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Poverty, inequality, and increased consumption of high calorie food: Experimental evidence
for a causal link.

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Abstract

Rising obesity represents a serious, global problem. It is now well established that obesity is associated with poverty and wealth inequality, suggesting that these factors may promote caloric intake. Whereas previous work has examined these links from an epidemiological perspective, the current paper examined them experimentally. In Study 1 we found that people experimentally induced to view themselves as poor (v. wealthy) exhibited increased calorie intake. In Study 2, participants who believed that they were poorer or wealthier than their interaction partners exhibited higher levels of anxiety compared to those in an equal partners condition; this anxiety in turn led to increased calorie consumption for people who had a strong need to belong. The findings provide causal evidence for the poverty-intake and inequality-intake links. Further, we identify social anxiety and a strong need to belong as important social psychological factors linking inequality to increased calorie intake.

Word Count: 146

Keywords: Food; Anxiety; Inequality; Poverty; Obesity.

54 Poverty and inequality are strongly associated with widespread obesity. The poverty–
55 obesity link is one of the most frequently identified: Obesity rates are highest amongst the
56 poor (James, 2004; James, Leach, Kalamara, & Shayeghi, 2001), in both developed and
57 developing nations (WHO, May 2012). In developed nations, however, socioeconomic
58 inequality has been identified as an even stronger predictor of obesity rates (K. Pickett,
59 Wilkinson, Brunner, Lobstein, & Wilkinson, 2005; Wilkinson & Pickett, 2009a). Analyses of
60 cross-national data and data from the 50 US states revealed that obesity rates are strongly
61 correlated with income inequality, with more unequal states characterized by higher
62 incidence of obesity (K. Pickett et al., 2005). The higher obesity rates cannot be solely
63 attributed to more extreme poverty in unequal societies; in such societies higher incidence of
64 obesity and obesity-related health conditions (i.e., diabetes, hypertension, cancer, and heart
65 disease) are evident at all levels of the social gradient (Banks, Marmot, Oldfield, & Smith,
66 2006; Marmot, 2006). That is, compared to their counterparts in more equal societies, people
67 at all socio-economic levels in unequal societies – upper, middle, and lower – fare worse in
68 terms of health-related outcomes, although the difference between unequal and more equal
69 societies is largest for those with lower incomes (Banks, Marmot, Oldfield, & Smith, 2006;
70 Marmot, 2006).

71 The finding that even the wealthy in unequal societies suffer from higher rates of
72 obesity and have worse health outcomes than their counterparts in more equal societies
73 suggests that inequality impacts through mechanisms distinct from wealth-dependent access
74 to health services, higher quality food, and better living conditions. Several authors have
75 suggested the role of inequality-triggered psychological processes – specifically stress and
76 anxiety – as underlying these negative health outcomes (Marmot, 2006; K. Pickett et al.,
77 2005; Wilkinson & Pickett, 2009b). The proffered psychological explanation of the effect of
78 inequality on health in general, and obesity in particular, has been extensively argued.

79 However, to our knowledge it has never been experimentally investigated. The aim of the
80 current research is to test the effect of poverty and inequality on the consumption of high-
81 calorie food using an experimental psychological approach.

82 Consumption of food high in fat, sugar, and overall calorific content (high-calorie
83 food) is considered a leading cause of obesity (cf. Drewnowski & Specter, 2004). If under
84 conditions of experimentally induced perceptions of poverty and inequality people increase
85 their consumption of high-calorie food, this may reveal the psychological mechanisms that
86 link these socioeconomic conditions to obesity. We propose that both perceptions of poverty
87 and socioeconomic inequality contribute to increased calorie intake.

88 **Relationship between perceived poverty and food consumption**

89 Viewing oneself as poor may increase calorie intake as it is linked to perceptions of
90 scarcity. Ample research has demonstrated that when food scarcity is perceived or
91 anticipated, organisms exhibit an allostatic, ‘feed-forward’ tendency to compensate for future
92 calorie deficits (for reviews, see Schulkin, 2003; Sterling, 2004). For instance, rats learn to
93 eat more when presented with signals of impending food scarcity (Jarvandi, Thibault, &
94 Booth, 2009). Similarly, cues associated with meal interruption reinvigorate the appetite of
95 sated rats (Galarce & Holland, 2009). Human research in naturalistic settings has also
96 revealed a relationship between food scarcity or insecurity and compensatory eating (Olson,
97 Bove, & Miller, 2007), suggesting that the positive association between high food insecurity
98 and high BMI may be explained by pre-emptive calorie intake (Basiotis & Lino, 2003;
99 Olson, 1999). Indeed, recent experimental research demonstrated that following exposure to
100 words associated with environmental harshness and scarcity (e.g., survival, struggle,
101 withstand) people preferentially seek high-calorie food and consume larger amounts of it
102 (Laran & Salerno, 2013; Swaffield & Roberts, 2014).

103 Because access to food is often a function of other resources (e.g., wealth), viewing
104 oneself as poor and lacking resources may also lead to increased food consumption. Further,
105 this eating behavior may occur in the absence of hunger or continue despite satiation.

106 **Relationship between inequality and anxiety**

107 In addition to poverty, socioeconomic inequality is a key contributor to both obesity
108 and other negative health outcomes (for overviews, see Wilkinson & Pickett, 2009a&b).
109 Most relevant for the current argument is the strong association between inequality and the
110 prevalence of stress and mental illness, particularly anxiety disorders: People in unequal
111 societies experience more stress and anxiety than people in more equal societies (Marmot,
112 2004; K. Pickett & Wilkinson, 2010).

113 Unequal societies have steep social gradients with large status differences. This
114 makes the rewards associated with being higher on the social ladder particularly appealing,
115 and the costs of being at the lower end particularly harsh. Having higher status means
116 material comfort, prestige, and greater opportunity for social engagement and influence (cf.
117 Marmot, 2004; Wilkinson & Pickett, 2009b). By contrast, lower status means not only a
118 poorer and less comfortable life, but additionally a lack of prestige and limited social capital.
119 This polarization of rewards and costs in unequal societies may be a powerful source of
120 chronic stress and anxiety.

121 The link between low social rank and stress and anxiety is extensively documented
122 amongst both humans and non-humans. Subordinate monkeys tend to have higher levels of
123 the stress-related hormone cortisol (Sapolsky, 2004; Shively & Clarkson, 1994), and when
124 given the opportunity to self-administer cocaine do so at higher rates than dominant monkeys
125 (Morgan et al., 2002). Similar effects of low status have been also identified in humans:
126 People at the bottom of workplace hierarchies exhibit the highest levels of stress (Marmot,
127 2005, 2006), arguably due to negative social evaluation and lower perceived control (for an
128 overview, see Marmot, 2004).

129 Although the burden of inequality disproportionately falls on the shoulders of those at
130 the bottom, occupying a privileged position in an unequal society may not be anxiety-free,

131 either. Those who have what others desire may fear being envied and challenged over the
132 legitimacy of their privileged position. Although being envied may be a positive experience
133 which communicates that one occupies a desirable social rank, it additionally involves threat,
134 the ‘hanging sword of Damocles’: The envied may be a subject to ill wishing and harmful
135 intent (Miceli & Castelfranchi, 2007). Findings from a recent analysis of the European Social
136 Survey (round 4; 2008-2010) revealed that fear of crime is more prevalent in unequal
137 societies, and it is predominantly expressed by members of ethnic majority and socially
138 privileged groups. Furthermore, the negative effect of inequality on wellbeing amongst ethnic
139 majority, privileged groups was explained by fear of crime (Vauclair & Bratanova, 2015).
140 People who occupy privileged positions in unequal societies may be wise to fear being
141 challenged and envied by others: Polarization of resources is associated with greater
142 competition, higher levels of aggression, and lower levels of trust and cooperation
143 (Loughnan et al., 2011; Neville, 2012; Oishi, Kesebir, & Diener, 2011; Wilkinson & Pickett,
144 2009b). The increased risk of being challenged and the high cost of losing rank may cause
145 those who occupy the upper levels of unequal societies to experience negative emotions,
146 including anxiety from being envied.

147 Inequality, therefore, may induce stress and anxiety regardless of whether a person
148 occupies the higher or lower end of a social hierarchy. It is important to note that the source
149 of inequality-induced stress and anxiety is *fundamentally* social; people are worried about
150 what others think of them. A diverse body of research demonstrated that real or imagined
151 social-evaluative threats, such as criticism, envy, and exclusion, are powerful stressors
152 (Dandeneau et al., 2007; Dickerson & Kemeny, 2004; Stroud, Tanofsky-Kraff, Wilfley, &
153 Salovey, 2000) as they pose a threat to the ‘social self’ (Gruenewald, Kemeny, Aziz, &
154 Fahey, 2004; Schlenker & Leary, 1982). The experience of social threat and the ensuing
155 stress and anxiety are deeply rooted in our basic human need to be accepted and positively
156 evaluated by others (need to belong; cf. Baumeister & Leary, 1995). The stronger an
157 individual’s need to belong, the more vigilant they are to cues of rejection and social

158 evaluation (C. L. Pickett, Gardner, & Knowles, 2004). If the anxiety induced by inequality is
159 fundamentally social and evaluative, people who possess a strong need to belong should be
160 particularly vulnerable to its detrimental effects on health and psycho-social wellbeing.
161 Conversely, people who are only weakly motivated to relate to others should be less affected
162 when confronted with inequality.

163 **Relationship between anxiety and food consumption**

164 If inequality causes stress and anxiety, then the relationship between inequality and
165 obesity might be due to inequality-induced anxiety triggering increased food consumption.
166 Converging evidence from surveys, human and animal experimentation, and
167 neurophysiological studies suggests that stress and anxiety influences food selection and
168 consumption.

169 Stress is associated with increased pursuit and consumption of palatable, high-calorie
170 food (for an overview, see Gibson, 2006). Survey studies examining food choices have
171 revealed that people preferentially choose sweeter and fattier snack foods when they report
172 feeling stressed (Oliver & Wardle, 1999). These self-report findings have been also
173 confirmed with a hormonal measure of stress: People with high cortisol reactivity tend to
174 consume greater amounts of palatable, high-calorie food (Newman, O'Connor, & Conner,
175 2007). Experimental studies have also demonstrated that people consume more sweet and
176 high-fat food following anxiety-inducing ego-threatening tasks (Rutters, Nieuwenhuizen,
177 Lemmens, Born, & Westerberp-Plantenga, 2009). Furthermore, research examining food
178 intake in rats revealed that compared with controls, chronically stressed rats show increased
179 consumption of palatable foods (Dallman et al., 2003).

180 These findings are not surprising: high-calorie food is a readily accessible source of
181 pleasure and comfort (Dallman, Pecoraro, & la Fleur, 2005), and has the capacity to alleviate
182 stress- and anxiety-related dysfunction (Dallman et al., 2003). In short, research from self-

183 reports, hormone and psychophysiological studies, and behavioral tasks all indicate that stress
184 and anxiety appear to push people towards increased calorie intake.

185 **The Current Research**

186 The preceding discussion outlined research supporting the links between obesity and
187 poverty and inequality, and the interrelations among inequality, stress and anxiety, and
188 calorie intake. However, the causal relationship between these socioeconomic conditions and
189 calorie intake has not been experimentally established. The hypotheses that perceived poverty
190 triggers increased food intake (*poverty-intake* hypothesis) and that inequality induces stress
191 and anxiety, which in turn lead to increased food intake (*inequality-anxiety-intake*
192 hypothesis), therefore remain untested. The current research tests these propositions.

193 For the purposes of the current studies, we adopt Mullainathan and Shafir's (2013)
194 definition of poverty as the perception of financial and material scarcity. That is, we assume
195 that feeling poor or wealthy stems from an evaluation of how much resources a person
196 possesses and what they can afford in absolute terms. Along with these authors, we also
197 assume that the perceptions of financial and material scarcity are embedded in the norms and
198 expectations of a specific society, as what counts as a sufficient level of resources varies from
199 one societal context to another (e.g., owning a suit appropriate for a job interview may be a
200 must in a developed society, but may be less essential in developing societies; cf.
201 Mullainathan & Shafir, 2013). Inequality, on the other hand, is operationally defined as a
202 relative evaluation of how much wealth a person possesses *compared* to others.

203 We examine the effects of poverty and inequality simultaneously because feeling poor
204 (wealthy) in absolute terms and in comparison to others may understandably co-occur.
205 Failing to achieve 'acceptable' living standards, for instance, can both yield an absolute and
206 relative assessment of poverty (e.g., I am poor *and* I am poorer than others). Moreover,
207 unequal societies are characterized by higher levels of materialism, consumerism, and
208 advertising (Bauer, Wilkie, Kim, & Bodenhausen, 2012), all of which inflate what is
209 considered an acceptable level of possessions. People with lower incomes may therefore

210 struggle to attain such inflated standards of living, further deepening their perceptions of
211 poverty and deprivation. Feeling poor and feeling deprived can simultaneously influence
212 eating behavior, pushing people to approach high calorie food and consume larger amounts
213 of it. In Study 1 we examined the *poverty-intake* and *inequality-anxiety-intake* hypotheses by
214 experimentally manipulating participants' feelings of absolute poverty and measuring
215 inequality. Study 2 inverted this approach and experimentally manipulated inequality whilst
216 measuring perceptions of absolute poverty.

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Study 1

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The aim of Study 1 was to examine both the direct poverty-intake hypothesis and the anxiety-mediated association between inequality and food intake. To examine the direct link between poverty and consumption, we experimentally induced participants to feel poor or wealthy and measured subsequent calorie intake. If poverty directly affects calorie intake, participants manipulated to feel poor should consume more calories. To examine the role of inequality on anxiety and calorie intake, we measured participants' subjective socioeconomic position and their levels of anxiety before they consumed food. We used subjective socioeconomic position as a proxy measure of inequality as it is inherently comparative in nature and rating one's own position requires taking into account the entire social hierarchy of a society, from the very wealthy to the very poor (Singh-Manoux, Marmot, & Adler, 2005).

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We expected inequality to be associated with anxiety, regardless of whether people report occupying lower or higher positions on the socioeconomic hierarchy. However, the source of anxiety is expected to differ; people with a lower socioeconomic position should feel anxious due to concerns of being negatively evaluated, looked down on, and socially excluded, whereas those with a higher socioeconomic position should worry about being

235 envied. In both cases we expect that inequality-induced anxiety will be associated with
236 increased calorie intake (see Figure 1 for a graphic representation of Study 1 design).

237 [Figure 1 around here]

238 **Method**

239 **Participants.** Participants were 54 British undergraduate students (28 female), with
240 mean age of 20.54 years ($SD = 4.79$). They participated in exchange for course credit.

241 **Materials and procedure.** Upon arrival, participants were seated in separate cubicles
242 and informed that they would participate in two short, unrelated studies. The first study was
243 presented as examining perceptions of wealth in society. The second study was introduced as
244 examining enjoyment of food during a recreational activity. Participants were informed that
245 they would be asked to consume and evaluate the taste of two snacks as part of that study. At
246 the beginning of the session participants provided a measure of their family's socioeconomic
247 position (1=*Lower/Working*; 7=*Upper/Wealthy*); this served as a measure of inequality.
248 Participants were also asked to report their current level of hunger (1=*Not at all hungry*;
249 7=*Very hungry*) and other basic demographics (i.e., age, gender, nationality).

250 Participants were then randomly assigned to the experimental conditions. In the
251 wealthy condition the participants read a paragraph describing how many people in their
252 society lived in financial and material abundance (i.e., being able to cover their living
253 expenses, and to buy and do the things they wanted). Conversely, participants in the poor
254 condition read a paragraph describing how many people in their society lived in material and
255 financial scarcity (i.e., living from pay check to pay check, watching the pennies, and trying
256 to stretch their budgets to cover their basic living expenses). Participants were then asked to
257 write a few sentences on how they are similar to the group described in the respective
258 paragraphs. Identifying similarities in self-other comparisons has been shown to increase the
259 salience of the common features and result into assimilation to the target (cf. Mussweiler,
260 2003). The writing task was therefore designed to increase the salience of participants' own
261 experience of living with scarce (vs. abundant) resources, and to make them feel poor or

262 wealthy via assimilation to the group they read about. Although the manipulation was
263 designed to primarily induce feelings of absolute poverty and wealth, it is conceivable that
264 feelings of relative deprivation and advantage may also ensue due to the socially constructed
265 nature of poverty and wealth (cf. Mullainathan & Shafir, 2013). To check whether the
266 manipulation elicited the intended effect, participants were asked to indicate on two separate
267 items the extent to which they felt poor and wealthy. To partial out any feelings of relative
268 deprivation or advantage that may have resulted from the experimental manipulation,
269 participants were also asked to indicate on two separate items the extent to which they felt
270 relatively deprived and relatively advantaged compared to others. Next, participants
271 completed a questionnaire designed to measure inequality-induced anxiety. This five-item
272 questionnaire measured their concerns with regard to how others may evaluate them based on
273 their material wealth (i.e., I worry: “that others will look down on my possessions; whether I
274 will be accepted by my peers; that others will think I cannot afford good things in life; that
275 people will consider me lower class; that other people will envy my privileged background”).
276 Responses to all items were measured on a 7-point scale (1=*Strongly disagree*; 7=*Strongly*
277 *agree*).

278 Next, participants were introduced to the study on taste and snacking. They were told
279 they would watch two short National Geographic style videos about art and nature (approx. 4
280 min). Prior to each video they were served a snack plate – crackers (i.e., plain Ritz,
281 containing 57.5g of carbohydrates, 26.1g of fat, and 493kcal per 100gr) and chocolates (i.e.,
282 Galaxy Minstrels, containing 70g of carbohydrates, 22g of fat, and 503kcal per 100gr). The
283 two types of food were used to balance for a preference for sweet or savory snacks. After the
284 end of the first video the plate with crackers was removed and the plate of chocolates was
285 served.

286 The plates were weighed before and after they were served to participants by
287 experimenters blind to the condition. The serving size of the chocolates was approximately
288 150g (+/- 3g); the serving size of crackers was approximately 100g (+/- 3g). Electronic scales
289 (measurement error of +/- 1g) were used to weigh the snacks. The calorie intake measure was
290 the sum of calories consumed from each snack. After participants finished watching the
291 videos and snacking on the food, they were asked to rate how tasty (1=*Not at all tasty*;
292 7=*Very tasty*) and enjoyable (1=*Not at all enjoyable*; 7=*Very enjoyable*) they found each type
293 of snack, and how likely it is that they would buy it in the future (1=*Not at all likely*; 7=*Very*
294 *likely*). Finally, participants were debriefed.

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Results

296 Preliminary analyses

297 **Random assignment check.** The success of any experimental manipulation depends
298 on the equivalence of the study groups with regard to demographic and individual differences
299 characteristics. In our study, it is especially important that the two groups are equivalent in
300 terms of socioeconomic status so that any differences between conditions can be attributed to
301 the experimentally induced perceptions of poverty and wealth. This was indeed the case:
302 participants assigned to the poverty condition tended to have middle class background ($M =$
303 3.81 , $SD = 1.06$), just like participants assigned to the wealth condition ($M = 3.82$, $SD =$
304 1.33), $p = .97$. The interaction effect of the experimental condition and socioeconomic class
305 on calorie intake was also non-significant, $F(1, 49) = .38$, $p = .54$. The two groups did not
306 significantly differ in terms of gender distribution and levels of hunger, either ($ps < .90$).
307 Furthermore, only six of the participants reported nationality other than British, and
308 excluding these participants from the analyses did not change the patterns of results reported
309 below. In other words, our sample consisted mainly of middle class university students ($M =$
310 3.82 , $SD = 1.20$) with British nationality, and the two study groups were statistically
311 equivalent in terms of relevant background characteristics, allowing us to test the *poverty-*
312 *intake* hypothesis experimentally.

313 **Manipulation check.** The two items measuring the extent to which participants felt
314 poor and wealthy following the manipulation were strongly negatively correlated ($r(54) = -$
315 $.57, p < .001$), so they were averaged (after appropriate reversal) to form a composite
316 measure of poverty. Feelings of relative deprivation and advantage following the
317 manipulation were also highly negatively correlated ($r(54) = -.66, p < .001$), and the same
318 procedure was used to form a composite score of relative deprivation.

319 An ANCOVA analysis, where the manipulation check measure of relative deprivation
320 was partialled out, revealed that participants in the poverty condition saw themselves as
321 poorer ($M = 4.44, SE = 0.13$) than participants in the wealth condition ($M = 3.97, SE = 0.15$),
322 and this difference was significant, $F(2,51) = 4.87, p = .032$. This result indicates that the
323 experimental manipulation exerted the intended unique effect on feelings of poverty and
324 wealth.

325 The five items measuring anxiety were factor analyzed using Principal Component
326 Analysis with a Varimax rotation. The analysis confirmed the presence of two factors with
327 eigenvalues greater than 1. The four items measuring anxiety related to lower socioeconomic
328 position loaded strongly (.75 to .88) on one of the factors, while the item measuring envy
329 concerns loaded on the second factor (.98). The four anxiety items formed a reliable scale
330 (Cronbach's $\alpha = .84$) and were averaged in a composite measure for anxiety of being looked
331 down on. The four items measuring how tasty and enjoyable participants found the chocolate
332 and the crackers, respectively, also formed a sufficiently reliable scale ($\alpha = .62$) and were
333 averaged in a composite measure of tastiness.

334 **Main analyses**

335 **Data analysis plan.** The *poverty-intake* and *inequality-anxiety-intake* hypotheses are
336 tested in a two-step fashion. Firstly, the *poverty-intake* hypothesis is tested by a MANOVA,
337 which allows us to simultaneously examine the effect of condition on calorie intake as the

338 main DV, but also on two related DVs – food tastiness and intention to buy the food. The
339 MANOVA analysis is carried out with and without including gender and hunger as covariates
340 to test the robustness of the results. Secondly, by using a multiple mediators approach
341 (Preacher & Hayes, 2008), the *inequality-anxiety-intake* hypothesis is examined. In this
342 analysis self-reported socioeconomic position, as a proxy-measure of inequality, is included
343 as the predictor; anxiety of being looked down on and anxiety of being envied are the two
344 proposed mediators; calorie intake is the outcome variable. We hypothesised that poverty and
345 inequality can simultaneously affect eating behaviour. Thus, to show that the *inequality-*
346 *anxiety-intake* obtains while controlling for the *poverty-intake* effect, condition is included as
347 a covariate, along with gender and hunger. To test the robustness of the results, however, the
348 multiple mediation analysis is also carried out without including condition, gender, and
349 hunger as covariates.

350 **Test of the *poverty-intake* hypothesis.** Two participants were excluded from this
351 analysis: One who consumed no food due to allergies and one who consumed calories >3
352 standard deviations above the mean in their condition. A MANOVA revealed that there was a
353 significant difference in food consumption and evaluation based on experimental condition, F
354 $(3, 48) = 4.74, p = .006$, Wilk's $\Lambda = .772$, partial $\eta^2 = .23$. The follow-up univariate tests
355 revealed that participants in the poverty condition: 1) consumed on average more calories (M
356 $= 254.17, SD = 167.41$) than participants in the wealth condition ($M = 164.76, SD = 91.86$), F
357 $(1, 50) = 5.70, p = .021$, Cohen's $d = 0.66$; 2) enjoyed the taste of the high calorie food more
358 ($M = 5.42, SD = .79$) than those in the wealth condition ($M = 4.79, SD = .92$), $F(1, 50) =$
359 $7.14, p = .010$, Cohen's $d = 0.75$; and 3) expressed a stronger intention to buy the snacks in
360 the future ($M = 4.48, SD = 1.20$) compared with participants in the wealth condition ($M =$
361 $3.65, SD = 1.28$), $F(1,50) = 5.80, p = .020$, Cohen's $d = 0.67$. To account for the multiple
362 comparisons and reduce the likelihood for Type I error, we employed a variant of
363 Bonferroni's correction appropriate for tests involving non-independent DVs (cf. Holm,
364 1979). In this procedure, instead of the classical Bonferroni formulae for determining levels

365 of significance (α/n), a sequential levels for rejecting the null hypothesis are calculated by
366 comparing the highest obtained p -level to $\alpha/1$, the second highest – to $\alpha/(n-1)$, and the lowest
367 obtained p -level – to α/n (Holm, 1979). This procedure has been developed as a more
368 powerful alternative to the conservative Bonferroni correction, which also takes into account
369 the non-independence of the DVs. If $\alpha = .05$, then the significance levels at which the null
370 hypothesis could be rejected for the present study are: .05, .025, and .017. A comparison to
371 the obtained p s in the MANOVA analysis – .021, .020, and .010 – reveals that the results
372 from this study reached statistical significance.

373 A subsequent MANOVA analysis also included the effects of gender and hunger. The
374 multivariate effect of condition remained significant, $F(3, 46) = 4.89, p = .005$, Wilk's $\Lambda =$
375 $.76$, partial $\eta^2 = .24$. This analysis revealed that male participants consumed more calories (M
376 $= 266.43, SD = 166.15$) than female participants ($M = 156.72, SD = 78.16$), $F(1, 48) = 6.50,$
377 $p = .014$, and those reporting higher levels of hunger consumed more calories, $B = 24.12, p =$
378 $.043$. The effect of the two covariates on food tastiness and intentions to buy did not reach
379 standard levels of significance, $ps \geq .125$. The univariate effect of condition on the three DVs
380 remained significant: $p = .042$ for calorie intake, $p = .005$ for food tastiness, and $p = .016$ for
381 intentions to buy. These findings suggest that feeling poor not only increases immediate
382 calorie intake, but also bolsters the desire to consume high calorie food in the future, and
383 these effects remain significant when gender and hunger are accounted for.

384 **Test of the *inequality-anxiety-intake* hypothesis.** We followed the multiple
385 mediators approach (Preacher & Hayes, 2008) to examine whether subjective socioeconomic
386 position, as a proxy-measure of inequality, affected the amount of calories consumed through
387 inequality-related anxiety of being looked down on and being envied, while controlling for
388 the effects of experimentally induced poverty and wealth, levels of hunger, and gender. It
389 should be noted that contemporary approaches to mediation analysis do not require a

390 significant effect of the independent variable on the dependent variable, and instead focus on
391 assessing the significance of the indirect path specified by model (Hayes, 2009; Rucker,
392 Preacher, Tormala, & Petty, 2011). To conduct a formal significance test on the specified
393 indirect paths we relied on the default bootstrapping procedure implemented in the
394 corresponding macro (Preacher & Hayes, 2008) whereby a path is deemed significant if the
395 95% bias corrected bootstrap confidence intervals (CIs) do not include zero.

396 Gender (0 = male; 1 = female) again emerged as a significant predictor of calorie
397 intake, $B = -66.91$, $p = .046$, while the effect of hunger was marginally significant, $B = 19.69$,
398 $p = .068$. The effects of the remaining variables included in the model are summarized in
399 Figure 2. The same pattern of results from the multiple mediation analysis is obtained when
400 hunger, gender, and the experimental condition are not included in the model as covariates.

401 [Figure 2 around here]

402 The overall model containing the direct effect of the experimental manipulation, the
403 indirect effects of socioeconomic position via anxiety and the effects of hunger and gender,
404 was significant, $F(6, 45) = 6.44$, $p < .001$. Combined, the predictors explained 46% of the
405 variance associated with calorie intake. As expected, higher socioeconomic position
406 positively predicted anxiety of being envied and negatively predicted anxiety of being looked
407 down on, although this result was marginally significant. The experience of these inequality-
408 related anxieties positively predicted calorie intake. Critically for our hypothesis,
409 examination of the confidence intervals confirmed that both types of anxiety mediated the
410 effect of socioeconomic position on food consumption, confirming the path from inequality
411 to calorie intake via anxiety; 95% CIs [-27.43; -0.68] for anxiety of being looked down on,
412 and 95% CIs [0.20; 32.17] for anxiety of being envied.

413 Discussion

414 The results of Study 1 support both the *poverty-intake* and *inequality-anxiety-intake*
415 hypotheses. When participants were induced to feel poor, they consumed significantly more
416 calories. The average difference between the two conditions equated to 89.41 calories or a

468 **Participants.** Participants were ninety-three British undergraduates (63 female) with
469 mean age of 20.53 years, $SD = 1.83$. The study took approximately 20 minutes to complete
470 and participants were paid £5.

471 **Procedure and Measures.** Participants were recruited in groups of three to five and
472 no participants were previously acquainted with each other. After registering their interest to
473 participate in the study, participants were emailed a link to a 5-item questionnaire to complete
474 prior to arriving to the lab. The five questions were designed to measure their need to belong
475 (e.g., I want to “fit in” with other students from Kent University; I would like to feel accepted
476 by other students from Kent University; 1=*Strongly disagree*; 7=*Strongly agree*; $\alpha = .79$), and
477 were used to form the moderator variable for the study. Upon arrival at the lab the
478 participants were seated in separate cubicles. As in Study 1, participants were informed that
479 the session included two separate studies. One of the studies examined perceptions of
480 personal economic situation and ostensibly included a 10-minute group discussion on
481 personal finances to be held at the very end of the session. The second study examined food
482 enjoyment during leisure activities.

483 All questions were administered electronically. The session began with items
484 assessing basic demographics and current levels of hunger (1=*Not at all*; 7=*Very much*). In a
485 subsection entitled “Background information for the study on Personal Finances” participants
486 rated how often they could afford to buy the food and clothes they liked, to go out to
487 restaurants and clubs with friends, to afford different sorts of entertainment, such as cinema
488 or concerts (1=*Very rarely*; 7=*Always*). Participants were also asked to indicate how much
489 they agreed with the statements “I can afford to buy most of the things I want”, and “I am
490 generally satisfied with how much money I have” (1=*Strongly disagree*; 7=*Strongly agree*).
491 The seven items measuring ability to afford goods and activities formed a highly reliable
492 scale ($\alpha = .91$). We believe that self-assessed ability to afford is an appropriate and highly

493 relevant measure of perceived chronic poverty as it not only reflects the amount of resources
494 the participants possess, but also their subjective assessment of whether these resources are
495 scarce or sufficient (for a similar argument, see Mullainathan & Shafir, 2013). We therefore
496 included the ability to afford scale in the study analysis as a measure of perceived chronic
497 poverty. In the same “Background information for the study on Personal Finances”
498 subsection the participants were also asked to indicate their living allowance per month (in £)
499 and what percentage of this amount could be used for discretionary spending. They were also
500 asked to rate their family’s socioeconomic position (1=*Very poor*; 7=*Very wealthy*). These
501 additional questions aimed to aid the cover story and the experimental manipulation, which
502 involved receiving a “computer calculated” feedback (see paragraph below). Only the ability
503 to afford scale was intended to be part of the experimental design, however, and only this
504 scale is included in the analysis as a measure of perceived chronic poverty.

505 Upon completion of these questions, participants were instructed via a screen in the
506 online questionnaire to notify the experimenter. The experimenter explained that this was
507 necessary to ensure that all participants completed the questionnaire to this point, so that the
508 computer can collate all ratings and provide individual feedback. Then they were asked to
509 continue with the questionnaire.

510 The next page contained a reminder about the group discussion to take place at the
511 end of the study. It also informed the participants that based on their responses and the
512 responses of the other participants, they appear to come from either a *more affluent, more*
513 *deprived, or equal* background (randomly assigned) than the rest of the students taking part in
514 their session, and that they can afford to buy and do either *more, less, or roughly the same*
515 things as the other participants. To make sure participants paid attention to this information, a
516 multiple choice question was included on which participants had to indicate their background
517 (more affluent, more deprived, or equal) compared to the other participants.

518 Then participants were asked to write a paragraph on their expectations of the
519 discussion. Two coders rated the paragraphs on how anxious, uncomfortable, and

545 the 7-point scale (1=*Very poor*; 7=*Very wealthy*), with a relatively small standard deviation,
546 $M_{total} = 3.78$, $SD_{total} = 1.21$. A univariate ANOVA also revealed that the three study groups
547 did not statistically differ in socioeconomic status, $F(2, 90) = .85$, $p = .43$. The interaction
548 effect of the experimental condition and socioeconomic class on calorie intake was non-
549 significant, either, $F(2, 87) = 1.48$, $p = .23$. The three groups did not significantly differ in
550 terms of gender distribution and levels of hunger ($ps < .40$). In terms of nationality, the
551 sample was also highly homogenous, with only seven participants reporting nationality other
552 than British. These results indicate that the random assignment was successful in forming
553 equivalent study groups, and therefore allows us to experimentally test the *inequality-anxiety-*
554 *intake* hypothesis.

555 Main Analyses

556 **Data analysis plan.** As shown on Figure 3, the Study 2 design involves a moderated
557 mediation, in which the experimentally manipulated inequality is the predictor, anxiety is the
558 proposed mediator, need to belong is the proposed moderator, and calorie intake is the
559 outcome variable. Prior to testing this model, however, it is necessary to examine whether
560 anxiety, as the proposed mediator, varies as a function of condition. Based on this design and
561 rationale, the data analysis is planned as follows: (1) we test whether participants in the
562 unequal conditions experience greater anxiety than those in the equal condition; (2) if this
563 pre-condition is met, we create a binary variable for inequality (0 = equality; 1 = inequality)
564 by joining the two inequality conditions; (3) we carry out the moderated mediation analysis
565 while including as covariates ability to afford, as a measure of perceived chronic poverty,
566 along with gender and hunger, in order to test the effects of inequality and poverty on calorie
567 intake simultaneously; (4) we carry out the moderated mediation analysis without the
568 covariates to examine the robustness of the findings, and (5) we carry out a simple
569 moderation analysis (with and without covariates) in order to unpack the moderation by need
570 to belong of the anxiety–calorie intake link.

595 The overall model was significant, $F(7, 85) = 5.51, p < .001$, and the predictors
596 explained 31% of the variance associated with calorie intake. Participants who reported lower
597 ability to afford goods and activities consumed more calories. This finding provides a
598 replication of the effect of experimentally induced poverty obtained in Study 1, and shows
599 that perceived chronic poverty is also associated with higher calorie intake. Furthermore, as
600 shown in the preceding analyses, participants in the unequal conditions expressed greater
601 discussion-related anxiety than those in the equal condition. Confirming our hypothesis for
602 moderated mediation, the interaction between anxiety and participants' need to belong was
603 significant, $B = 15.59, p = .022$, and so was the indirect effect of inequality on calorie intake
604 through anxiety for participants high in need to belong 95%CI [3.49; 73.27]. This pattern of
605 moderated mediation results remains when the covariates are not included in the model.

606 **Unpacking the moderation by need to belong of the *anxiety-calorie intake* link.**

607 To further explore the interaction and examine the effect of anxiety on calorie intake for
608 different levels of need to belong, a simple moderation model was employed (Hayes, 2013)
609 where anxiety was treated as predictor of calorie intake, need to belong as the moderator, and
610 the effects of chronic poverty, gender, and levels of hunger were again included as covariates.
611 As expected, anxiety positively predicted calorie intake for participants high (75th and 90th
612 percentiles) but not for participants low or moderate (25th and 50th) in need to belong (see
613 Figure 4 and Table 1). To illustrate the interaction, the simple slopes were plotted for the 25th,
614 50th, 75th, and 90th percentiles of the need to belong and the anxiety measures (Figure 4). The
615 simple slopes effects and significance levels are presented in Table 1. The same pattern of
616 results obtains when the covariates are not included in the model. In sum, the moderated
617 mediation model demonstrated that the experimentally induced inequality triggered higher
618 levels of apprehension and anxiety, which increased calorie intake for people with a strong
619 need to belong.

620 **Discussion**

646 increased consumption. When participants felt poor, either chronically (Study 2) or through
647 an experimental manipulation (Study 1), they consumed more calories. This finding is
648 consistent with recent research demonstrating that when people perceive their environment as
649 harsh they preferentially choose high-calorie food and consume larger amounts of it (Laran &
650 Salerno, 2013). Research with animals has also shown that environmental cues of scarcity are
651 sufficient to trigger increased consumption (Jarvandi et al., 2009) and reinvigorated appetite
652 amongst sated animals (Galarce & Holland, 2009). It appears that humans and animals
653 respond similarly to harsh and scarce environments, and this response takes the form of pre-
654 emptive increase in food consumption. By taking a self-referential approach and
655 manipulating subjective perceptions of poverty we additionally demonstrated that perceiving
656 a lack in personal resources can elicit the same urge to consume greater amounts of food as
657 found in studies manipulating environmental scarcity.

658 In addition to absolute poverty, feeling poor relative to others had a clear effect on
659 calorie consumption: Whether this position was chronic (Study 1) or experimentally induced
660 (Study 2), people who felt poorer than others consumed more calories. Across two studies,
661 consumption was shown to be due to increased anxiety, particularly anxiety due to
662 anticipated negative social evaluation. The links between low social position and anxiety, and
663 low social position and obesity have been repeatedly demonstrated (Marmot, 2004; K Pickett,
664 et al., 2005): Unequal societies show increased incidence of both obesity and anxiety
665 disorders, particularly amongst people with lower incomes. Whereas other studies have
666 focused on a macro-societal level (for an overview, see Wilkinson & Pickett, 2009b), the
667 current research demonstrates these effects within-individuals and under experimental
668 manipulation. The conclusion is that being on the disadvantaged side of an unequal
669 distribution elicits anxiety, which in turn triggers increased calorie intake.

670 The link between inequality and calorie intake is not limited to people on the
671 disadvantaged side of the scale. Two studies show that wealthier individuals consume more,
672 whether their social rank is chronic (Study 1) or manipulated (Study 2). Like those who see

673 themselves as poorer than others, seeing oneself as wealthier is linked to increased anxiety,
674 which in turn is linked to increased calorie intake. This anxiety primarily involves a fear of
675 being envied. Although the obesity gap between equal and unequal societies is smaller for the
676 wealthy than the poor (Banks et al., 2006), its existence might be explained by anxiety
677 triggered through a fear of envious comparison and amplified by threatened social
678 connection.

679 The anxiety linking inequality to increased food intake in these two studies has a
680 decidedly social flavor; it is a fear of negative social evaluation due to a downward or upward
681 social comparison. Given that this is a primarily social anxiety, it is understandable that
682 people's chronic need to affiliate with others amplifies this link. People who feel a strong
683 need to belong appear the most likely to consume calories when confronted with inequality.
684 This finding points to social alienation as an important risk factor linking inequality to
685 increased calorie intake. Unfortunately for people living in unequal societies, income
686 inequality is associated with decreased trust (Neville, 2012; Oishi, et al., 2011), increased
687 violence (Hsieh & Pugh, 1993), and reduced social connection (Uslaner & Brown, 2005), all
688 of which are likely to lead to greater alienation and an increasingly unfulfilled need to
689 belong. In short, unequal societies may not only create the anxiety that leads to increased
690 food intake, but additionally amplify this link by undermining the fulfillment of their
691 citizens' need to belong.

692 The findings from the present research can be relevant for intervention programs
693 aimed at preventing and reducing obesity. Typically, such interventions involve educational
694 campaigns on recommended daily calorie intake (e.g., through food labeling), and
695 encouragement to adhere to a healthy diet. However, if increased consumption of high calorie
696 food is triggered by perceptions of poverty and by inequality-induced anxiety, these factors
697 may hamper the effectiveness of information-based interventions. If poverty is subjectively

698 experienced as a threat to physical survival in a scarce environment, inequality is experienced
699 as a threat to social inclusion and respectful regard, and increased calorie intake helps
700 alleviating these adverse experiences, then their effects on eating behavior may somewhat
701 undermine the influence of health recommendations and educational campaigns. Although
702 more research is needed to assess this possibility, consistent with others (e.g., Marmot, 2004;
703 Wilkinson & Pickett, 2009b), our research suggests that a large-scale societal change that
704 reduces poverty and inequality may provide a long-term solution to a number of health
705 problems, including obesity.

706 To summarize, the current studies make a valuable and overdue psychological
707 contribution to the literature on the socioeconomics of obesity. Adopting an experimental
708 approach allowed us to manipulate and investigate these effects at the level of the individual,
709 exploring the *poverty-intake* and the *inequality-anxiety-intake* links. We provide first
710 evidence for the causal role of anxiety in linking inequality with calorie intake. Further, we
711 demonstrate that this link is strengthened when people feel a strong need to relate to others.
712 Taken together, our findings suggest that the well-known epidemiological link between
713 socioeconomic conditions and obesity may be underpinned by the psychology of human
714 emotions and social motives.

715 **Limitations and Future Directions**

716 Obesity is a complex phenomenon, and our study captures only part of it. Focusing on
717 psychological mechanisms as the links between poverty and inequality and increased calorie
718 intake, and examining these links experimentally, did not allow us to account for a number of
719 factors shown to increase the risk of obesity. For instance, sleep deprivation, sedentary
720 lifestyle, and the physical living environment have all been demonstrated to influence
721 incidence of obesity (Chaput, Després, Bouchard, & Tremblay, 2008; Chaput, Klingenberg,
722 Astrup, & Sjödin, 2011; Lake & Townshend, 2006), but remained unaccounted for in the
723 current research. People from different ages and socioeconomic background are likely to
724 differ along these and other dimensions important for understanding the causes of obesity.

725 Our research was based on samples drawn from a largely middle class student population,
726 and is thus only partially representative of the general population. A quasi-experiment
727 comparing the eating behavior of people occupying higher and lower socioeconomic ranks
728 and measuring relevant living conditions and lifestyle patterns as covariates, can provide a
729 richer insight of how perceptions of poverty and inequality influence calorie intake in more
730 naturalistic setting.

731 Furthermore, to our knowledge the current research is the first to test the link between
732 inequality-induced anxiety and calorie intake; as such, the measures used to assess anxiety
733 were not previously validated, but rather created for the purposes of the current studies.
734 Future research can develop more comprehensive measures of inequality-related anxiety and
735 validate those measures with diverse samples. In addition, to better establish the links
736 between inequality and anxiety, and anxiety and calorie intake, self-report measures of
737 anxiety can be supplemented with physiological and hormonal indicators of stress, such as
738 skin conductance and cortisol levels.

739 Despite these limitations, however, the current research provided first evidence for the
740 operation of psychological processes linking socioeconomic conditions and obesity by
741 showing that poverty and inequality increase consumption of high calorie food. We believe
742 that future efforts aimed at further understanding the causes of obesity and designing
743 effective interventions can benefit from incorporating a psychological perspective.

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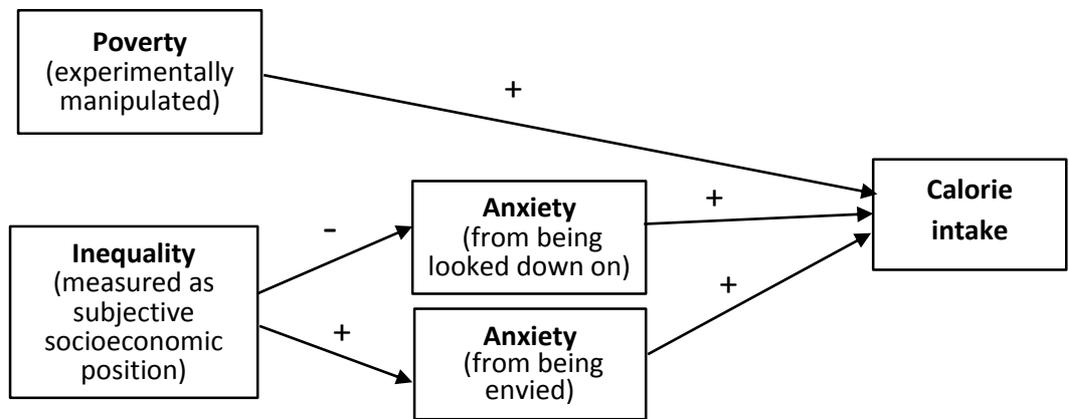


Figure 1. A graphic representation of the main variables included in the design for Study 1 and their expected effects on calorie intake.

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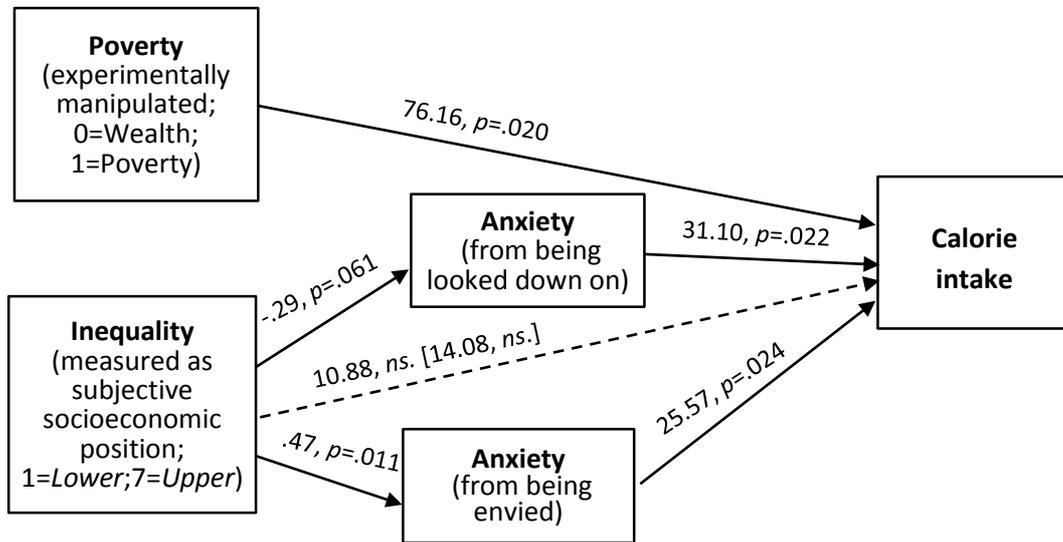


Figure 2. A multiple mediator model of the combined effects of experimentally induced poverty and wealth, and anxiety induced by relative socioeconomic position on calorie intake, controlling for experimental condition, gender, and hunger. The value in parentheses is the effect of chronic socioeconomic position on calories consumed prior to the inclusion of the measures of anxiety to be looked down on/ envied as the proposed mediators. The reported coefficients are the unstandardized B-coefficients (Study 1).

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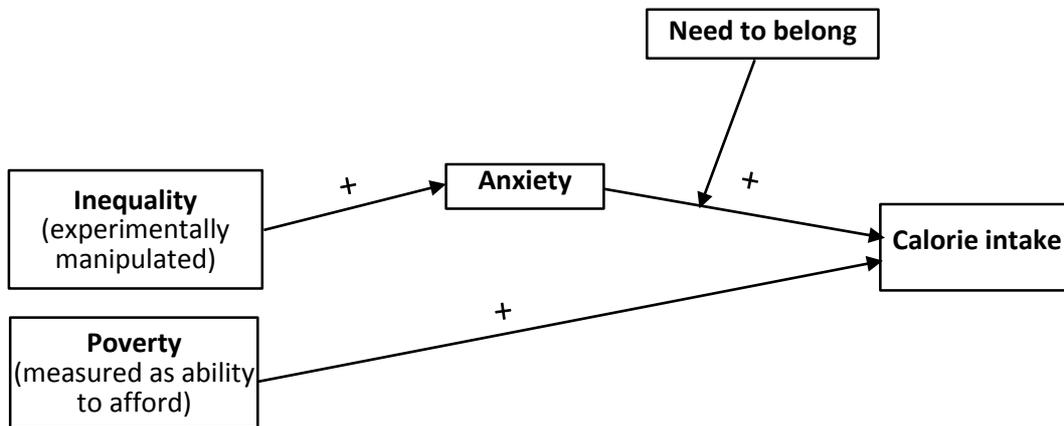


Figure 3. A graphic representation of the main variables included in the design for Study 2 and their expected effects on calorie intake.

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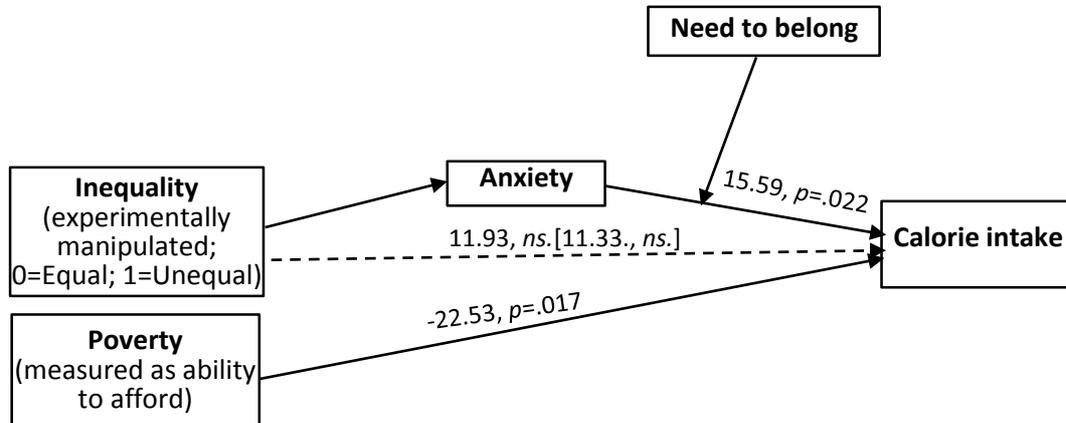
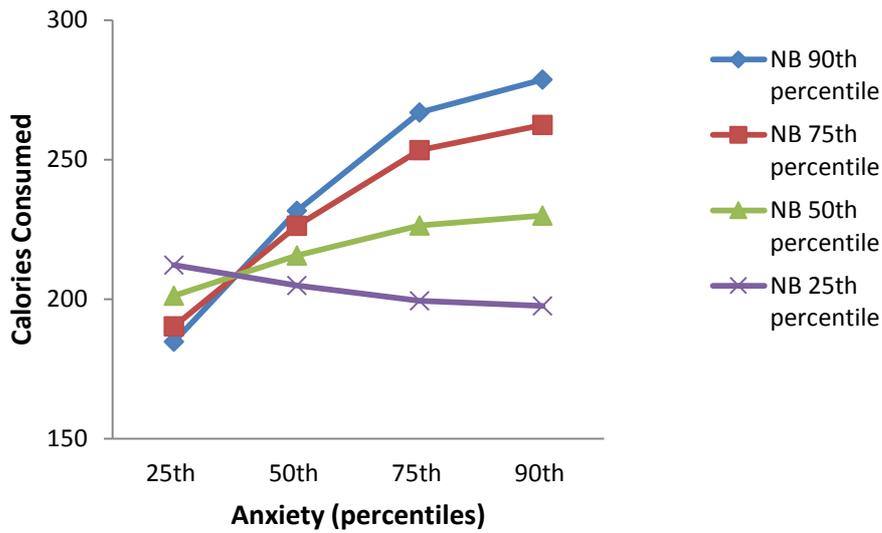


Figure 4. A model combining the moderated by need to belong effect of inequality-induced anxiety on calorie intake and the effect of ability to afford (absolute poverty) while controlling for gender and hunger. The value in parentheses is the effect of condition on calories consumed prior to the inclusion of anxiety as the proposed mediator, need to belong as the proposed moderator, and their interaction term. The reported coefficients are the unstandardized B-coefficients (Study 2).



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981 *Figure 5.* Simple slope analyses of the effect of anxiety on calorie intake at the 25th, 50th, 75th,

982 and 90th percentile of need to belong (NB) as the proposed moderator (Study 2).

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999 Table 1. The effect of anxiety on calories consumed for the 25th, 50th, 75th, and 90th

1000 percentiles of need to belong as the proposed moderator.

Need to belong	<i>B</i>	<i>SE</i>	<i>t</i>	<i>p</i>	95% CIs
25 percentile	-2.82	7.87	-.36	.720	-18.68; 12.73
50 percentile	7.34	6.17	1.19	.238	-5.41; 19.80
75 percentile	17.49	7.43	2.35	.020	2.52; 32.23
90 percentile	22.57	8.90	2.54	.013	5.59; 42.73

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