Plate-clearing tendencies and portion size are independently associated with main meal food intake in women: a laboratory study

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Abstract

Background: Larger portion sizes of food promote increased food intake, although the mechanisms explaining the portion size effect are unclear. In the present study we examined whether the tendency to clear one's plate when eating is associated with greater food intake in response to larger portion size.

Method: We recruited female participants who were either self-reported habitual plate clearers (N=48) or non-plate clearers (N=41) into a laboratory study. In a between-subjects design, participants were served either a 'normal' (500g) or 'large' (1000g) portion of pasta for lunch and ate as much as they desired.

Results: There was no significant interaction found between portion size and plate-clearing tendencies; portion size had a similar sized effect on food intake in both plate clearers and non-plate clearers. A significant main effect of portion size was found, whereby participants consumed significantly more when served the large versus the normal portion (100.55g difference, p<.001, η_p^2 = .16). There was also a significant main effect of plate clearing; participants with a tendency to clear their plate when eating consumed significantly more than non-plate clearers (68.21g difference, p=.006, η_p^2 = .08).

Conclusions: The tendency to clear one's plate when eating was associated with increased food intake during a lunchtime meal. Increasing the portion size of the lunchtime meal increased food intake, although the tendency for a larger portion size to increase food intake was observed irrespective of participant plate-clearing tendencies.

Key Words: Portion size; plate clearing; food environment

Introduction

The tendency for larger portion sizes of food to promote increased food intake, the 'portion size effect', has been observed across multiple food types [1–4], situations (e.g. laboratory [2] and restaurant setting [3]) and participant populations [4–6]. The portion size effect occurs irrespective of who determines the amount of food on the plate [6] and individual differences such as BMI, dietary restraint, disinhibition or gender [1, 2, 6, 7]. Since the 1970s, portion sizes of foods served both in and outside of the home have been increasing and marketplace portions now exceed nutrition recommendations [8–11]. Because of this, it has been suggested that increases in portion size may be partly responsible for population level weight gain [12–14].

A variety of potential underlying mechanisms explaining why portion size influences food intake have been proposed, but the general lack of supporting evidence means that these underlying mechanisms remain unclear and widely debated (see Herman [15] and Benton [16] for recent reviews). A normative explanation suggests that consumers rely on external cues such as portion size to inform on what is a 'normal' or 'appropriate' amount to eat [15, 17, 18]; if people are served larger portions this indicates that a larger amount of food is appropriate to consume and this results in increased food intake. In a similar vein, Marchiori, Papies and Klein [19] propose that an anchoring and adjustment process may explain the portion size effect. Portion size serves as a cognitive 'anchor' or reference point to determine how much to eat, and adjustments away from this anchor are then made based on additional information such as hunger or liking of the food.

A tendency to clear one's plate when eating out of habit ("plate clearing") could explain why larger portion sizes promote overeating as we reason that individuals who attempt to plate clear will be more influenced by the amount of food served to them (i.e. they are less reliant on internal signals of satiety). Past research has linked plate clearing to

obesity, showing that individuals with overweight and obesity are more likely to clear their plate when eating than their normal weight counterparts [20–22]. More recently, two studies [23, 24] have shown that self-reported plate-clearing tendencies are positively associated with BMI, suggesting that a tendency to plate clear is a risk factor for obesity. Moreover, in these studies [23, 24] a large proportion of participants reported plate-clearing tendencies, suggesting that plate clearing is relatively common. In support of this, a study by Hinton et al [25] found that in 83% of meals, 90% or more of the food weight was consumed. Fay et al [26] found that plate clearing was reported for 91% of meals and pre-planned in 92% of cases. Furthermore, 28% of participants reported plate clearing despite reaching satiation earlier in the meal. Thus, the tendency to plate clear when eating appears to be common and this behavioural tendency could in part explain why consumers eat more when served larger portions of food.

A small number of portion size studies have examined in secondary analyses whether plate-clearing tendencies moderate the influence that larger portions have on food intake, and have found no evidence that plate-clearing tendencies statistically moderated the influence of portion size on food intake [1, 2]. However, the extent to which plate-clearing tendencies could explain the influence that portion size had on food intake was not the primary focus of these studies, resulting in a limited sample size for moderation analysis, along with limited information regarding how plate-clearing tendencies were measured and whether the sample included a substantial number of participants with and without plate-clearing tendencies. Thus, there has been no research to date that has primarily examined whether plate-clearing tendencies are associated with increased ad-libitum food intake.

The aim of the present study was to examine whether the tendency to clear one's plate when eating is associated with greater food intake in response to increased portion size. We recruited participants who self-reported a tendency to clear their plate when eating (plate

clearers) and participants who did not self-report this tendency (non-plate clearers) into a laboratory study. Participants were served either a normal or large sized lunchtime meal and meal food intake was objectively measured. This design allowed us to examine whether the influence that portion size has on food intake is moderated by plate-clearing tendencies (portion size*plate-clearing tendency interaction effect), to replicate the effect that portion size has on food intake (main effect of portion size), and to examine whether the tendency to clear one's plate when eating is associated with increased food intake (main effect of plate-clearing tendency). We predicted that plate-clearing tendencies would moderate the influence of portion size on food intake; portion size would significantly influence food intake among participants with a tendency to plate clear when eating, but this effect would be smaller (or non-existent) among participants without a tendency to plate clear when eating. We also predicted that both portion size and a tendency to plate clear would be independently associated with increased food intake.

Method

Participant Recruitment and Eligibility

We aimed for a minimum sample size of 80 participants ($n \geq 20$ per group) for analytical purposes. We recruited slightly above this number (N=91) in case of having to exclude participant data. As our primary interest was in whether plate-clearing tendencies moderated the portion size effect (and were unsure of the likely association between plate clearing and energy intake), we opted for this sample size as it provided sufficient power to detect an overall effect of portion size on food intake that was moderate to large in statistical size (d = 0.65, 80% power, $p<.05$), which is in line with a review of portion size studies by Zlatevska [29]. We opted to recruit females only, as gender has been shown to moderate the magnitude of the portion size effect on food intake [1, 2, 30].

Participants were recruited from staff and students at the University of Liverpool and the surrounding area. The majority of participants (73%) were reimbursed financially for their participation and a minority of participants were 1st year psychology students participating in exchange for course credit. Eligibility criteria were as follows: female, BMI (self-reported): 18.5-29.9, no history of food allergies, characterized as either a plate clearer or a non-plate clearer based on responses to an online screening questionnaire. Demographics questions (age, gender, height and weight), and questions unrelated to the study (i.e. lifestyle questions) were included in the online screening questionnaire to disguise its purpose. Embedded in the questionnaire was an item used to measure plate-clearing tendencies, as used in [23]. Participants responded to the question "I always tend to clear my plate when eating" using a 5-point Likert scale. Participants who answered 'agree' were deemed ineligible, as we reasoned that they may not have a particularly strong tendency to plate clear. Participants answered 'strongly disagree', 'disagree', or 'neither agree nor disagree' were eligible to participate as non-plate clearers; those who answered 'strongly agree' were eligible to participate as plate clearers. Therefore, our two groups of participants were those who identified strongly as being habitual plate clearers ("plate clearers") or did not identify as being habitual plate clearers ("non-plate clearers").

Design

The current study used a between-subjects design. The independent variables were plate-clearing tendency (plate clearer or non-plate clearer) and portion size condition (normal or large). Participants were randomly assigned to a portion size condition using an online random number generator (https://www.random.org/lists/).

Demand Characteristics

To disguise the aims of the study it was described to participants as being about 'Hunger and Cognitive Performance'. During the study participants completed a word search task before and after being served a lunchtime meal of pasta in tomato sauce. Feedback questionnaires about the word search tasks were also included to corroborate the cover story, and at the end of the study participants were also asked about their beliefs regarding the study purpose (see procedure), in order to account for findings being explained by demand characteristics.

Test Food

Participants were served pasta in tomato sauce at a 1:1 ratio (Tesco Conchiglie pasta, Dolmio Bolognese 'Smooth Tomato' sauce) in either a 500g or 1000g portion on a standard white dinner plate, with a 500ml glass of water. The 'normal' and 'large' portion sizes used were chosen from the results of a pilot study in which participants reported on the size of pasta meals that would be normal and large in size. These portions were selected to be larger than what people who typically eat in order to reduce the possibility of there being an insufficient amount of food that would have produced an artificial ceiling effect on how much participants ate. In line with other portion size studies (e.g. [6, 30]), the large portion size in the present study was 100% larger than the normal portion size. Pasta dishes have been used as a test food in other portion size studies (e.g. [3, 6]) and pilot testing indicated that participants found the meal to be palatable, which was also confirmed by satisfaction ratings in the current study.

Main Measures

Appetite: A mood and appetite measures questionnaire was used, including three appetite items: hunger, fullness, and desire-to-eat. These were presented as paper-based 100mm visual

analogue scale questions (e.g. “How FULL do you feel right now?”) with the anchors of “Not at all” to “Extremely”. The accuracy of measurement was confirmed by double entry.

Plate-clearing tendencies: To measure plate-clearing tendencies during the laboratory visit participants completed a self-report measure of plate clearing, as used in [23]. The measure consists of 5 questions (“I always tend to clear my plate when eating.”; “I normally finish eating when my plate is empty.”; “Before I start eating, I normally plan to finish the serving I am about to eat.”; “I rarely leave food on my plate.”; “It is normal for me to have very little food left or an empty plate at the end of a meal.”) with a five point Likert scale response format (strongly disagree to strongly agree). Scores were summed, with a higher score indicating stronger plate-clearing tendencies (α = 0.89, [23]).

The Dutch Eating Behaviour Questionnaire (DEBQ): The DEBQ [31] was used to measure external eating, emotional eating and restraint (e.g. “Do you have the desire to eat when you are irritated?” never to very often).

Perceptions of Portion Size: Participants were asked to indicate their opinion regarding the size of the portion they were served for lunch (“In my opinion, the portion I was given in this study was…”) with a seven point Likert scale response format (too small” = 1, to “too large” = 7).

Awareness of Study Hypotheses: Participants completed a final questionnaire which included a free-text response question regarding what the participants believed the aim of the study to be (“What do you think the aim of the study was?”).

Other Measures

Participants also completed other measures relating to their eating habits and their experience during the study that we included for future research purposes, and therefore did not plan to

analyse in the present study. For a full description of these additional measures and missing questionnaire data see the online supplementary material.

Procedure

The study was approved by the University of Liverpool Ethics Committee. Participants attended a single weekday lunchtime session. To standardize appetite participants were asked not to eat in the two hours prior to the study, or drink in the hour prior to the study. On arrival the experimenter obtained informed consent and verbally confirmed that the participant had no known food allergies and had not eaten in the two hours prior to the study session. Participants then completed the word search task, in which they were given three minutes to find as many words as possible from a list provided in the grid of letters. This was followed by a cognitive task feedback questionnaire, which included filler questions about the difficulty of the task and any distractions they experienced whilst completing the task, and a bogus personality questionnaire consisting of 10 questions. Participants then completed the mood and appetite questionnaire. After completing a short questionnaire to confirm an absence of food allergies, participants were served the lunchtime meal. Participants were told that they could eat and drink as much as they desired and to press a buzzer located in the cubicle to alert the experimenter when they had finished. Upon completion, the experimenter removed the lunchtime meal. Participants were then given a second word search task to complete, after which they answered another cognitive task feedback questionnaire and the mood and appetite measures questionnaire for a second time. Participants then completed the plate-clearing measure, some additional questions that included the perceptions of portion size item, the DEBQ, and a final questionnaire that included the awareness of study hypotheses measure, before having their height and weight measured. Finally, the

experimenter debriefed the participant and reimbursed them for their time. The experimental session lasted for approximately 50 minutes.

Main Analysis Strategy

A 2 x 2 ANOVA, with the between subjects factors of plate clearing (plate clearer/non-plate clearer) and portion size (normal/large), was used to test whether participant characteristics (age, BMI, external eating, restraint and emotional eating) differed between conditions. We examined differences in appetite (desire-to-eat, hunger, fullness) using mixed ANOVAs, with time (before meal/after meal) as the within-subjects factor, and portion size (normal/large) and plate-clearing tendency (plate clearer/non-plate clearer) as the between-subjects factors.

To test our main hypotheses we planned to conduct a 2 x 2 ANOVA with factors of portion size (normal/large) and plate-clearing tendency (plate clearer/non-plate clearer). The dependent variable was the weight of food eaten (in grams), which was calculated by weighing the plate of food before and after consumption. We also planned to run a hierarchical regression analysis to examine whether controlling for potential confounding variables had any effect on the results observed, with the following predictors: plate clearing*portion size interaction, portion size (normal/large), plate-clearing tendency (plate clearer/non-plate clearer), BMI, emotional eating score, restraint score and external eating score. Results were considered significant at a $p<.05$.

Sensitivity Analyses

We also planned to examine whether the pattern of results seen in our main analysis was observed when total plate clearing was treated as a continuous variable using a moderation analysis, which was run using PROCESS [32]. Portion size (normal/large) was the

independent variable (X), weight of food eaten in grams the outcome variable (Y) and plate-clearing tendency (continuous score derived from total scale score) was the moderator (M). Finally, we also planned to examine the effect of removing participants that were aware of the study aims or those who finished the portion they were served on our main planned analysis. Participants were characterised as being aware of the study aims if in their written response to the question "What do you think the aim of the study was?" they mentioned the influence of portion size. Two researchers independently coded participant responses to this question, and agreed that 11 participants appeared to show some awareness of the study aims. Participants were identified as having finished the portion if they left less than 10% of the weight of the portion uneaten. Under this criterion, 7 participants (6 plate clearers, 1 non-plate clearer) were identified as finishing the normal portion size and no participants were identified as finishing the large portion size.

Results

Table 1. Participant characteristics, meal satisfaction and average plate clearing score (values are mean (±SD) and ANOVA results)

Table 2. Appetite ratings (100-mm VAS) pre-and post-lunch (values are mean (±SD) and ANOVA results)

Table 3. Mean weight of food eaten in grams (values are mean (±SE))

*Sample characteristic*s

A total of 91 participants were recruited (48 plate clearers and 43 non-plate clearers). Two participants were excluded from analyses due to researcher error in the weight of food served. This resulted in 89 participants being retained for use in our main analysis; 48 plate clearers and 41 non-plate clearers, with a mean age of 25 (±10.22) years and a mean BMI of 22.4 (±2.63) kg/m² (see Table 1 for sample characteristics data for each condition). The average plate-clearing scores were 4.23 (±0.63) for the plate-clearing group and 2.75 (±0.80) for the non-plate clearing group (see Table 1 for average plate-clearing scores for each condition). There were no significant main effects or interactions for age, BMI, external eating or emotional eating (see Table 1), with the exception of a significant main effect of plate clearing on restraint scores (p=.001), whereby plate clearers reported significantly higher dietary restraint scores than non-plate clearers (see Table 1). The meal received reasonable satisfaction ratings across the conditions and there were no significant differences between the conditions, with the exception of a significant main effect of portion size on satisfaction scores (p=.016), with participants served the large portion size reporting lower meal satisfaction than those served the normal portion size (see Table 1). There were no significant differences between the conditions on average plate-clearing score, with the exception of a significant main effect of plate-clearing group on average plate-clearing score, with plate clearers scoring significantly higher on the plate-clearing scale than non-plate clearers (see Table 1).

Self-reported appetite

As expected, participants felt significantly less desire-to-eat, significantly less hungry, and significantly fuller post-lunch relative to pre-lunch (i.e. main effect of time in each analysis; see Table 2). There was no significant portion size*plate-clearing tendency interaction, main

effect of portion size condition or main effect of plate-clearing tendency on any of the three self-reported appetite measures (pre- and post-meal ratings, see Table 2).

Perception of portion size

There was no portion size*plate-clearing tendency interaction effect [$F(1,85)=0.05$, $p=.823$, $\eta_p^2 <.01$] or main effect of plate-clearing tendency [$F(1,85)=0.06$, $p=.814$, $\eta_p^2 <.01$] on perceived normality of portion size indicating that perceptions of the portion sizes served were similar among plate clearers and non-plate clearers. As expected, there was a significant main effect of portion size on perceived normality of portion size served [$F(1,85)=87.60$, $p<.001$, $\eta_p^2 =.51$]; participants that were served the large portion size perceived it as being larger in size than participants served the normal sized portion.

Main outcomes

The mean weight of food eaten in each condition is displayed in Table 3. The 2 x 2 ANOVA indicated that there was no significant portion size*plate-clearing tendency interaction effect on food intake [$F(1, 85) = 0.42$, $p=.519$, $\eta_p^2 = .01$]. Thus, the magnitude of the portion size effect was similar in plate clearers and non-plate clearers (see Table 3). However, there was a significant main effect of portion size; significantly more food was consumed when participants were served a large vs. normal sized portion [$F(1, 85) = 16.15$, $p<.001$, $\eta_p^2 = .16$]. There was also a significant main effect of plate-clearing tendency; plate clearers consumed significantly more food than non-plate clearers [$F(1, 85) = 7.84$, $p=.006$, $\eta_p^2 = .08$]. Re-running this analysis with the 11 participants characterised as showing awareness of the study aims removed from the sample did not change the pattern of statistical significance observed. Re-running this analysis with the 7 participants identified as finishing the normal portion removed from the sample did not change the pattern of statistical significance observed. A

hierarchical regression was used to examine whether controlling for participant BMI, emotional eating, restraint and external eating affected the results of the main analyses. The regression model predicted 21% of variance in weight of food eaten, $\Delta R^2 = .21$, $F(7, 81) = 4.38$, $p<.001$. As in the main analysis the portion size by plate clearing interaction was non-significant ($\beta = .04$, $p=.675$), portion size was significantly positively associated with weight of food eaten ($\beta = .36$, $t(81) = 3.69$, $p<.001$), and so was plate clearing ($\beta = .23$, $t(81) = 2.22$, $p=.029$). Participant BMI ($\beta = .11$, $p=.251$), emotional eating ($\beta = .22$, $p=.078$), restraint ($\beta = .04$, $p=.683$), and external eating ($\beta = -.06$, $p=.627$) were not significant predictors of weight of food eaten.

Results of sensitivity analyses

When plate clearing was treated as a continuous variable the same pattern of results was observed as in the main analysis. The regression model predicted approximately 36% of variance in weight of food eaten, $R^2 = .36$, $F(3, 85) = 15.57$, $p<.001$. Plate-clearing tendencies did not significantly moderate the effect of portion size on weight of food eaten ($b = 3.26$, se = 4.48, $p=.469$, 95% CI [-5.64, 12.16]), however there was a significant effect of portion size on weight of food eaten ($b = 108.11$, se = 22.65, $p<.001$, 95% CI [63.07, 153.15]), and a significant effect of plate-clearing tendency on weight of food eaten ($b = 11.56$, se = 2.23, $p<.001$, 95% CI [7.13, 16.00]). Including meal satisfaction as a covariate in our main analysis strategy did not influence the pattern of statistical significance observed.

Discussion

The primary aim of the present study was to examine whether individual differences in plate-clearing tendencies moderate the influence that portion size has on meal food intake in a laboratory setting. We found that the influence that portion size had on food intake was

similar in size irrespective of participant plate-clearing tendencies, which is consistent with Rolls, Roe, Meengs and Wall [3]. Thus, there was no evidence that a tendency to clear one's plate explains the effect that portion size has on food intake. In line with a number of other studies [1–7] we found that portion size had a significant effect on meal food intake, whereby participants consumed more food when served a larger portion. We also found that irrespective of the portion size served, participants with a self-reported tendency to clear their plate when eating consumed significantly more food than participants who did not self-report a tendency to clear their plate when eating.

As far as we are aware, the results of the present study are the first to link plate-clearing tendencies to increased food intake. Plate clearing has been associated with increased BMI [23, 24] and because of this it has been suggested to be a potentially maladaptive behaviour in the current obesogenic environment [23, 24]. We found that irrespective of the portion size served participants with a tendency to clear their plate when eating consumed significantly more food than non-plate clearers. However, because the portion sizes provided in the present study were deliberately selected to be large, very few participants actually cleared their plate. Thus, based on the present study it seems likely that individuals with a tendency to clear their plate when eating may have a desire to do so and this may increase the amount of food they consume at a meal even if it does not result in all available food being consumed. This finding was robust to controlling for other dietary habits (such as dietary restraint) and BMI, which suggests that the association between a tendency to clear one's plate when eating and increased meal food intake is not explained by plate clearers and non-plate clearers differing on these other variables. The present findings therefore suggest that a tendency to clear one's plate when eating may promote overeating. However, because we examined food intake at a single test meal, we do not know whether the increased food intake observed among plate clearers would be compensated for at

subsequent meals. Thus, examining whether plate-clearing tendencies promote excessive consumption in the long-term would now be informative.

As in many other portion size studies [29] we found evidence for the portion size effect, and our results further highlight the robust nature of the portion size effect, as even a group of participants who explicitly reported not being motivated to plate clear when eating were susceptible to the influence of portion size. This indicates that the portion size effect is not limited to individuals who have a tendency to clear their plate when eating. However, we also found that participant with plate-clearing tendencies consumed more (irrespective of portion size) than participants without such tendencies, which has behavioural implications. In the current obesogenic environment, individuals with plate-clearing tendencies are likely to be at higher risk of passive overconsumption, and thus likely to be at higher risk of weight gain.

The failure to find evidence in support of plate-clearing tendencies moderating the influence of portion size on meal food intake may indicate that factors other than plate-clearing tendencies are better placed to explain why portion size has a reliable effect on food intake. However, the present study has limitations that warrant consideration. Because the study was conducted in a laboratory setting demand characteristics may in part explain why the influence of portion size on food intake was similar in size across plate clearers and non-plate clearers. For example, even if participants without plate-clearing tendencies did not wish to consume a considerable amount of food from the portion sizes provided they may have felt it would be ill mannered to waste a very large amount of food. Likewise, although we conducted pilot work to select portion sizes served that would be ‘normal’ and ‘large’ in size, on average participants perceived the normal sized portion to be larger than normal. It is likely that the relationship between increasing portion sizes and food intake is curvilinear [29]; if the portion sizes served in the present study had been smaller in size it is plausible

that participants without plate-clearing tendencies may have continued to waste a substantial amount of food. However, participants with plate-clearing tendencies may have come close to finishing the amount of food served in both portion size conditions and this would likely lead to a larger effect of portion size on food intake in plate clearers vs. non-plate clearers. It is possible that the size of the portions and the large difference between the portion sizes led to a ceiling effect, "washing out" the effects of plate-clearing tendencies and thus limiting the ability to detect an interaction between portion size and plate clearing. In future, a wider range of portion sizes should be used to allow greater sensitivity to the potential influence of plate clearing on the portion size effect, especially given that the portion size effect has been found to be curvilinear [29]. It should also be noted that we found a main effect of portion size on meal satisfaction, with those in the large portion size condition reporting lower meal satisfaction. This finding is consistent with research which suggests that consumers habituate to large portions of food and find them less enjoyable by meal end [33].

Further limitations of the present research were that our sample was not representative of the general population and that plate-clearing tendencies were self-reported. We presume that participants are likely to be able to report with some accuracy on whether they tend to clear their plate when eating, but self-report measures can introduce bias and objective measurement of plate-clearing tendencies would be preferential. There is now evidence that self-reported plate-clearing tendencies predict elevated food intake (the present study) and BMI [23, 24], and objectively measured plate clearing is more common among individuals with overweight and obesity than those of normal weight [20–22]. Work that makes use of objective measurement of plate-clearing tendencies to clarify the extent to which plate clearing is a behavioural risk factor for excess consumption and weight gain would therefore be valuable. Addressing these potential limitations of the present research in future studies

will clarify the relationship between plate-clearing tendencies and the influence of portion size on food intake.

Conclusion

In this laboratory study of female participants, the tendency to clear one's plate when eating was associated with increased food intake during a lunchtime meal. Experimentally manipulating the portion size of the lunchtime meal also affected food intake, although the tendency for a larger portion size to increase food intake was observed irrespective of plate-clearing tendencies.

List of additional files

Additional file 1

Format: Microsoft word document (.docx)

Title: Table 1. Participant characteristics, meal satisfaction and average plate clearing score

Additional file 2

Format: Microsoft word document (.docx)

Title: Table 2. Appetite ratings (100-mm VAS) pre-and post-lunch

Additional file 3

Format: Microsoft word document (.docx)

Title: Table 3. Mean weight of food eaten in grams

List of abbreviations

Dutch Eating Behavior Questionnaire (DEBQ)

Declarations

Ethics approval and consent to participate

Ethical approval was gained from the University of Liverpool's IPHS Research Ethics Committee (reference number: IPHS-1516-LB-134-Generic RETH000955). Participants provided written consent prior to participation.

Consent for publication

Not applicable.

Availability of data and material

The study materials and the dataset generated and analysed during the current study are both available in the Open Science Framework repository [osf.io/t2cey].

Competing interests

The author(s) declare that they have no competing interests.

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Authors' contributions

FS designed the study, was the primary writer of the manuscript, recruited participants, and collected, analyzed and interpreted the data. ER and CAH contributed to the conceptualization and design of the experiment. All authors contributed to the manuscript writing.

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Table 1. Participant characteristics, meal satisfaction and average plate clearing score (values are mean (±SD) and ANOVA results)

	Plate clearers (n = 48)		Non-plate clearers (n = 41)		Main effect of Portion Size condition	Main effect of Plate clearing group	Portion Size by Plate clearing interaction effect
Portion size condition	Normal (n = 25)	Large (n = 23)	Normal (n = 21)	Large (n = 20)			
Age (years) [b]	25.54 (±8.41)	28.09 (±12.16)	25.05 (±11.96)	22.65 (±7.34)	p>0.99, η_p^2 <.01	p=.178, η_p^2 =.02	p=.261, η_p^2 =.02
BMI (kg/m²) [b]	21.50 (±2.18)	22.85 (±2.43)	23.18 (±3.60)	22.39 (±2.00)	p=.619, η_p^2 <.01	p=.282, η_p^2 =.01	p=.058, η_p^2 =.04
Emotional Eating [a]	2.66 (±0.84)	2.80 (±1.00)	2.31 (±0.79)	2.50 (±0.55)	p=.341, η_p^2 =.01	p=.066, η_p^2 =.04	p=.883, η_p^2 <.01
Restraint [a b]	2.85 (±0.54)	2.95 (±0.71)	2.25 (±0.65)	2.60 (±0.78)	p=.127, η_p^2 =.03	p=.001***, η_p^2 =.12	p=.378, η_p^2 =.01
External Eating [a b]	3.59 (±0.65)	3.56 (±0.66)	3.30 (±0.54)	3.51 (±0.49)	p=.472, η_p^2 =.01	p=.173, η_p^2 =.02	p=.354, η_p^2 =.01
Satisfaction	4.04 (±0.79)	3.65 (±0.98)	4.19 (±0.75)	3.75 (±0.55)	p=.016*, η_p^2 =.07	p=.463, η_p^2 =.01	p=.876, η_p^2 <.01
Plate-clearing score [c]	4.30 (±0.65)	4.15 (±0.61)	2.79 (±0.88)	2.71 (±0.73)	p=.457, η_p^2 =.01	p<.001***, η_p^2 =.52	p=.825, η_p^2 <.01

Table 1 displays the differences between plate clearers and non-plate clearers with regards to participant characteristics (age, BMI, emotional eating, restraint, external eating), meal satisfaction and plate-clearing score. It also displays the results of ANOVAs investigate significant differences between plate clearers and non-plate clearers and individuals in each portion size condition.

All ANOVA results were non-significant, with the exception of a main effect of portion size condition on satisfaction, whereby meal satisfaction was rated as significantly lower in the large compared to the normal portion size condition; a main effect of plate clearing on restraint, whereby plate clearers scored significantly higher in restraint than non-plate clearers; and a main effect of plate clearing on average plate clearing score, whereby plate clearers scored significantly higher on the plate clearing scale than non-plate clearers.

*p<.05; **p<.01, ***p<.001

[a] DEBQ subscales are scored from 1-5 with higher values denoting greater emotional eating, restraint and external eating.

[b] These variables contain data from <89 participants, as they are missing data (see online supplementary materials).

[c] The highest possible average plate-clearing score is 5.

Table 2. Appetite ratings (100-mm VAS) pre-and post-lunch (values are mean(±SD) and ANOVA results)

		Plate clearers (n = 48)		Non-plate clearers (n = 41)		Main effect of Time	Main effect of Portion Size	Main effect of Plate clearing	Portion Size by Plate clearing interaction effect
	Portion size condition	Normal (n = 25)	Large (n = 23)	Normal (n = 21)	Large (n = 20)				
Pre Lunch	Desire-to-eat [a]	62.33 (±28.69)	67.90 (±16.35)	60.47 (±27.08)	64.15 (±22.46)	p<.001***, η_p^2 =.85	p=.360, η_p^2 =.01	p=.594, η_p^2 <.01	p=.869, η_p^2 <.01
	Hunger [a]	63.83 (±30.23)	69.73 (±19.60)	64.86 (±24.38)	65.91 (±23.41)	p<.001***, η_p^2 =.86	p=.260, η_p^2 =.02	p=.691, η_p^2 <.01	p=.429, η_p^2 =.01
	Fullness [a]	18.35 (±16.81)	18.42 (±16.30)	16.69 (±21.19)	19.38 (±13.54)	p<.001***, η_p^2 =.92	p=.626, η_p^2 <.01	p=.888, η_p^2 <.01	p=.447, η_p^2 =.01
Post Lunch	Desire-to-eat [a]	8.28 (±10.03)	7.85 (±8.38)	8.47 (±9.48)	7.97 (±12.99)				
	Hunger [a]	7.98 (±9.42)	3.00 (±2.28)	6.78 (±11.93)	5.91 (±12.38)				
	Fullness [a]	85.57 (±10.83)	86.95 (±9.94)	88.22 (±11.39)	84.94 (±14.29)				

Values are Mean(±SD) for pre-lunch and post-lunch appetite measures, and results of a mixed ANOVA with time (before meal/after meal) as the within-subjects factor, and portion size (normal/large) and plate clearing tendency (plate clearer/non-plate clearer) as the between-subjects factors.
Participants felt significantly less desire-to-eat, significantly less hungry, and significantly fuller post-lunch relative to pre-lunch. There was no significant portion size*plate-clearing tendency interaction, main effect of portion size condition or main effect of plate-clearing tendency on any of the three self-reported appetite measures.
***p<.001.
[a] These variables contain data from <89 participants, as there are missing data (see online supplemental material).

Table 3. Mean weight of food eaten in grams (values are mean(±SE))

	Plate Clearers	Non-plate Clearers	Plate Clearers and Non-plate Clearers Combined
Normal Portion Size Condition	353.01 (±20.44), *n* =25	299.48 (±17.79), *n* = 21	***328.57 (±14.18), *n* = 46
Large Portion Size Condition	468.97 (±31.56), *n* = 23	383.29 (±26.78), *n* = 20	***429.12 (±21.76), *n* = 43
Portion Size Conditions Combined	**408.58 (±20.15), *n* = 48	**340.36 (±17.96), *n* = 41	

Table 1 displays the mean weight of food eaten (in grams).The mean difference in food intake between the normal and large portion size conditions was 100.55g (p<.001). The mean difference in food intake between plate clearers and non-plate clearers was 68.21g (p=.006). **p<.01; ***p<.001. *n* indicates number of participants.