,  $p = 0.02$ ; a simple  
456 slopes analysis showed that the effect of condition on snack choice just reached significance  
457 for participants who reported feeling less tired,  $b = -1.32$ ,  $OR = 0.27$ ,  $p = 0.05$ . Lastly, there  
458 was a significant interaction between condition and self-reported BMI when the control  
459 condition (coded as 0) was compared with the Mars prime condition (coded as 1),  $b = -0.27$ ,  
460  $OR = 0.76$ ,  $p = 0.03$ , as before, none of the simple slopes reached significance.

461

462

#### 4. Discussion

463

464 Contrary to expectations, the results showed no effect of the logos on snack choice; the  
465 percentage of participants selecting the M&S snack and the Mars bar was similar across all  
466 three conditions. Although this does not support the initial prediction, two explanations that  
467 may account for this finding are discussed below.

468

469 Firstly, the priming task may have been too weak to have an effect on snack choice due to the  
470 complexity of the image shown to participants. Despite research evidence showing that even  
471 subliminal primes can increase the accessibility of a mental concept and influence subsequent  
472 behaviour (Van den Bussche et al., 2009; Karremans et al., 2006), these studies usually  
473 involve presenting the prime stimuli in isolation; for example, presenting a concept by itself  
474 rather than as part of a more detailed image. As it has been proposed that the level of concept  
475 activation achieved is determined by the duration and intensity of the prime stimuli presented  
476 (Bargh & Chartrand, 2000), it may be that the activation of the mental concepts in the present  
477 study was too low to show an effect.

478

479 Secondly, the effectiveness of the priming task may have been compromised by the inclusion  
480 of several different concepts in the prime image. Negative priming effects occur when the

481 inhibition of a prime stimulus reduces the accessibility of the corresponding mental concept  
482 during a subsequent task (Tipper, 1985). According to Frings et al. (2015), if an initial  
483 distractor stimulus subsequently becomes the target stimulus in a cognitive or behavioural  
484 task, response to this target is reduced in terms of latency and/or accuracy. For example,  
485 perception of the image may have activated irrelevant mental concepts through the  
486 identification of Gareth Southgate, as well as recognition of the logos that were not food-  
487 related. As the specific food-related logos in the image were irrelevant to the initial priming  
488 task – recognition of the individual in the image – they may have acted as distractor stimuli  
489 and therefore become less accessible as a result.

490

491 Overall, the results of study one did not support the hypothesis that exposure to food-related  
492 primes would increase the selection of the corresponding snack in a subsequent choice task.  
493 However, the results may have been influenced by the specific priming task employed; the  
494 task did not require conscious processing of the prime stimuli which was presented as part of  
495 a more detailed image that included various logos that were unrelated to food. Therefore, the  
496 aim of study two was to advance study one by including a stronger priming task that involved  
497 consciously processing the prime stimuli, as well as administering a more sensitive measure  
498 of food choice.

499

## 500 **5. Study Two**

501

### 502 **5.1 Study Two Overview**

503 In order to examine the effect of unhealthy food-related logos on food choice, participants  
504 were primed through the completion of a novel priming task that involved distinguishing  
505 between an original and a modified version of various brand logos. Approximately five  
506 minutes after completing the priming task, participants were presented with a food selection  
507 task that involved selecting five foods from a list of 12 healthy and 12 unhealthy food items.  
508 The first confirmatory hypothesis (H1) stated that participants who were exposed to the  
509 unhealthy food-related logos would select a greater number of unhealthy food items during  
510 the food selection task. The second confirmatory hypothesis (H2) stated that participants  
511 exposed to the unhealthy food-related logos who were also high in trait mindfulness would be  
512 less influenced by the prime stimuli (moderation). The data analysis also explored whether  
513 any effect of the unhealthy food-related logos on food choice was moderated by alertness,

514 last food consumption, conscious effort to eat healthily, and/or BMI. As for study one, these  
515 variables were included as previous research findings have shown them to influence food  
516 choice (Ghvanidze et al., 2017; Hoefling & Strack, 2010; Wells & Cruess, 2006; Cohen et al.,  
517 2011), although none have been examined in this specific context. This study was pre-  
518 registered on the Open Science Framework prior to the start of the data collection period  
519 ([osf.io/cdb5p](https://osf.io/cdb5p)).

520

## 521 **5.2 Participants**

522 An a priori power calculation was conducted for an independent t-test using the software  
523 G\*Power (Faul et al., 2009). This showed that 156 participants would be required to detect a  
524 medium main effect of priming on food choice (0.4) and achieve a 0.8 level of power with  
525 alpha set at 0.05. Therefore, a total of 170 female participants were recruited (before  
526 exclusions) through leaflets administered in the Department of Psychology, as well as an  
527 advertisement on the online experiment management system SONA. Females were recruited  
528 as it was important for the participants to be motivated to eat healthily in order to find a  
529 priming effect; no motivation to eat healthily would likely lead to the selection of the  
530 unhealthy foods regardless of the prime stimuli due to the greater reward associated with  
531 highly palatable foods that are unhealthy. The assumption that females are more motivated  
532 than males to eat healthy foods in order to regulate body weight was confirmed by Renner et  
533 al. (2012). The inclusion criteria also stated that participants must be at least 18 years old,  
534 have resided in the UK for a minimum of three years (to ensure familiarity with the logos),  
535 and have normal or corrected-to-normal vision (to ensure each logo could be perceived  
536 clearly). Furthermore, any individuals with a food allergy or who identified as vegan were  
537 excluded from the study due to the influence this may have on the food selection task. Ethical  
538 approval was granted by the City, University of London Psychology Department Research  
539 Ethics Committee.

540

## 541 **5.3 Measures**

542 ***Demographic Information.*** The demographic information questionnaire comprised measures  
543 of age and education; participants stated the highest level of education attained at the time of  
544 the study.

545

546 **Alertness.** Level of alertness was measured by asking participants to rate how alert they felt  
547 in the present moment on a 7-point Likert scale from ‘Extremely alert’ to ‘Extremely  
548 unalert’.

549

550 **Food Selection Task.** The food selection task presented participants with a total of 24 food  
551 items, including 12 healthy foods and 12 unhealthy foods that were identified through a pilot  
552 study (see pilot study one in the supplementary materials). Each participant was asked to  
553 select five foods to evaluate in a supposed ‘taste test’ at the end of the study, with both the  
554 healthy and unhealthy categories comprised of six savoury and six sweet food items.

555

556 **Food Desire.** Food desire was measured by asking participants to rate how much they wanted  
557 to consume the food items in the present moment, without concern for calories or a healthy  
558 diet. The participants rated each of the 24 food items on a 7-point Likert scale from ‘No  
559 desire’ to ‘Extreme desire’.

560

561 **Five-Facet Mindfulness Questionnaire Short-Form (FFMQ-SF).** The FFMQ-SF is a 24-  
562 item questionnaire that measures trait mindfulness through five components: observing,  
563 describing, acting with awareness, non-judgement, and non-reactivity (Bohlmeijer et al.,  
564 2011). The observing subscale consists of four items ( $\alpha$  for the present study = 0.52),  
565 whereas the describing subscale ( $\alpha = 0.85$ ), acting with awareness subscale ( $\alpha = 0.81$ ), non-  
566 judgement subscale ( $\alpha = 0.80$ ), and non-reactivity subscale ( $\alpha = 0.74$ ) all consist of five  
567 items. The authors have confirmed the replicability and validity of the questionnaire by cross-  
568 validating with an independent sample of participants (Bohlmeijer et al., 2011).

569

570 **Funnelled Debrief.** Awareness of the link between the priming task and the food selection  
571 task was assessed by asking participants a series of questions based on the awareness check  
572 guidelines provided by Bargh and Chartrand (2000). For example, participants were asked  
573 whether they had any ideas about the aim of the present study and whether any of the tasks  
574 completed during the ‘first study’ could have influenced their responses during the ‘second  
575 study’ (see supplementary materials for a complete list of questions).

576

577 **Eating Behaviour.** Motivation to consume a healthy diet was measured by means of a single  
578 question; participants were asked to rate the statement ‘I make a conscious effort to eat

579 healthy foods' on a 7-point Likert scale from 'Strongly disagree' to 'Strongly agree'.  
580 Participants were also asked to specify (1) whether they were following a particular diet at  
581 the time of the study; (2) the last time they consumed food to the nearest 15 minutes; and (3)  
582 when they next planned to consume food to the nearest 15 minutes.

583

584 **Body Mass Index (BMI).** After giving consent, the height and weight of each participant was  
585 taken so that BMI could be calculated.

586

#### 587 **5.4 Priming Task**

588 Both the priming and control tasks consisted of 18 trials whereby each trial involved  
589 distinguishing between an original and a modified version of a well-known brand logo.  
590 Participants in the prime condition were presented with six trials of unhealthy food-related  
591 logos, six trials of social media logos, and six trials of car logos. Participants in the control  
592 condition were presented with the same logos as the prime condition, apart from the  
593 presentation of six trials of clothing shop logos in place of the six trials of unhealthy food-  
594 related logos. The following unhealthy food-related brand logos were identified through two  
595 pilot studies (see pilot study one and two in the supplementary materials) and comprised the  
596 main prime stimuli: McDonald's, Ben & Jerry's, Magnum, Cadbury's, Thornton's, and Mr  
597 Kipling. Each logo was approximately 15cm by 10cm on the computer screen, although this  
598 varied slightly depending on the shape of the logo. For each trial, participants were asked to  
599 indicate whether they recognised the logo and to identify the original version. The duration of  
600 the exposure to each prime stimuli could not be measured due to the logos being presented in  
601 a random order by Qualtrics. Furthermore, even though the responses to each trial were  
602 recorded, the participants were not given any feedback regarding their performance on the  
603 priming task.

604

#### 605 **5.5 Procedure**

606 Participants were recruited through advertisements in the department and the experiment  
607 management system SONA. All participants were emailed and asked to confirm that they  
608 adhered to the eligibility criteria before taking part. The study was completed through the  
609 computer software Qualtrics in one of the behavioural research laboratories located in the  
610 Department of Psychology. On arrival, participants were informed that they would be  
611 completing two separate studies to disguise the true aim of the research. All participants were  
612 given a study information sheet and asked if they had any questions before giving informed

613 consent. Explicit instructions were provided on the computer screen to guide participants  
614 through the study.

615

616 The ‘first study’ was titled ‘Recognition memory and thinking style’ and took approximately  
617 10 minutes to complete. The researcher waited outside the laboratory while the study was  
618 being completed to avoid unconsciously influencing the responses made. Participants were  
619 initially asked to state their age, educational attainment and present level of alertness before  
620 being automatically randomised to either the prime or control condition by Qualtrics. The  
621 participants then completed either the priming task or the control task which are described in  
622 section 5.4 above. Subsequently, participants were asked to complete the 10-item rational-  
623 experiential inventory (REI-10) which is a brief measure of thinking style and was  
624 administered purely as a decoy to prevent participants from becoming aware of the true aim  
625 of the study; the responses to this questionnaire were not included in the present analysis. On  
626 completion of the REI-10, a message on the computer screen asked the participant to inform  
627 the researcher they had now completed the 'first study' and were ready to start the 'second  
628 study'. The studies were purposely set up as separate projects in Qualtrics to prevent the  
629 participants from becoming aware of the link between the priming task and the food selection  
630 task.

631

632 The ‘second study’ was titled ‘Food evaluation and personality’ and also took approximately  
633 10 minutes to complete. Prior to starting the ‘second study’, the participants were reminded  
634 that the first task was to select five foods to consume and evaluate as part of a ‘taste test’ at  
635 the end of the study; this reminder ensured that participants were under the impression they  
636 would have to consume the five foods selected later on. The researcher then left the  
637 laboratory to avoid unconsciously influencing the subsequent responses made. Once five  
638 foods had been selected from the 12 healthy and 12 unhealthy foods items, the participants  
639 were asked to rate their desire for each of the 24 foods on a 7-point Likert scale from ‘No  
640 desire’ to ‘Extreme desire’; the order in which the foods were presented during this task was  
641 automatically randomised by Qualtrics. This task was followed by completion of the FFMQ-  
642 SF and the behavioural approach systems subscale of the RST-PQ. After filling out both  
643 questionnaires, the participants were given the verbal funnelled debrief to ensure they were  
644 unaware of the link between the priming task and the food selection task. The final part of the  
645 study involved completing the eating behaviour questionnaire and recording the height and  
646 weight of participants who consented to having these measures taken. Following this, the

647 participants were told that they would not be required to complete the taste test and were  
648 informed of the true nature of the study; all participants received a debrief sheet and were  
649 asked if they had any questions or comments regarding the study. As a result of not  
650 completing the taste test and as a thank you for taking part, all participants were offered a  
651 snack to take away with them. Lastly, the assigned number of course credits or payment due  
652 was given to each participant.

653

## 654 **5.6 Data Analyses**

655 Both confirmatory hypotheses were specified before the first author began collecting the  
656 study data. Although the pre-registration form stated that both hypotheses would be analysed  
657 by means of several regression analyses, the first confirmatory hypothesis was analysed using  
658 an independent t-test as this was considered more appropriate. A third confirmatory  
659 hypothesis stated that trait mindfulness would reduce the effect of the unhealthy food-related  
660 logos through a reduction in reward reactivity (mediation). However, as the reinforcement  
661 sensitivity theory of personality questionnaire measures trait reward reactivity, it was not  
662 possible to determine whether this acts as a mediating variable; therefore, we have omitted  
663 any further discussion of this. Even though no exploratory analysis were specified prior to the  
664 study, the potential for certain variables to act as moderating variables was also examined.

665

666

## 6. Results

667

### 668 **6.1 Data Screening and Participant Characteristics**

669 A total of four participants did not meet the inclusion criteria and were therefore excluded  
670 from the main analysis; all four of these participants showed awareness of the true aim of the  
671 study during the funnelled debrief. A further eight participants were excluded for the  
672 following reasons: the first six participants may have been unaware the five foods selected  
673 were to be consumed as part of a ‘taste test’, as all six participants started to leave the  
674 laboratory after completing the ‘second study’; one participant was aiming to gain weight  
675 which may have increased the number of unhealthy foods selected; and one participant was  
676 found to be chewing gum throughout both studies, which may have influenced appetite. This  
677 resulted in a final sample size of 158 participants. Table 3 shows the demographic and  
678 personal characteristics of the participants as a function of condition. Table 4 shows a  
679 correlation matrix of the predictor and criterion variables.

680

681 **Table 3**682 *Characteristics of Participants as a Function of Condition*

Characteristic <sup>a</sup>	Control ( <i>n</i> = 82)	Prime ( <i>n</i> = 76)
Age (Mean, SD)	21.8 (6.3)	20.8 (6.8)
Completed education level (%)		
GCSE's	1	0
A-Levels	70	78
Bachelor's degree	11	12
Postgraduate degree	12	5
Other	6	5
Alertness (Mean, SD)	5.6 (1.0)	5.7 (1.1)
Conscious effort to eat healthily (Mean, SD)	4.8 (1.3)	4.8 (1.2)
Dieting (%)	9	9
Last food consumption in hours (Mean, SD) <sup>b</sup>	2.8 (3.8)	3.1 (3.7)
BMI <sup>c</sup> (Mean, SD)	23.3 (5.4)	24.5 (6.4)

683 <sup>a</sup>Alertness and conscious effort to eat healthily were both measured on 7-point Likert scales  
684 where higher scores reflected a higher agreement with each measure.

685 <sup>b</sup>One missing value in the control condition.

686 <sup>c</sup>Number who declined to have measures taken: Control = 9, prime = 12.

687

688 **Table 4**689 *A Correlation Matrix of the Predictor and Criterion Variables*

	1	2	3	4	5	6	7
1 Condition	1						
2 Alertness	0.04	1					
3 Conscious desire to eat healthily	0.01	0.11	1				

4	Desire for healthy food	-0.05	-0.09	0.04	1			
5	Desire for unhealthy food	0.15	-0.06	-0.07	0.25**	1		
6	Mindfulness score	-0.03	0.20*	0.15	-0.08	0.20*	1	
7	Food choice score	0.03	0.05	-0.21**	-0.11	0.02	-0.17*	1

690 \*Correlation is significant at the 0.05 level (two-tailed).

691 \*\*Correlation is significant at the 0.01 level (two-tailed).

692

### 693 **6.2 Confirmatory Analysis: The Effect of Condition on Unhealthy Food Choice (H1)**

694 The number of unhealthy food choices made by each participant were summed to give a total  
695 unhealthy food choice score out of 5; participants selecting 5 healthy foods scored 0 and  
696 participants selecting 5 unhealthy foods scored 5. As four participants selected six foods to  
697 consume rather than five, these scores were adjusted to reflect the proportion of unhealthy  
698 food choices made by each participant based on the selection of five foods; this was  
699 calculated by dividing the original unhealthy food choice score by six and then multiplying  
700 by five. The descriptive statistics showed that the mean unhealthy food choice score was  
701 similar for both the control condition (mean = 2.88, SD = 1.41) and the prime condition  
702 (mean = 2.96, SD = 1.40); an independent t-test confirmed that there was no difference in the  
703 food choices made by both conditions,  $t(156) = -0.36, p = 0.72$ . The mean unhealthy food  
704 choice scores for the control condition and prime condition are visually represented in Figure  
705 2. This hypothesis was also tested through an analysis of covariance in order to control for  
706 alertness, last food consumption, conscious effort to eat healthily, and BMI; as this made no  
707 difference to the results, these variables were removed from the analysis.

708

#### 709 **Figure 2**

710 *The Mean Unhealthy Food Choice Scores for the Control and Prime Conditions*

711

712 *Insert Figure 2 here*

713

### 714 **6.3 Confirmatory Analysis: The Moderating Effect of Mindfulness on Unhealthy Food** 715 **Choice Score (H2)**

716 A hierarchical linear regression was run to determine whether trait mindfulness (centred)  
717 moderated the association between condition and unhealthy food choice score. The analysis  
718 involved entering trait mindfulness at step 1, condition at step 2, and the interaction term at

719 step 3. Table 5 shows a main effect of trait mindfulness on unhealthy food choice score  
 720 whereby participants higher in trait mindfulness were significantly less likely to select  
 721 unhealthy foods,  $\beta = -0.17$ ,  $t = -2.19$ ,  $p = 0.03$ . The results also showed there was no  
 722 significant interaction between condition and trait mindfulness on unhealthy food choice  
 723 score,  $\beta = 0.09$ ,  $t = 0.88$ ,  $p = 0.38$ . However, as the sample size calculation was based on the  
 724 first confirmatory hypothesis (main effect of priming on food choice) it may be the case that  
 725 this analysis was underpowered, increasing the likelihood of a type II error.

726

727 **Table 5**

728 *A Linear Regression Model Examining the Main and Moderating Effect of Trait Mindfulness*  
 729 *on Unhealthy Food Choice Score.*

	Food choice score		
	B	SE	Beta
Step 1			
Constant	2.92	0.11	
Trait mindfulness	-0.50	0.23	-0.17**
R <sup>2</sup>	0.03		
Step 2			
Constant	2.88		
Condition*	0.07	0.22	0.02
R <sup>2</sup>	0.03		
$\Delta R^2$	0.00		
Step 3			
Constant	2.89		
Interaction	0.40	0.46	0.09
R <sup>2</sup>	0.04		
$\Delta R^2$	0.01		

730 \*Control = 0, prime = 1.

731 \*\* $p < 0.05$ .

732

733 **6.4 Exploratory Analysis: The Association Between Trait Mindfulness and Unhealthy**  
 734 **Food Choice Score**

735 A forced entry multiple regression showed the association between the five subscales of the  
 736 FFMQ-SF and unhealthy food choice score was low to moderate (Multiple  $R = 0.27$ ,  $p =$   
 737  $0.04$ ) with the subscales accounting for 4% of the variance in unhealthy food choice score  
 738 (Adjusted  $R^2$ ). The data analysis showed that none of the subscales were intercorrelated

739 (observing, VIF = 1.08; describing, VIF = 1.21; non-reactivity, VIF = 1.21; acting with  
 740 awareness, VIF = 1.27; non-judgement, VIF = 1.44). Overall, non-judgement was the only  
 741 significant predictor of unhealthy food choice score whereby participants reporting higher  
 742 levels of non-judgement selected fewer unhealthy foods,  $\beta = -0.27$ ,  $p = 0.004$  (95% CI = -  
 743 0.79 – -0.15). The unstandardised and standardised coefficients for each of the five subscales  
 744 are shown in Table 6.

745

746 **Table 6**

747 *A Linear Regression Model Examining Associations between the Five Subscales of the*  
 748 *FFMQ-SF and Unhealthy Food Choice Score.*

	Food choice score		
	B	SE	Beta
Step 1			
Constant	4.77	0.82	
Observing	-0.27	0.17	-0.13
Describing	0.09	0.14	0.06
Non-reactivity	-0.09	0.16	-0.05
Acting with awareness	0.10	0.15	0.06
Non-judgement	-0.47	0.16	-0.27*

749 \* $p < 0.05$ .

750

### 751 **6.5 Exploratory Analysis: The Moderating Effect of States**

752 A series of hierarchical linear regressions were run to determine whether alertness, last food  
 753 consumption, conscious effort to eat healthily and BMI moderated the association between  
 754 condition and unhealthy food choice score. All moderator variables were mean centred before  
 755 being entered into the regression models. Each analysis involved entering the moderating  
 756 variable at step 1, condition at step 2, and the interaction term at step 3.

757

#### 758 *The Moderating Effect of Alertness, Last Food Consumption, Conscious Effort to Eat* 759 *Healthily, and BMI*

760 The results showed there was no main effect of alertness on unhealthy food choice score and  
 761 there was also no interaction effect between condition and alertness. Visual inspection of the  
 762 data showed that last food consumption had a non-normal distribution, although this was

763 corrected following a log10 transformation. The results showed there was no main effect of  
764 last food consumption on unhealthy food choice score and the coefficient of the interaction  
765 term was also not significant. However, a main effect of conscious effort to eat healthily on  
766 unhealthy food choice score was found, whereby higher levels of conscious effort to eat  
767 healthily were associated with fewer unhealthy food choices,  $\beta = -0.21$ ,  $t = -2.64$ ,  $p = 0.009$ .  
768 The coefficient of the interaction between condition and conscious effort to eat healthily was  
769 not significant. As five BMI scores were identified as outliers through tests of normality, the  
770 values of these scores were replaced with the largest BMI score that was not identified as an  
771 outlier (Kwak & Kim, 2017). The results showed there was no main effect of BMI on  
772 unhealthy food choice score and there was also no interaction effect between condition and  
773 BMI.

774

### 775 **6.6 Exploratory Analysis: The Effect of Condition on Desire**

776 As desire was measured on a 7-point Likert scale, a mean desire rating for the 12 unhealthy  
777 food products was calculated and compared between conditions. The descriptive statistics  
778 showed that the desire ratings were similar for both the control condition (mean = 2.38, SD =  
779 0.62) and the prime condition (mean = 2.58, SD = 0.69); an independent t-test confirmed that  
780 there was no difference in the desire ratings of both conditions,  $t(156) = 1.90$ ,  $p = 0.06$ .

781

## 782 **7. Discussion**

783

784 The results showed there was no effect of the unhealthy food-related primes on the number of  
785 unhealthy food items selected; the mean number of unhealthy food items selected was similar  
786 for both the prime and control conditions. Although this result was unexpected, two potential  
787 explanations to account for these findings are discussed below.

788

789 Firstly, the priming task exposed the participants to six unhealthy food-related logos which  
790 only accounted for 33% of the stimuli in the priming task. As the task was developed to  
791 increase the strength of the concept activation by presenting the primes at a high intensity for  
792 a fairly long duration, it was determined that a higher frequency of prime stimuli may  
793 increase the proportion of participants becoming aware of the aim of the study. However, the  
794 importance of frequent exposure to prime stimuli has been demonstrated by Srull and Wyer  
795 (1979) who varied both the proportion of prime stimuli presented (20% or 80%) and the

796 length of the priming task (30 items or 60 items). The results showed that participants  
797 exposed to a higher proportion of prime stimuli showed a stronger priming effect during a  
798 subsequent evaluation task than those exposed to a lower proportion of prime stimuli.  
799 Furthermore, participants who completed the 60-item priming task showed a stronger  
800 priming effect than participants who completed the 30-item priming task, even when both  
801 tasks had a high proportion of prime stimuli. Therefore, the lack of effect found in the present  
802 study may be due to the low proportion of prime stimuli presented during the priming task.

803

804 Secondly, the participants may have justified the selection of unhealthy foods by viewing the  
805 taste test as a 'one off' situation that is not frequently encountered. This is synonymous with  
806 the phenomenon of self-licensing whereby individuals are more likely to select hedonic food  
807 items when the decision context allows for consumption to be justified. It has been argued  
808 that 'sometimes indulgence is not determined by one's capacity to control oneself but rather  
809 by the availability of reasons to justify the prospective indulgence' (De Witt Huberts et al.,  
810 2012, p. 491). Therefore, the participants may have thought that consuming unhealthy foods  
811 on this occasion would have little impact on overall weight compared to more habitual eating  
812 behaviours. It may also be the case that the selection of one healthy food item justified the  
813 selection of one unhealthy food item (Chandon & Wansink, 2007). Research has also shown  
814 that the mere presence of a healthy food option can lead to the selection of an indulgent food  
815 choice (Wilcox et al., 2010). Although there is no way for future research to account for this,  
816 it is important to at least acknowledge the potential effect of self-licensing on the results.

817

818

## 8. General Discussion

819

### 8.1 The Findings in Relation to Theory and Previous Research

820 Both studies were based on the Situated Inference Model which proposes that exposure to a  
821 prime stimulus increases the accessibility of a synonymous mental concept in memory  
822 (Loersch & Payne, 2011). The individual misattributes this increased accessibility for their  
823 own thoughts and feelings which subsequently influences judgements, decisions, and  
824 behaviour. Overall, neither study provided support for the Situated Inference Model as both  
825 failed to show a significant effect of the prime stimuli on food choice. As discussed above,  
826 this may be because neither priming task successfully activated the corresponding mental  
827 concepts in memory. Although the priming task in study two was designed specifically to  
828

829 maximise the level of concept activation achieved, the effectiveness of both priming tasks  
830 employed was not confirmed. Secondly, as this model explicitly states that the increase in the  
831 accessibility of a mental concept is only temporary, it may also be the case that the delay  
832 between the priming task and the outcome measure in both studies was too long for the level  
833 of activation achieved. Thirdly, the participants in the prime condition may not have  
834 attributed the increased accessibility of the primed concepts to their own thoughts and  
835 feelings. If this is the case, then the increased accessibility of the primed concepts will have  
836 been dismissed by the participants during the food selection task, having no effect on the  
837 foods selected by the participants.

838

839 The findings reported by study one and study two are also in contrast with the results of  
840 previous research that has examined the effect of priming on eating and drinking behaviour  
841 (Chiou et al., 2013; Fishbach & Dhar, 2005; Karremans et al., 2006). However, as the  
842 purpose of study one was to replicate a natural setting where various stimuli are visible  
843 simultaneously, the priming task employed did not require conscious processing of the prime.  
844 In contrast, previous research has often employed priming tasks, such as the scrambled  
845 sentence task or a task that involves memorising and recalling a list of words, that require the  
846 participants to consciously process the prime stimuli. This means that the level of concept  
847 activation may have been significantly lower in study one compared to previous research.  
848 However, the priming task developed for study two appears to be comparable to the tasks  
849 employed in previous research, as the participants were required to consciously process the  
850 prime stimuli in order to complete the task. One potential explanation for the different effects  
851 found may be the substantial delay between the priming task and the food selection task in  
852 study two, which may have offset the level of concept activation initially achieved. However,  
853 it is uncertain whether there was a substantial delay between the priming task and the  
854 outcome measure in the three studies mentioned above, meaning it is unclear to what extent  
855 this may account for the difference in the findings reported.

856

857 Despite the lack of priming effects found, study two revealed a significant main effect of  
858 mindfulness on food choice, whereby participants higher in trait mindfulness selected a  
859 higher proportion of healthy foods. This supports previous research which also found that  
860 individuals higher in trait mindfulness selected healthier foods than individuals lower in trait  
861 mindfulness (Jordan et al., 2014). However, the present study specifically found that this was  
862 accounted for by non-judgement of inner experience – allowing thoughts and feelings to be

863 experienced without evaluating them as good or bad (Baer et al., 2008). This supports the  
864 proposition by Elkins-Brown et al (2017) who argue that mindfulness enhances self-control  
865 through two mechanisms: interoceptive awareness and non-judgemental acceptance.  
866 According to the authors, these mechanisms moderate responses to conflict-related affect by  
867 activating self-control processes that ensure behaviour is in line with present goals.  
868 Therefore, cultivating non-judgement of inner experience may be an effective way of  
869 encouraging healthier choices when faced with a variety of healthy and unhealthy options.

870

## 871 **8.2 Future Research**

872 As mentioned above, the lack of priming effect reported by both the field study and the  
873 laboratory study may be due to the ineffectiveness of the priming tasks completed. However,  
874 as the capacity of each task to activate the corresponding mental concepts in memory was not  
875 assessed, the extent to which this contributed to the null findings is unknown. Therefore, it is  
876 important that future research assesses the effectiveness of the specific priming task  
877 employed in order to confirm that the task was successful in activating the target concept.  
878 This could be achieved through presenting the prime stimuli at a subliminal level prior to the  
879 completion of a lexical decision task – a string of letters is presented immediately following  
880 the prime stimuli and the participant is asked to indicate whether it is a word or a non-word.  
881 The words presented are either target words or neutral words where the target words are  
882 either the same as or related to the prime stimuli. A decreased response time to the target  
883 words, compared to the neutral words, is taken as evidence that the priming task has been  
884 successful.

885

886 Secondly, future research would benefit from having greater control over the exposure  
887 duration to the prime stimuli; one of the main weaknesses of the present research is that the  
888 specific priming tasks employed precluded the possibility to control the length of time the  
889 participants were exposed to the primes. Based on the assumption that the level of concept  
890 activation achieved is determined by the intensity and duration of the exposure to the prime  
891 stimuli (Bargh & Chartrand, 2000), it is important for future research to ensure that the  
892 participants are exposed to the prime stimuli for a fairly long duration; a video of an  
893 interview with a football manager or player could achieve this while also ensuring that each  
894 participant is exposed to the prime stimuli for the same length of time. Furthermore, in order  
895 to test this formula directly, it would be interesting for future research to vary the exposure

896 time across conditions to determine whether a longer exposure time results in stronger  
897 priming effects in this particular context.

898

### 899 **8.3 Conclusions**

900 Although previous research has shown that exposure to prime stimuli can influence both  
901 eating and drinking behaviour, the research presented found no evidence for an effect of  
902 food-related logos on subsequent food choice. Even though this may be due to the specific  
903 priming tasks utilised, it is also important to consider the possibility that food-related logos  
904 have no effect on food choice. Consequently, further research is required to advance the  
905 present understanding of this topic.

906

### 907 **Author Contributions**

908 STF: designed and executed study one and study two; performed part of the data analysis for  
909 study one and all of the data analysis for study two; wrote the first draft of the manuscript.

910 AP: assisted with the data analysis for study one; wrote part of the result section for study  
911 one; edited the final manuscript. KT: collaborated with the design of study one and study  
912 two; edited the final manuscript. All authors approved the final version of the manuscript for  
913 submission.

914

### 915 **Declarations of Interest**

916 None

917

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922

### 923 **Data Availability**

924 All the study data is available on the Open Science Framework.

925

926

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