Appetite 100 (2016) 162–171

Contents lists available at ScienceDirect

Appetite

journal homepage: www.elsevier.com/locate/appet

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

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ARTICLE INFO

Article history:
Received 14 September 2015
Received in revised form
18 January 2016
Accepted 21 January 2016
Available online 22 January 2016

Keywords:
Food
Anxiety
Inequality
Poverty
Obesity

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.

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

The finding that even the wealthy in unequal societies suffer from higher rates of obesity and have worse health outcomes than their counterparts in more equal societies suggests that inequality impacts through mechanisms distinct from wealth-dependent access to health services, higher quality food, and better living conditions. Several authors have suggested the role of inequality-triggered psychological processes – specifically stress and anxiety – as underlying these negative health outcomes (Marmot, 2006; Pickett et al., 2005; Wilkinson & Pickett, 2009b). The proffered psychological explanation of the effect of inequality on health in general, and obesity in particular, has been extensively argued. However, to our knowledge it has never been experimentally investigated. The aim of the current research is to test the effect of poverty and inequality on the consumption of high-calorie food using an experimental psychological approach.

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http://dx.doi.org/10.1016/j.appet.2016.01.028
0195-6663/

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

1. Relationship between perceived poverty and food consumption

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

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

2. Relationship between inequality and anxiety

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

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

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

Although the burden of inequality disproportionately falls on the shoulders of those at the bottom, occupying a privileged position in an unequal society may not be anxiety-free, either. Those who have what others desire may fear being envied and challenged over the legitimacy of their privileged position. Although being envied may be a positive experience which communicates that one occupies a desirable social rank, it additionally involves threat, the 'hanging sword of Damocles': The envied may be a subject to ill wishing and harmful intent (Miceli & Castelfranchi, 2007). Findings from a recent analysis of the European Social Survey (round 4; 2008–2010) revealed that fear of crime is more prevalent in unequal societies, and it is predominantly expressed by members of ethnic majority and socially privileged groups. Furthermore, the negative effect of inequality on wellbeing amongst ethnic majority, privileged groups was explained by fear of crime (Vauclair & Bratanova, 2015). People who occupy privileged positions in unequal societies may be wise to fear being challenged and envied by others: Polarization of resources is associated with greater competition, higher levels of aggression, and lower levels of trust and cooperation (Loughnan et al., 2011; Neville, 2012; Oishi, Kesebir, & Diener, 2011; Wilkinson & Pickett, 2009b). The increased risk of being challenged and the high cost of losing rank may cause those who occupy the upper levels of unequal societies to experience negative emotions, including anxiety from being envied.

Inequality, therefore, may induce stress and anxiety regardless of whether a person occupies the higher or lower end of a social hierarchy. It is important to note that the source of inequality-induced stress and anxiety is *fundamentally* social; people are worried about what others think of them. A diverse body of research demonstrated that real or imagined social-evaluative threats, such as criticism, envy, and exclusion, are powerful stressors (Dandeneau, Baldwin, Baccus, Sakellaropoulo, & Pruessner, 2007; Dickerson & Kemeny, 2004; Stroud, Tanofsky-Kraff, Wilfley, & Salovey, 2000) as they pose a threat to the 'social self' (Gruenewald, Kemeny, Aziz, & Fahey, 2004; Schlenker & Leary, 1982). The experience of social threat and the ensuing stress and anxiety are deeply rooted in our basic human need to be accepted and positively evaluated by others (need to belong; cf. Baumeister & Leary, 1995). The stronger an individual's need to belong, the more vigilant they are to cues of rejection and social evaluation (Pickett, Gardner, & Knowles, 2004). If the anxiety induced by inequality is fundamentally social and evaluative, people who possess a strong need to belong should be particularly vulnerable to its detrimental effects on health and psycho-social wellbeing. Conversely, people who are only weakly motivated to relate to others should be less affected when confronted with inequality.

3. Relationship between anxiety and food consumption

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

Stress is associated with increased pursuit and consumption of palatable, high-calorie food (for an overview, see Gibson, 2006). Survey studies examining food choices have revealed that people preferentially choose sweeter and fattier snack foods when they report feeling stressed (Oliver & Wardle, 1999). These self-report findings have been also confirmed with a hormonal measure of stress: People with high cortisol reactivity tend to consume greater

amounts of palatable, high-calorie food (Newman, O'Connor, & Conner, 2007). Experimental studies have also demonstrated that people consume more sweet and high-fat food following anxiety-inducing ego-threatening tasks (Rutters, Nieuwenhuizen, Lemmens, Born, & Westerterp-Plantenga, 2009). Furthermore, research examining food intake in rats revealed that compared with controls, chronically stressed rats show increased consumption of palatable foods (Dallman et al., 2003).

These findings are not surprising: high-calorie food is a readily accessible source of pleasure and comfort (Dallman, Pecoraro, & la Fleur, 2005), and has the capacity to alleviate stress- and anxiety-related dysfunction (Dallman et al., 2003). In short, research from self-reports, hormone and psychophysiological studies, and behavioral tasks all indicate that stress and anxiety appear to push people towards increased calorie intake.

4. The current research

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

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

We examine the effects of poverty and inequality simultaneously because feeling poor (wealthy) in absolute terms and in comparison to others may understandably co-occur. Failing to achieve 'acceptable' living standards, for instance, can both yield an absolute and relative assessment of poverty (e.g., I am poor *and* I am poorer than others). Moreover, unequal societies are characterized by higher levels of materialism, consumerism, and advertising (Bauer, Wilkie, Kim, & Bodenhausen, 2012), all of which inflate what is considered an acceptable level of possessions. People with lower incomes may therefore struggle to attain such inflated standards of living, further deepening their perceptions of poverty and deprivation. Feeling poor and feeling deprived can simultaneously influence eating behavior, pushing people to approach high calorie food and consume larger amounts of it. In Study 1 we examined the *poverty-intake* and *inequality-anxiety-intake* hypotheses by experimentally manipulating participants' feelings of absolute poverty and measuring inequality. Study 2 inverted this approach and experimentally manipulated inequality whilst measuring perceptions of absolute poverty.

5. Study 1

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).

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

6. Method

6.1. Participants

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

6.2. Materials and procedure

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

Participants were then randomly assigned to the experimental conditions. In the wealthy condition the participants read a paragraph describing how many people in their society lived in financial and material abundance (i.e., being able to cover their living

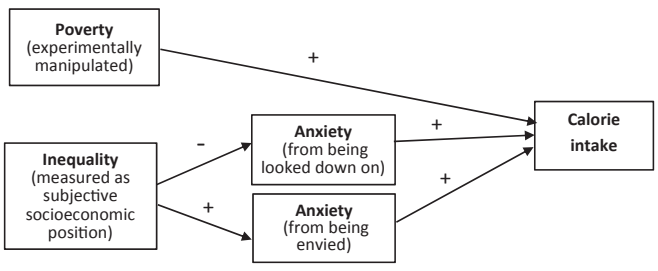

Fig. 1. A graphic representation of the main variables included in the design for Study 1 and their expected effects on calorie intake.

expenses, and to buy and do the things they wanted). Conversely, participants in the poor condition read a paragraph describing how many people in their society lived in material and financial scarcity (i.e., living from pay check to pay check, watching the pennies, and trying to stretch their budgets to cover their basic living expenses). Participants were then asked to write a few sentences on how they are similar to the group described in the respective paragraphs. Identifying similarities in self-other comparisons has been shown to increase the salience of the common features and result into assimilation to the target (cf. Mussweiler, 2003). The writing task was therefore designed to increase the salience of participants' own experience of living with scarce (vs. abundant) resources, and to make them feel poor or wealthy via assimilation to the group they read about. Although the manipulation was designed to primarily induce feelings of absolute poverty and wealth, it is conceivable that feelings of relative deprivation and advantage may also ensue due to the socially constructed nature of poverty and wealth (cf. Mullainathan & Shafir, 2013). To check whether the manipulation elicited the intended effect, participants were asked to indicate on two separate items the extent to which they felt poor and wealthy. To partial out any feelings of relative deprivation or advantage that may have resulted from the experimental manipulation, participants were also asked to indicate on two separate items the extent to which they felt relatively deprived and relatively advantaged compared to others. Next, participants completed a questionnaire designed to measure inequality-induced anxiety. This five-item questionnaire measured their concerns with regard to how others may evaluate them based on their material wealth (i.e., I worry: "that others will look down on my possessions; whether I will be accepted by my peers; that others will think I cannot afford good things in life; that people will consider me lower class; that other people will envy my privileged background"). Responses to all items were measured on a 7-point scale (1 = *Strongly disagree*; 7 = *Strongly agree*).

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

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

7. Results

7.1. Preliminary analyses

7.1.1. Random assignment check

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

7.1.2. Manipulation check

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

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

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

7.2. Main analyses

7.2.1. Data analysis plan

The *poverty-intake* and *inequality-anxiety-intake* hypotheses are tested in a two-step fashion. Firstly, the *poverty-intake* hypothesis is tested by a MANOVA, which allows us to simultaneously examine the effect of condition on calorie intake as the main DV, but also on two related DVs – food tastiness and intention to buy the food. The MANOVA analysis is carried out with and without including gender and hunger as covariates to test the robustness of the results. Secondly, by using a multiple mediators approach (Preacher & Hayes, 2008), the *inequality-anxiety-intake* hypothesis is examined. In this analysis self-reported socioeconomic position, as a proxy-measure of inequality, is included as the predictor; anxiety of being looked down on and anxiety of being envied are the two proposed mediators; calorie intake is the outcome variable. We

hypothesised that poverty and inequality can simultaneously affect eating behaviour. Thus, to show that the *inequality-anxiety-intake* obtains while controlling for the *poverty-intake* effect, condition is included as a covariate, along with gender and hunger. To test the robustness of the results, however, the multiple mediation analysis is also carried out without including condition, gender, and hunger as covariates.

7.2.2. Test of the poverty-intake hypothesis

Two participants were excluded from this analysis: One who consumed no food due to allergies and one who consumed calories >3 standard deviations above the mean in their condition. A MANOVA revealed that there was a significant difference in food consumption and evaluation based on experimental condition, $F(3, 48) = 4.74$, $p = .006$, Wilk's $\Lambda = .772$, partial $\eta^2 = .23$. The follow-up univariate tests revealed that participants in the poverty condition: 1) consumed on average more calories ($M = 254.17$, $SD = 167.41$) than participants in the wealth condition ($M = 164.76$, $SD = 91.86$), $F(1, 50) = 5.70$, $p = .021$, Cohen's $d = 0.66$; 2) enjoyed the taste of the high calorie food more ($M = 5.42$, $SD = .79$) than those in the wealth condition ($M = 4.79$, $SD = .92$), $F(1, 50) = 7.14$, $p = .010$, Cohen's $d = 0.75$; and 3) expressed a stronger intention to buy the snacks in the future ($M = 4.48$, $SD = 1.20$) compared with participants in the wealth condition ($M = 3.65$, $SD = 1.28$), $F(1,50) = 5.80$, $p = .020$, Cohen's $d = 0.67$. To account for the multiple comparisons and reduce the likelihood for Type I error, we employed a variant of Bonferroni's correction appropriate for tests involving non-independent DVs (cf. Holm, 1979). In this procedure, instead of the classical Bonferroni formulae for determining levels of significance (α/n), a sequential levels for rejecting the null hypothesis are calculated by comparing the highest obtained p-level to α/1, the second highest – to α/(n-1), and the lowest obtained p-level – to α/n (Holm, 1979). This procedure has been developed as a more powerful alternative to the conservative Bonferroni correction, which also takes into account the non-independence of the DVs. If $\alpha = .05$, then the significance levels at which the null hypothesis could be rejected for the present study are: .05, .025, and .017. A comparison to the obtained ps in the MANOVA analysis – .021, .020, and .010 – reveals that the results from this study reached statistical significance.

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

7.2.3. Test of the inequality-anxiety-intake hypothesis

We followed the multiple mediators approach (Preacher & Hayes, 2008) to examine whether subjective socioeconomic position, as a proxy-measure of inequality, affected the amount of calories consumed through inequality-related anxiety of being looked down on and being envied, while controlling for the effects of experimentally induced poverty and wealth, levels of hunger, and gender. It should be noted that contemporary approaches to mediation analysis do not require a significant effect of the independent variable on the dependent variable, and instead focus on assessing the significance of the indirect path specified by model (Hayes, 2009; Rucker, Preacher, Tormala, & Petty, 2011). To conduct a formal significance test on the specified indirect paths we relied on the default bootstrapping procedure implemented in the corresponding macro (Preacher & Hayes, 2008) whereby a path is deemed significant if the 95% bias corrected bootstrap confidence intervals (CIs) do not include zero.

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

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

8. Discussion

The results of Study 1 support both the *poverty-intake* and *inequality-anxiety-intake* hypotheses. When participants were induced to feel poor, they consumed significantly more calories. The average difference between the two conditions equated to 89.41 calories or a 54% increase in calories when participants felt poor. As expected, and consistent with previous research (e.g., Laran & Salerno, 2013; Olson et al., 2007), feeling poor is associated with increased calorie intake. Interestingly, the effects for calorie intake appear to be mirrored by self-reported tastiness and intention to buy the snacks in the future. This indicates that when participants feel poor they are not simply eating mindlessly. Rather,

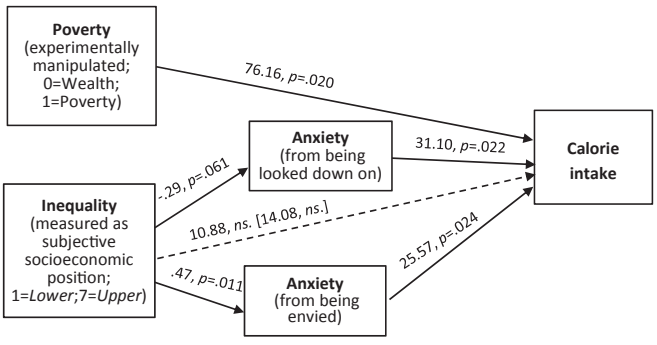

Fig. 2. A multiple mediator model of the combined effects of experimentally induced poverty and wealth, and anxiety induced by relative socioeconomic position on calorie intake, controlling for experimental condition, gender, and hunger. The value in parentheses is the effect of chronic socioeconomic 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).

they enjoy the high calorie food and intend to consume more in the future. 1971.

As predicted, the self-reported lower socioeconomic position was associated with increased anxiety about being seen as lower class and unworthy of social inclusion. This in turn was associated with significantly higher calorie intake. It appears that both absolute poverty and lower socioeconomic position independently contribute to increased consumption of high calorie food. Their additive effect might underlie the dual finding that obesity rates are highest amongst people with low incomes who live in unequal (v. more equal) societies (Banks et al., 2006; Pickett et al., 2005; Wilkinson & Pickett, 2009b).

Previous work has also suggested that wealthy individuals in unequal societies may suffer from obesity and obesity related illness at a higher rate than wealthy individuals in more equal societies (e.g., Banks et al., 2006). The results from the current study, obtained in one of the most unequal developed societies, match these findings. Participants from higher socioeconomic position reported more concern that they would be envied, and this anxiety in turn predicted increased calorie intake. Although they occupy (often vastly) different positions in the socioeconomic hierarchy, it appears that both poorer and wealthier individuals feel anxious, and that this anxiety increases calorie intake.

9. Study 2

Like Study 1, Study 2 explored the role of poverty and inequality in predicting calorie intake. However, it sought to extend the findings of Study 1 in several important regards. Study 2 included an experimental manipulation of inequality by leading participants to believe that they are poorer or wealthier than, or equal to other people in their immediate environment. This allows a stronger test of the causal role of inequality in calorie intake than Study 1. To examine this effect within participants' immediate social environment, and to increase the salience of personal wealth, the experiment was purported to involve a group discussion on personal finances. That is, participants believed that they would meet and discuss their personal finances with other students, and that these other students would be of a poorer, wealthier, or equal background to themselves. The anticipation of a face-to-face interaction with others from an equal or unequal background allowed us to examine the conditions under which inequality-induced anxiety leads to increased calorie intake. We hypothesized that participants in the unequal conditions (poorer or wealthier than their interaction partners) would exhibit greater anxiety when anticipating meeting economically different others and express greater apprehension to disclose information about their financial situation. Furthermore, participants' need to belong and to be positively regarded by their peers (Baumeister & Leary, 1995) may amplify the link between anxiety and consumption as it can intensify the affective response resulting from the anticipation of potentially negative social evaluation. We expected anxiety to lead to increased calorie intake particularly amongst those who have a strong need to belong to, and be accepted by their peers.

Study 1 manipulated perceived absolute levels of poverty and demonstrated its effect on calorie intake. In Study 2 we explored whether a similar effect holds for chronic beliefs about poverty. Moving from an experimental to a correlational approach will allow us to exploit naturally occurring variation in self-perceptions of poverty to examine whether this link holds independent of manipulation. If the perception of poverty is directly linked to increased food consumption, then participants who chronically feel poor should show increased calorie intake (see Fig. 3 for a graphic representation of Study 2 design).

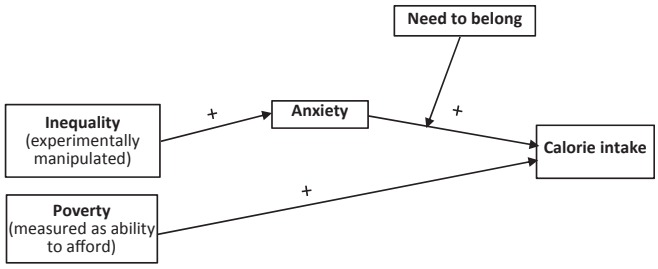

Fig. 3. A graphic representation of the main variables included in the design for Study 2 and their expected effects on calorie intake.

10. Method

10.1. Participants

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

10.2. Procedure and measures

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

All questions were administered electronically. The session began with items assessing basic demographics and current levels of hunger (1 = *Not at all*; 7 = *Very much*). In a subsection entitled "Background information for the study on Personal Finances" participants rated how often they could afford to buy the food and clothes they liked, to go out to restaurants and clubs with friends, to afford different sorts of entertainment, such as cinema or concerts (1 = *Very rarely*; 7 = *Always*). Participants were also asked to indicate how much they agreed with the statements "I can afford to buy most of the things I want", and "I am generally satisfied with how much money I have" (1 = *Strongly disagree;* 7 = *Strongly agree*). The seven items measuring ability to afford goods and activities formed a highly reliable scale ($\alpha = .91$). We believe that self-assessed ability to afford is an appropriate and highly relevant measure of perceived chronic poverty as it not only reflects the amount of resources the participants possess, but also their subjective assessment of whether these resources are scarce or sufficient (for a similar argument, see Mullainathan & Shafir, 2013). We therefore included the ability to afford scale in the study analysis as a measure of perceived chronic poverty. In the same "Background information for the study on Personal Finances" subsection the participants were also asked to indicate their living allowance per month (in £) and what percentage of this amount could be used for discretionary spending. They were also asked to rate their family's socioeconomic position (1 = *Very poor*; 7 = *Very wealthy*). These additional questions aimed to aid the cover story and the

experimental manipulation, which involved receiving a "computer calculated" feedback (see paragraph below). Only the ability to afford scale was intended to be part of the experimental design, however, and only this scale is included in the analysis as a measure of perceived chronic poverty.

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

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

Then participants were asked to write a paragraph on their expectations of the discussion. Two coders rated the paragraphs on how anxious, uncomfortable, and apprehensive participants expected to feel during the group discussion on a 7-point scale (1 = *No anxiety and apprehension expressed*; 7 = *A great deal of anxiety and apprehension expressed*). In deciding on the dimension for evaluation, we were guided by the definition of social anxiety as proposed by Schlenker and Leary (1982), particularly focusing on identifying signs of "… anxiety resulting from the prospect or presence of personal evaluation in real or imagined social situations" and "… a cognitive and affective response characterized by apprehension about an impending, potentially negative outcome that one thinks one is unable to avert" (p. 642). One of the coders was blind to the condition; the second coder was blind to both the condition and the hypotheses. The inter-rater correlation was high ($r(93) = .82$, $p < .001$), so the ratings were averaged to form a measure of anxiety.

Next, participants were informed that prior to the group discussion, they will participate in a short, unrelated study on snacking during recreational activity, such as watching videos. They were served both types of snacks – crackers (i.e., cheese flavored Ritz, containing 56.5 g of carbohydrates, 24.7 g of fat, and 484 kcal per 100 g) and chocolate (i.e., Galaxy Minstrels, as in Study 1) – and viewed a short National Geographic style video (approx. 4min 30sec). Since the dependent variable was the overall calorie intake regardless of snack type, the two snacks were served simultaneously. Finally, participants were debriefed and reimbursed for their time.

11. Results

11.1. Preliminary analyses

11.1.1. Random assignment check

As in Study 1 we tested whether the participants assigned to the three experimental conditions are equivalent in terms of socioeconomic status, gender, and hunger. Since our sample was also drawn from the student population at the University of Kent as in Study 1, we expected it would mainly consists of middle class participants. This was indeed the case: mean family class ratings were around the middle of the 7-point scale (1 = *Very poor*; 7 = *Very wealthy*), with a relatively small standard deviation, $M_{total} = 3.78$, $SD_{total} = 1.21$. A univariate ANOVA also revealed that the three study groups did not statistically differ in socioeconomic status, $F(2, 90) = .85$, $p = .43$. The interaction effect of the experimental condition and socioeconomic class on calorie intake was non-significant, either, $F(2, 87) = 1.48$, $p = .23$. The three groups did not significantly differ in terms of gender distribution and levels of hunger ($ps < .40$). In terms of nationality, the sample was also highly homogenous, with only seven participants reporting nationality other than British. These results indicate that the random assignment was successful in forming equivalent study groups, and therefore allows us to experimentally test the *inequality-anxiety-intake* hypothesis.

11.2. Main analyses

11.2.1. Data analysis plan

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

11.2.2. Test of the inequality-anxiety link

A precondition of the hypothesized mediating role of anxiety was that participants in the unequal conditions (poorer and wealthier) experienced greater anxiety in anticipation of discussing their personal finances with other students than participants in the equal condition. This pre-condition was clearly met: A univariate ANOVA revealed that there was a significant effect of condition, $F(2, 90) = 5.68$, $p = .005$, $\eta_p = .11$; a post-hoc analysis confirmed that participants in both unequal conditions experienced greater anxiety in anticipation of the group discussion ($M_{poorer} = 4.97$, $SD_{poorer} = 1.77$; $M_{wealthier} = 5.31$; $SD_{wealthier} = 1.67$) than participants in the equal condition ($M_{equal} = 3.78$, $SD_{equal} = 1.98$), and these differences were significant: $p = .011$ between equal and poorer, and $p = .002$ between equal and wealthier. The poorer and wealthier conditions did not significantly differ, $p = .45$. As expected, being poorer or wealthier induced increased feelings of anxiety pending an interaction task.

11.2.3. Tests of the inequality-anxiety-intake and the poverty-intake hypotheses

To test our proposed model of moderated mediation, which specified that inequality-induced anxiety should lead to increased consumption for people high in need to belong, we joined the two unequal conditions to obtain a binary independent variable: equality vs. inequality. This allowed us to test the moderated mediation model (Hayes, 2013). To mirror the model tested in Study 1 (see Figs. 1 and 2) and take into account the effect of poverty, the ability to afford measure was included as a covariate,

along with the effects of gender and hunger. As in Study 1, gender (0 = male; 1 = female) influenced the amount of calories consumed, $B = -78.65$, $p = .003$, with males consuming more than females. Participants who reported being hungrier also consumed more calories, $B = 25.89$, $p = .001$. The effects of the remaining variables included in the model are summarized in Fig. 4.

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

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

To further explore the interaction and examine the effect of anxiety on calorie intake for different levels of need to belong, a simple moderation model was employed (Hayes, 2013) where anxiety was treated as predictor of calorie intake, need to belong as the moderator, and the effects of chronic poverty, gender, and levels of hunger were again included as covariates. As expected, anxiety positively predicted calorie intake for participants high (75th and 90th percentiles) but not for participants low or moderate (25th and 50th) in need to belong (see Fig. 5 and Table 1). To illustrate the interaction, the simple slopes were plotted for the 25th, 50th, 75th, and 90th percentiles of the need to belong and the anxiety measures (Fig. 5). The simple slopes effects and significance levels are presented in Table 1. The same pattern of results obtains when the covariates are not included in the model. In sum, the moderated mediation model demonstrated that the experimentally induced inequality triggered higher levels of apprehension and anxiety, which increased calorie intake for people with a strong need to belong.

12. Discussion

The findings obtained by experimentally manipulating inequality go far beyond simply replicating the effect observed in Study 1 where chronic inequality was operationalized as subjective socioeconomic position. Participants induced to see themselves as either wealthier or poorer compared to other students exhibited increased anxiety, and this increased anxiety led to increased calorie intake. Importantly, this effect was moderated by need to belong; the more participants wanted to connect to other students, the stronger the impact of inequality-induced anxiety on food consumption. Although most people have a need to belong and be accepted by their peers (Baumeister & Leary, 1995), these findings point to a vulnerable subsection of the community for whom this need is particularly strong. A strong need to be accepted by others appears to play an important role in converting the increased apprehension and anxiety triggered by inequality into increased calorie intake.

For poverty, Study 2 confirmed the experimental finding from Study 1 on a chronic level; people who chronically perceive themselves as poor – that they cannot afford things in life – consume more calories. This effect was significant when controlling for experimentally manipulated inequality, gender, and hunger.

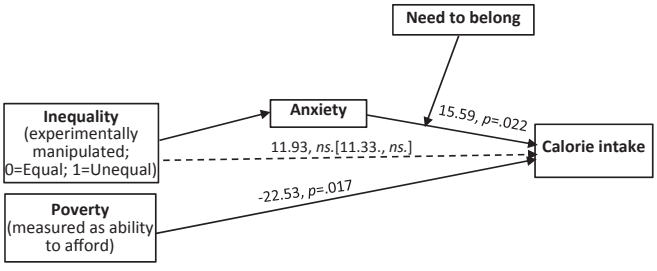

Fig. 4. A model combining the moderated by need to belong effect of inequality-induced anxiety on calorie intake and the effect of ability to afford (absolute poverty) while controlling for gender and hunger. The value in parentheses is the effect of condition on calories consumed prior to the inclusion 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).

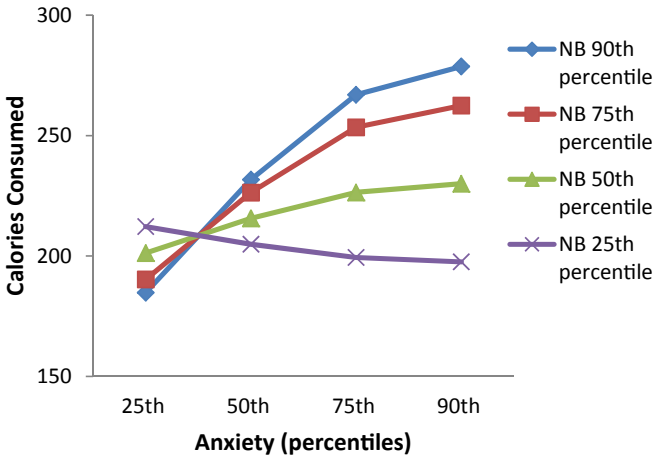

Fig. 5. Simple slope analyses of the effect of anxiety on calorie intake at the 25th, 50th, 75th, and 90th percentile of need to belong (NB) as the proposed moderator (Study 2).

Table 1
The effect of anxiety on calories consumed for the 25th, 50th, 75th, and 90th percentiles of need to belong as the proposed moderator.

Need to belong	*B*	*SE*	*t*	*p*	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

13. General discussion

The current research provides experimental evidence for two previously hypothesized causal links between socioeconomic factors and food consumption. It provides evidence that perceptions of poverty lead to increased calorie intake. It also provides evidence that inequality increases calorie intake by increasing anxiety amongst people occupying both the lower (poorer) and upper (wealthier) ends of unequal distributions. Study 1 demonstrated the poverty-intake effect experimentally and the inequality-intake effect correlationally, and Study 2 did the inverse.

The present research helps to better understand the previously identified poverty-obesity link by identifying perceptions of poverty-related resource scarcity as a trigger of increased consumption. When participants felt poor, either chronically (Study 2) or through an experimental manipulation (Study 1), they consumed more calories. This finding is consistent with recent

research demonstrating that when people perceive their environment as harsh they preferentially choose high-calorie food and consume larger amounts of it (Laran & Salerno, 2013). Research with animals has also shown that environmental cues of scarcity are sufficient to trigger increased consumption (Jarvandi et al., 2009) and reinvigorated appetite amongst sated animals (Galarce & Holland, 2009). It appears that humans and animals respond similarly to harsh and scarce environments, and this response takes the form of pre-emptive increase in food consumption. By taking a self-referential approach and manipulating subjective perceptions of poverty we additionally demonstrated that perceiving a lack in personal resources can elicit the same urge to consume greater amounts of food as found in studies manipulating environmental scarcity.

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

The link between inequality and calorie intake is not limited to people on the disadvantaged side of the scale. Two studies show that wealthier individuals consume more, whether their social rank is chronic (Study 1) or manipulated (Study 2). Like those who see themselves as poorer than others, seeing oneself as wealthier is linked to increased anxiety, which in turn is linked to increased calorie intake. This anxiety primarily involves a fear of being envied. Although the obesity gap between equal and unequal societies is smaller for the wealthy than the poor (Banks et al., 2006), its existence might be explained by anxiety triggered through a fear of envious comparison and amplified by threatened social connection.

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

The findings from the present research can be relevant for intervention programs aimed at preventing and reducing obesity. Typically, such interventions involve educational campaigns on recommended daily calorie intake (e.g., through food labeling), and encouragement to adhere to a healthy diet. However, if increased consumption of high calorie food is triggered by perceptions of poverty and by inequality-induced anxiety, these factors may hamper the effectiveness of information-based interventions. If poverty is subjectively experienced as a threat to physical survival in a scarce environment, inequality is experienced as a threat to social inclusion and respectful regard, and increased calorie intake helps alleviating these adverse experiences, then their effects on eating behavior may somewhat undermine the influence of health recommendations and educational campaigns. Although more research is needed to assess this possibility, consistent with others (e.g., Marmot, 2004; Wilkinson & Pickett, 2009b), our research suggests that a large-scale societal change that reduces poverty and inequality may provide a long-term solution to a number of health problems, including obesity.

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

14. Limitations and future directions

Obesity is a complex phenomenon, and our study captures only part of it. Focusing on psychological mechanisms as the links between poverty and inequality and increased calorie intake, and examining these links experimentally, did not allow us to account for a number of factors shown to increase the risk of obesity. For instance, sleep deprivation, sedentary lifestyle, and the physical living environment have all been demonstrated to influence incidence of obesity (Chaput, Després, Bouchard, & Tremblay, 2008; Chaput, Klingenberg, Astrup, & Sjödin, 2011; Lake & Townshend, 2006), but remained unaccounted for in the current research. People from different ages and socioeconomic background are likely to differ along these and other dimensions important for understanding the causes of obesity. Our research was based on samples drawn from a largely middle class student population, and is thus only partially representative of the general population. A quasi-experiment comparing the eating behavior of people occupying higher and lower socioeconomic ranks and measuring relevant living conditions and lifestyle patterns as covariates, can provide a richer insight of how perceptions of poverty and inequality influence calorie intake in more naturalistic setting.

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

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

Acknowledgments

This research was supported by a grant of the Walloon Region awarded to a team of Université Libre de Bruxelles researchers, including the third and the forth authors (Belgium, FOOD4GUT, project # 1318148), and a fellowship from the Bureau des RelationsInternationales (BRIC) of the Université Libre de Bruxelles awarded to the first author.

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