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

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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).

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 ^a	Control (<i>n</i> = 60)	M&S Prime (<i>n</i> = 56)	Mars Prime (<i>n</i> = 54)
Females (%) ^b	32	45	47
Age (Mean, SD) ^{cd}	25.1 (9.8)	24.0 (7.3)	27.8 (11.2)
Completed education level (%) ^e			
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 (%) ^f	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) ^g	23.9 (3.4)	23.1 (3.5)	25.2 (4.7)

357 ^aConscious 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 ^bThree missing values in the control condition and the Mars prime condition.

360 ^cOne missing value in the control condition and the M&S prime condition.

361 ^dSignificance based on Welch's F-test due to unequal homogeneity of variance.

362 ^ePercentages may not total 100 due to rounding.

363 ^fOne missing value in the M&S prime condition.

364 ^gNumber 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
Included						
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).

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 (α 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 ^a	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) ^b	2.8 (3.8)	3.1 (3.7)
BMI ^c (Mean, SD)	23.3 (5.4)	24.5 (6.4)

683 ^aAlertness 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 ^bOne missing value in the control condition.686 ^cNumber 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 ²	0.03		
Step 2			
Constant	2.88		
Condition*	0.07	0.22	0.02
R ²	0.03		
ΔR^2	0.00		
Step 3			
Constant	2.89		
Interaction	0.40	0.46	0.09
R ²	0.04		
ΔR^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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