



Research report

Portion size and intended consumption. Evidence for a pre-consumption portion size effect in males? ☆



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ABSTRACT

Larger portions increase energy intake (the 'portion size effect'); however, the mechanisms behind this effect are unclear. Although pre-meal intentions are thought to be an important determinant of energy intake, little research has examined how much of a meal individuals intend to eat when served standard versus larger portion sizes. Three studies examined the effect of manipulating portion size on intended food consumption. In Studies 1 (spaghetti bolognese) and 2 (curry and rice) male participants were shown an image of either a standard or a larger meal and indicated how much of the meal they intended to consume. In Study 3 male and female participants were served either a standard or a larger portion of ice cream for dessert, they indicated how much they intended to consume and then ate as much of the ice cream as they desired. Regardless of being shown standard or large portion sizes, in Studies 1 and 2 participants reported that they intended to eat the majority of the meal, equating to a large difference in intended energy consumption between portion size conditions (a 'pre-consumption portion size effect'). This finding was replicated in male participants in Study 3, although females intended to eat a smaller proportion of the larger portion of ice cream, compared to the standard portion. Both male and female participants tended to eat in accordance with their pre-meal intentions and a portion size effect on actual consumption was subsequently observed in males, but not in females. The portion size effect may be observed when measuring pre-meal intended consumption in males.

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Introduction

Portion size has been shown to have a substantial influence on energy intake, whereby larger portions of food promote increases in energy consumption, otherwise known as 'the portion size effect' (Kral, 2006; Rolls, Morris, & Roe, 2002; Steenhuis & Vermeert, 2009). Given reports that portion sizes have increased in recent times (Nielsen & Popkin, 2003; Smiciklas-Wright, Mitchell, Mickel, Goldman, & Cook, 2003) and reducing portion sizes might be of benefit to public health (Steenhuis & Vermeert, 2009), there have now been a relatively large number of empirical studies examining the portion size effect (e.g. Fisher, Arreola, Birch, & Rolls, 2007; Kral, Roe, & Rolls, 2004; Raynor & Wing, 2007). A recent review and meta-analysis of this literature has confirmed that the portion size effect is observed across a variety of food types, settings and participant populations (Zlatevska, Dubelaar, & Holden, 2014). However, to date we know very little about the underlying mechanisms that explain why people tend to consume more energy when they are

served larger portions (Benton, 2015; Burger, Fisher, & Johnson, 2011).

A number of potential explanations for the portion size effect have been proposed. A suggestion made by Steenhuis and Vermeert (2009) is that people enjoy value for money, so they eat the majority of food portions they have purchased, although several studies show that portion size influences food intake even when participants are provided with foods they have not had to buy (e.g. Levitsky & Youn, 2004). Other suggestions are in part based around the concept of portion size providing a cue as to what is a 'normal' amount of food to eat (Herman & Polivy, 2008; Hermans, Larsen, Herman, & Engels, 2012; Wansink & van Ittersum, 2007). A recent suggestion that builds on normative interpretations of portion size is based around decision making and anchoring. Because portion size tells us what a 'normal' amount of food is, this constitutes a form of anchor which consumers work from in order decide how much to eat (Marchiori, Papies, & Klein, 2014). This interpretation comes from a series of experiments by Marchiori et al. (2014) which suggest that when making a decision about how much food to consume, evaluations are anchored to the size of portions consumers have recently viewed.

There is growing consensus that meal size and energy intake is governed by cognitive activity associated with meal planning that occurs before a meal begins (Brunstrom, 2011, 2014). In a

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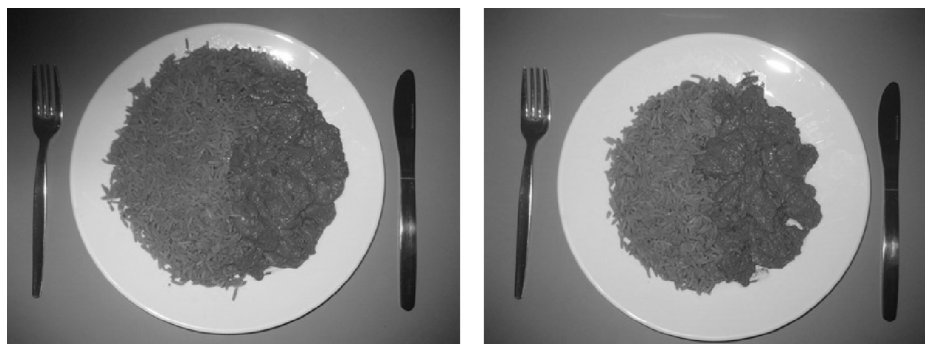


Fig. 1. Example images, larger and standard portions of rice and curry in Study 2.

questionnaire-based study (Fay et al., 2011), planned meal size was found to be significantly associated with ingested meal size. More specifically (and with respect to the most recently consumed meal), most participants reported that they intended to consume their entire meal from the outset and followed through with this plan (Fay et al., 2011). Pre-meal intended consumption also appeared resistant to modification over the course of the meal, with very few participants reporting consumption that deviated from their pre-meal plans.

Whilst the above findings indicate the importance of pre-meal intentions in determining energy intake, the role of intended consumption in cases where portion sizes are determined by an external agent (e.g., in a restaurant), as opposed to serving oneself a portion size, is less clear. Furthermore, to our knowledge, no studies have examined the effect of varying portion sizes on intended consumption. On this basis, the aim of the present work was to examine the amount of food that individuals intend to eat when served standard versus larger portions sizes of food. Three experimental studies were conducted. In Studies 1 and 2 male participants completed an Internet-delivered questionnaire in which they were shown standard or larger portions of a main meal and they rated how much of the portion they would intend to consume. As people generally intend to eat most of the food they serve themselves (Fay et al., 2011), it was predicted that pre-meal consumption intentions (in terms of intended energy consumption, in kcal) would be influenced by portion size, whereby participants would intend to eat more food when presented with a larger portion relative to a smaller portion (a 'pre-consumption portion size effect'). Thus, the aim of Studies 1 and 2 was to establish whether there may be initial evidence of a pre-consumption portion size effect. Following on from this, in Study 3, male and female participants were served either a standard or a larger portion of ice cream in a controlled laboratory setting. They rated how much they intended to consume, before being allowed to consume the food. Finally, in order to build on and extend previous findings on pre-meal intentions (Fay et al., 2011), Study 3 aimed to establish that pre-meal intended consumption is indeed strongly related to actual food intake, by testing whether the amount of food participants intended to consume was similar to the amount they subsequently ate.

Overview of Studies 1 and 2

Design

Across two online studies participants were shown an image of either a standard or a larger portion size of a main course (between subjects) and were asked how much of the portion they would intend to eat if they were served it at a restaurant. We examined intended consumption for different meal types across the two studies. In both of these initial studies only male participants were recruited,

in order to sample a heterogeneous sample of participants whose energy intake is known to be strongly influenced by portion size (Zlatevska et al., 2014).

Photographic stimuli

Standardised photographs of food portion sizes were used in Studies 1 and 2. The foods were sourced from a UK supermarket. The standard portion for each food constituted the recommended serving size. The larger portion was 50% larger than the standard portion in both studies. We selected two meals that are commonly served in restaurant settings. The food in Study 1 was spaghetti bolognese (standard portion condition: 400 g, 470 kcal; large portion condition: 600 g, 705 kcal) and in Study 2 it was chicken curry and rice (standard portion condition: 500 g, 740 kcal; large portion condition: 750 g, 1110 kcal). Standardised photographs were taken from above and food was placed on a standard sized serving plate. A normal sized knife and fork were positioned either side of the plate to act as size reference points. See Fig. 1 for example photographs.

Study 1: method

Participants

One hundred and twenty-four male participants (M age = 30.0, SD = 8.9 yrs), with a mean BMI of 27.1 (SD = 8.0) kg/m² were recruited online from Amazon Mechanical Turk (US) in exchange for a small monetary reward. The study advertisement described the study as being about attitudes to food and specified that only males could take part and vegetarians were ineligible (due to the foods used). All studies were approved by the authors' institutional ethics board (University of Liverpool, UK). In both Studies 1 and 2 we aimed to recruit around 60–70 participants per cell of the experiment in order to detect a medium sized effect ($d = 0.5$) at 80% power ($p < 0.05$). Participants taking part in Study 1 were unable to participate in Study 2.

Procedure

After providing informed consent, participants were randomly assigned to view the standard or larger serving of spaghetti bolognese. Underneath the image, participants were asked to 'Imagine you ordered this meal at a restaurant for an evening meal and the waiter now brings this plate of food over. How much of the portion of food would you plan to eat? Please answer as a percentage from 0–100'. After providing their answer, on the next page participants were asked to rate how normal the size of food portion appeared ('a normal serving size would be', on a 7 point scale, 'a lot bigger' to 'a lot smaller') in order to ascertain if the portion sizes provided appeared relatively normal. They also estimated how many

calories were in the meal. Next, participants completed a series of measures which we believed could influence intended consumption, which we included to ensure experimental conditions were well balanced. They reported how much they liked spaghetti bolognese and how filling they found spaghetti bolognese (both 5 point Likert, strongly agree to strongly disagree), as well as how frequently they ate spaghetti bolognese (7 point scale, ranging from 'on a daily basis' to 'yearly or less'). Participants also completed five questions measuring the tendency to clear one's plate when eating, using 5 point Likert scales (e.g. 'I rarely leave food on my plate'). See Robinson, Aveyard, and Jebb (2015) for more information about this measure. Participants then rated how hungry they were, on a scale of 1–10, with 1 being not hungry at all and 10 extremely hungry. Finally, participants completed demographic measures, which included age and self-reported weight and height.

Analysis strategy

Individual t-tests were used to compare the standard and larger portion size conditions on potentially confounding variables: age, attitudes towards the food, BMI, hunger, plate clearing tendencies (plate clearing was measured by collapsing scores across the five individual items; Cronbach's $\alpha = 0.90$). The main analysis of interest was to examine the percentage of the meal participants intended to eat in the standard versus larger portion condition and an independent samples t-test was used to compare this. To further examine whether there was evidence for a pre-consumption portion size effect (i.e. whether being served a larger portion resulted in an increase in the number of calories participants intended to eat), the calorie content of each participants' intended consumption amount was also calculated and we based this on the assumption that participants would eat a similar proportion of all meal components. For example, if a participant in the standard portion size condition intended to eat 50% of their portion, their intended calorie consumption would be 235 kcals, whereas if a participant in the larger condition intended to eat 50% of their portion, their intended calorie consumption would be 302.5 kcals. This was also compared across the two conditions using a t-test. Unless otherwise stated, values in all study result sections refer to means and standard deviations.

Study 1: results

Participant characteristics

Participants in the larger ($n = 60$) and standard ($n = 64$) portion size conditions did not significantly differ in terms of BMI, age, hunger, plate clearing or how filling, likeable or frequently they ate spaghetti bolognese ($ps > 0.10$). Participants tended to report familiarity with spaghetti bolognese; 75% of participants reported consuming the food more often than once a year.

Intended consumption

Participants in the standard portion size and larger portion size conditions reported intending to consume a similar percentage of their portions [$t(122) = -0.17$, $p = 0.86$, $d = 0.03$]. Participants in the standard portion size condition intended to consume 82.7% ($SD = 22.8$) of the meal and participants in the larger size conditions intended to consume 84.0% ($SD = 19.6$). Converted to calories, this resulted in participants in the larger portion size condition having a larger intended energy consumption than the standard sized condition [$t(122) = 9.17$, $p < 0.001$, $d = 1.65$]. Participants in the standard portion size condition intended to consume 389.1 kcals ($SD = 107.2$) and participants in the larger size conditions intended to consume 592.1 kcals ($SD = 138.1$). Thus, when served a standard

or larger portion of food, on average participants intended to eat the majority of the food served, which equated to sizeable differences between the conditions for intended energy consumption.

Perceived normality of portion sizes

There was no significant difference between the standard (Mean = 4.3, $SD = 0.92$, $n = 64$) and larger (Mean = 4.6, $SD = 1.1$, $n = 60$) portion size conditions for how normal participants thought the portion size they were served was [$t(122) = 1.7$, $p = 0.09$, $d = 0.3$]. The mean score across the two conditions on the scale ('a normal serving of spaghetti bolognese would be') was 4.4 (which denotes the response: 'the same size as this'). This suggests that participants believed the portion they were shown was a relatively normal size.

Study 2: method

The aim of Study 2 was to examine whether the findings observed in Study 1 would replicate to a different meal type.

Participants and procedure

One hundred and seventeen US males (M age = 29.7, $SD = 9.2$ yrs), with a mean BMI of 26.4 ($SD = 5.3$) kg/m^2 participated. The same recruitment strategy and eligibility criteria were used as in Study 1, as was the same analysis strategy. The procedure was exactly the same as in Study 1, although images of the chicken curry and rice were used and questions referred to chicken curry and rice. Participants tended to report familiarity with chicken curry and rice; 70% of participants reported consuming the food more often than once a year.

Study 2: results

Participant characteristics

Participants in the larger ($n = 59$) and standard ($n = 58$) portion size conditions did not significantly differ in terms of BMI, age, hunger, plate clearing or how filling, likeable or frequently they ate rice and curry ($ps > 0.10$).

Intended consumption

Participants in the standard portion size and larger portion size conditions reported intending to consume a similar percentage of their portion [$t(115) = -0.90$, $p = 0.37$, $d = 0.17$]. Participants in the standard portion size condition intended to consume 82.3% ($SD = 21.5$) of the meal and participants in the larger size conditions intended to consume 78.5% ($SD = 23.9$). Calculated as calories, this resulted in participants in the large portion size condition having a larger intended consumption than the standard sized condition [$t(115) = 6.47$, $p < 0.01$, $d = 1.2$]. Participants in the standard portion size condition intended to consume 608.7 kcals ($SD = 159.2$) and participants in the larger size conditions intended to consume 870.9 kcals ($SD = 265.4$). Thus, when served a standard or larger portion of food participants reported intending to eat the majority of the food served, which equated to sizeable differences between the conditions for intended energy consumption.

Perceived normality of portion sizes

There was no significant difference in how normal participants thought the portion size they were served was between the standard (Mean = 4.5, $SD = 0.78$) and larger (Mean = 4.7, $SD = 0.9$) portion size conditions [$t(115) = 1.24$, $p = 0.22$, $d = 0.23$]. The mean score on the scale was 4.6 and this suggests participants believed the portion they were shown was a relatively normal size.

Studies 1 and 2 discussion

In both studies, regardless of being shown standard or a larger portion size, participants intended to eat the majority of the food served, resulting in evidence for an intended 'pre-consumption portion size effect'. Importantly this effect was found for two different meal foods. Regardless of portion size condition, participants in both studies evaluated standard and larger portion sizes of spaghetti bolognese and curry as being relatively normal in size. This finding is of interest because the actual energy content of the larger portion sizes was 50% greater than in the standard portion sizes. Thus, it appears as though a relatively wide range of food portion sizes are perceived by consumers as being 'normal' or appropriate amounts of food to consume, which is consistent with findings from a field study by [Diliberti, Bordi, Conklin, Roe, and Rolls \(2004\)](#). Although intentions tend to be a good predictor of behaviour ([Sheeran, 2002](#)), Studies 1 and 2 did not measure actual consumption and used hypothetical scenarios. Therefore, Study 3 examined actual consumption. The primary aim of Study 3 was to examine whether a portion size effect would be observed on both pre-meal intended consumption (as in Studies 1 and 2) and actual consumption, when served a standard versus a larger portion. Given that Studies 1 and 2 sampled males only, in Study 3 both males and females were recruited, in order to be able to conduct a preliminary examination of whether the consistent findings observed across Studies 1 and 2 would also be observed in females.

Study 3: method

Overview

After consuming a sandwich for lunch, participants were served either a standard or a larger portion of ice cream as dessert. Participants rated how much of the ice cream they intended to eat and were then told that they could eat as much or as little as they wanted. Perceived normality of portion sizes served was not measured in Study 3 in order to minimise demand effects on food intake.¹ To detract from the main aims of the study, participants were led to believe the study examined cognitive ability and mood after consuming a meal. It was hypothesised that there may be evidence for a pre-meal portion size effect on intended consumption, as well as a portion size effect on actual consumption. Given that a recent finding suggest that females are less influenced by portion size than males ([Zlatevska et al., 2014](#)), it was tentatively hypothesised that any portion size effects on intended and actual consumption may be less pronounced in females than in males.

Design

The study was a 2 × 2 between-subjects design with portion size condition (standard vs. larger) and gender (male vs. female) as factors. Based on the large between group differences for intended energy consumption observed in Studies 1 and 2, it was estimated that approximately 44 participants were required (80% power, $p < 0.05$). This sample size was doubled (88) and recruitment was stratified by gender, in order to examine gender differences.

Participants

Eighty-eight participants (M age = 33.1, SD = 11.4 yrs), with a mean BMI of 25.3 (SD = 4.4) kg/m² were recruited from staff and

students at a UK university in exchange for a small monetary reward. Forty-four males and 44 females were recruited. The study advertisement described the study as being about cognitive ability and mood. Participants were informed that a lunch-time meal would be provided and participants had to have no history of food allergy. Participants were also informed that disliking of sandwiches or ice cream was an exclusion criterion.

Test foods

Participants were served a standard portion of vanilla ice cream (approximately 75 grams, 62 kcals) or a larger portion of vanilla ice cream (approximately 175 grams, 145 kcals) in a bowl. The standard portion amount was based on the manufacturer's serving recommendations and the larger serving (133% greater in size than the standard portion) was based on an estimate of an amount that would be larger than the standard serving, but that would still fit into the bowl used and therefore appear as a relatively normal serving. We used the same sized portions (larger vs. standard) for males and females, as this is how portion size is normally provided when dining out (i.e. regardless of gender, patrons receive the same portion sizes when dining out or buying food from a food outlet). The ice cream was bought from a UK supermarket (82.9 kcal/100g). In order to ensure each participant would want to eat the lunchtime sandwich, prior to the study participants could register their preference between a chicken (162 g, 380 kcal), sausage (177 g, 398 kcal), egg (152 g, 280 kcal) or cheese (159 g, 405 kcal) sandwich. The sandwiches were bought from a local supermarket and were all standard serving sizes. Of the 88 participants, 65 ate their full sandwich and the remaining 23 tended to consume the majority of the sandwich. Mean sandwich energy intake was 294.1 kcal (SD = 78.3).²

Procedure

Prior to the experiment, participants were informed by email they would be served lunch, including a sandwich and ice cream dessert, and were asked to make a preference about sandwich filling. Sessions took place between 12 pm and 2 pm on weekdays. Participants were randomly allocated to the standard portion size or larger portion size condition. Participants were seated in a cubicle alone and were presented with a series of mood ratings, which included an item measuring hunger (e.g. how hungry are you right now?, 10 cm visual analogue scale, 'not at all' to 'extremely'). Then participants were provided with a word search (to distract from the main study aims). The word search took approximately five minutes and involved finding ten food and drink related words (e.g. coffee) in a large grid of letters. Participants rated on a 1–100 scale how easy and interesting the task was. After this participants were served their sandwich.³ The researcher next provided participants with mood measures to complete, followed by the serving of ice cream.

² Given that the sandwiches served varied in energy content, a 2 × 2 ANOVA with sandwich energy intake as the dependent variable was conducted, in order to ensure conditions and genders were balanced for sandwich energy intake. Sandwich energy intake did not differ as a function of condition ($p = 0.58$) or gender ($p = 0.34$) and the interaction between the two was non-significant ($p = 0.57$). All of our main analyses reported in the present study were also conducted with sandwich energy intake as a covariate and none of the reported results significantly differed. Similarly, conditions were balanced for grams of sandwich eaten and its inclusion as a covariate does not affect any of the reported results.

³ Although intended consumption of the sandwich was not of interest in the study, prior to eating the sandwich we asked participants (using the same measure as for ice cream) to report how much of the sandwich they intended to eat, rather than only asking about the ice cream. It was presumed that only asking about the intended amount of ice cream to be consumed could have drawn attention to the study hypotheses. Participants intended to eat 89% of the sandwich on average. This did not differ across experimental condition ($p = 0.31$) or gender ($p = 0.38$) and there was no interaction between condition and gender on intended sandwich consumption ($p = 0.48$).

¹ Given one of the main hypotheses in Study 3 concerned whether portion size influenced food intake, drawing further attention to how normal the portion sizes looked (by asking participants to rate this prior to eating) may have made this hypothesis more transparent to participants.

Table 1
Participant characteristics in Study 3.

	Males (n = 44)		Females (n = 44)	
	Larger portion condition (n = 21)	Standard portion condition (n = 23)	Larger portion condition (n = 23)	Standard portion condition (n = 21)
Age (in years)	32.9 (14.0)	31.0 (10.8)	33.2 (11.0)	35.4 (11.1)
Baseline hunger (0–100 mm, VAS)	62.0 (18.0)	50.0 (24.7)	55.4 (23.8)	61.6 (18.1)
BMI (kg/m ²)	26.7 (3.8)	24.3 (3.2)	24.7 (4.5)	25.7 (5.6)
Dietary restraint (1–21 scale)*	8.6 (4.8)	6.1 (4.0)	9.3 (4.5)	9.8 (5.1)
Plate clearing tendencies (1–5 scale)*	4.3 (0.8)	4.3 (0.8)	3.4 (0.9)	3.7 (0.8)

Values are means (SD in brackets).

* Denotes significant gender difference ($p < 0.05$).

Participants rated how much of the ice cream they intended to eat (same measure as in Studies 1 and 2; 0–100%), before being left to consume as much or as little of the portion as they liked. The bowl was weighed and re-weighed after consumption in order to calculate the amount eaten. Participants were provided with a final questionnaire which included the plate clearing measure described in Study 1 and the Restraint Scale of the Three Factor Eating Questionnaire (Stunkard & Messick, 1985), gender, age and some questions about their experience during the study, including what they thought the aims of the study were. The restraint scale was included in order to check for between condition differences in dieting tendencies. Weight and height was then measured using electronic scales and a stadiometer. The participants were debriefed, reimbursed (£10) and thanked for their time.

Analysis strategy

In order to examine whether conditions were balanced for age, BMI, baseline hunger, plate clearing and restraint, separate 2×2 ANOVAs were planned. To test the effect of portion size condition and gender on intended consumption (in % of portion and kcals) and actual consumption of ice cream (in kcals), 2×2 ANOVAs were conducted. If a significant interaction between gender and portion size was observed for a dependent variable, the effect of portion size condition was followed up in males and female separately using independent samples t-tests. A paired samples t-test was used to compare similarity between intended consumption (in % of portion) and actual consumption (in % of portion).

Study 3: results

Participant characteristics

There were no significant differences between portion size conditions for BMI, age, hunger, plate clearing or restraint ($ps > 0.20$). There were also no significant interactions between portion size condition and gender for any of the variables ($ps > 0.05$). There were no significant gender differences for baseline hunger, BMI or age ($ps > 0.19$), although males scored lower on the measure of dietary

restraint ($p = 0.03$) than females and males had higher plate clearing tendencies than females ($p < 0.001$). See Table 1 for means and standard deviations of these measures as a function of portion size condition and gender.

Intended and actual consumption

ANOVA indicated no significant main effect of portion size condition [$F(1, 84) = 3.32$, $p = 0.07$, *partial eta squared* = 0.04] on the percentage of the portion of ice cream that participants intended to consume. There was a main effect of gender [$F(1, 84) = 13.7$, $p < 0.01$, *partial eta squared* = 0.14] and a significant interaction between condition and gender [$F(1, 84) = 8.8$, $p = 0.004$, *partial eta squared* = 0.09] (see Table 2).

ANOVA indicated a significant main effect of portion size condition [$F(1, 84) = 32.7$, $p < 0.001$, *partial eta squared* = 0.28] and gender [$F(1, 84) = 24.1$, $p < 0.001$, *partial eta squared* = 0.22] on actual consumption of ice cream. There was also a significant interaction between condition and gender [$F(1, 84) = 17.3$, $p < 0.001$, *partial eta squared* = 0.17] (see Table 2).

As significant interactions between gender and conditions were observed for both intended and actual consumption, we next examined the effect of condition on these measures in males and females separately.

Males

There was not a significant difference between the standard portion size condition and larger portion size condition in terms of the percentage of the ice cream portion that males intended to consume ($t(42) = 0.82$, $p = 0.42$, $d = 0.24$). See Table 2. Participants in both conditions intended to consume the majority of the portion served. These consumption intentions equated to 51.1 kcals and 128.5 kcals of intended ice cream consumption in the standard and larger portion size conditions, respectively ($t(42) = 11.2$, $p < 0.001$, $d = 3.38$). There was also an effect of condition on actual ice cream consumption. Males in the larger portion size condition consumed significantly more calories of ice cream than participants in the standard portion size condition ($t(42) = 7.0$, $p < 0.001$, $d = 2.12$),

Table 2
Intended consumption and actual consumption in Study 3.

	Males (n = 44)		Females (n = 44)	
	Larger portion condition (n = 21)	Standard portion condition (n = 23)	Larger portion condition (n = 23)	Standard portion condition (n = 21)
Intended consumption (in %)	88.3 (17.6)	81.9 (32.2) = 0.24	50.4 (26.1) ^a	77.6 (28.0) ^a = 1.01
Intended consumption (in kcals)	128.5 (25.6) ^b	51.1 (20.1) ^b = 3.38	73.2 (37.9) ^c	48.5 (17.5) ^c = 0.82
Actual consumption (in %)	76.8 (24.6)	87.8 (22.3) = 0.47	41.0 (23.1)	80.9 (27.7) = 1.57
Actual consumption (in kcals)	111.7 (36.0) ^d	54.8 (13.9) ^d = 2.12	59.5 (33.7)	50.5 (17.4) = 0.33

Values are means (SD in brackets). Same superscript letters denote significant difference ($p < 0.05$) between two cells reported in main text.

Participants were served a large portion of vanilla ice cream (approximately 175 grams, 145 kcals) or a standard portion of ice cream (approximately 75 grams, 62 kcals).

which equated to almost a 100% increase in intake from the standard to larger portion size condition. See Table 2 for means and SDs.

Females

Females in the standard portion size condition and larger portion size condition significantly differed in terms of the percentage of the ice cream portion that they intended to consume ($t(42) = 3.3$, $p = 0.002$, $d = 1.01$). See Table 2. Females in the larger portion size condition intended to consume significantly less of their portion (50.4%) than females in the standard portion condition (77.6%). There was some evidence of a significant pre-consumption portion size effect on intended consumption in calories, as these consumption intentions equated to 73.2 kcals and 48.5 kcals of ice cream in the larger and standard portion size conditions, respectively, which was significantly different ($t(42) = 2.7$, $p = 0.009$, $d = 0.82$). There was no effect of condition on actual consumption in calories ($t(42) = 1.1$, $p = 0.28$, $d = 0.33$), with little difference in ice cream consumption between the two conditions. See Table 2 for consumption means and standard deviations.

Dietary restraint

We explored (post-hoc) whether dietary restraint may account for the gender effects observed for both intended and actual consumption by including dietary restraint scores as a factor in the earlier reported 2×2 ANOVAs. Including dietary restraint as a covariate (or as an additional categorical variable: high vs. low restraint, according to a median split) did not remove the significant (p s remained < 0.05) gender and gender \times condition effects observed for intended or actual consumption of ice cream, suggesting that the observed gender effects are unlikely to be attributable to gender differences in dietary restraint.

Similarity between intended and actual consumption

We also examined similarity between intended consumption (intended % of portion to be consumed) and actual consumption (in % of portion participants ate). In general, participants consumed a similar proportion of the meal as they had intended to; intended and actual consumption percentages did not significantly differ ($t(87) = 1.24$, $p = 0.22$, $d = 0.10$), with the mean difference between intended (74.2%, $SD = 30.4\%$) and actual (71.3%, $SD = 30.0\%$) consumption percentage being small. Moreover, across gender and portion size conditions, the difference between intended percentage and actual percentage consumed was small (see Table 2).

General discussion

Across three studies male participants exhibited evidence of a 'pre-consumption portion size effect'. In Study 1 and Study 2, regardless of being shown either a standard or a larger meal portion size, males consistently reported that they would intend to consume the majority of the meal and this equated to sizeable differences in intended consumption (in kcal) between portion size conditions. In Studies 1 and 2, only intended hypothetical consumption was measured, whilst in Study 3 actual consumption was also measured. In Study 3, prior to eating, regardless of being served a standard or a larger portion size of ice cream, males again reported that they intended to eat the majority of the meal and subsequently did so. A portion size effect on actual consumption was also observed; male participants had a higher energy intake in the larger portion size condition than in the standard portion size condition. Study 3 also examined female participants' intended and actual consumption of a standard versus a larger portion of ice cream. Females exhibited a different pattern of results than males. Females

intended to eat proportionally less of the larger portion of ice cream and although there was a small difference in intended calories between the standard versus larger portion size condition, there was no evidence of a portion size effect on actual energy intake.

The observed results are consistent with the idea that pre-meal planning plays an important role in energy intake (Brunstrom, 2011; Fay et al., 2011). Firstly, in Study 3 we found that participants ate a very similar amount of food to the amount they had intended to. In addition, across all studies we found that the well-replicated portion size effect appeared when measuring pre-meal intended consumption (in kcal). A number of researchers have suggested that a more in depth study of the decision making processes which occur when served larger portions is needed in order to understand underlying mechanisms (e.g. Brunstrom, 2014; Burger et al., 2011; Zlatevska et al., 2014). The present research adopted this approach and our findings suggest that amongst males, the influence of portion size on energy intake may be observed when initially deciding how much of a food portion to eat. One potential interpretation of our findings is, providing that a portion size appears relatively normal in size (as was the case for both the standard and larger portion sizes used in Studies 1 and 2), males may apply a simple rule of thumb and plan to eat the majority of food served at a meal, which in turn leads to larger portion sizes increasing energy intake. Further direct testing of this proposition would now be valuable. Our findings are also in line with recent evidence that drivers of food intake do not solely exert their influence within a meal and may influence meal size before eating has begun (Wilkinson, Hinton, Fay, Rogers, & Brunstrom, 2013). For example, it has recently been shown that participants anticipate the well-replicated 'variety effect' on energy intake when making screen-based portion size selections; specifically, participants indicated that they would eat more food when variety in the meal was systematically increased (Wilkinson et al., 2013).

Unlike male participants, female participants in Study 3 reported that they intended to eat a much smaller percentage of the larger portion of ice cream than the standard portion. Calculated as calories, this produced a small but statistically significant difference in intended consumption between the two portion size conditions. There was no effect of portion size on ice cream intake in females; both conditions consumed a similar amount of ice cream. We had hypothesised that the portion size effect may have been less pronounced in females, as studies to date have tended to show that the effect of larger portions on food intake is weaker in females than males (Zlatevska et al., 2014). However, as studies have shown that portion size can influence the amount of food females eat (Fisher et al., 2007; Kral et al., 2004), the lack of effect of portion size on food intake in females in the present study warrants attention. There are a number of explanations which could account for why a portion size effect was not observed in females. Given that perceptions of a normal sized portion tend to be smaller in females than males (Lewis et al., 2015), the amount provided in the larger portion condition may have been deemed to be too large to be classed as an appropriate or 'normal' portion by females, which in turn could have resulted in them intending to eat only around half of it. Given that we did not measure how appropriate participants perceived the portion sizes to be in Study 3, this suggestion is speculative and now requires formal testing. Alternatively, because males and females ate a similar sized sandwich as a main course during lunch, it could have been that females (but not males) were already satiated prior to consuming the ice cream due to their lower energy requirement and this is why they intended to eat less ice cream.

Portion sizes

In the present studies we used 'standard' portion sizes which were in line with the manufacturer's recommended serving sizes of the

foods used (standard portion size conditions) and in the larger portion size conditions, these standard serving sizes were increased by 50% (Study 1 and Study 2) and 133% (Study 3). These manipulations resulted in sizeable differences in energy content between portion size conditions, but it is unlikely that the larger portion sizes provided in these studies could be perceived as being inappropriately large (as data from Studies 1 and 2 suggested). Although we can conclude that there was evidence of a portion size effect on intended consumption for the portion sizes used in the present study, it is plausible that such an effect may be reduced or removed if very large inappropriate portion sizes of food were to be used. Given that there is now evidence that the effect increasing portion size has on food consumption becomes non-linear once a portion size is already large (Zlatevska et al., 2014), it may be the case that portion size effects on intended consumption display a similar pattern. Thus, we tentatively hypothesise that portion size effects on intended consumption are likely to be observed only when meal portions are deemed to appear relatively 'normal' or appropriate in size.

Limitations and future directions

As the portion size effect has been well replicated amongst males (Burger et al., 2011; Rolls et al., 2002) and has recently been suggested to be stronger in males than in females (Zlatevska et al., 2014), mainly males participated in these studies. Although given the consistency of findings in Studies 1 and 2, we decided to explore possible gender differences when designing Study 3. This is a limitation of the present research because we cannot make generalisations or strong conclusions concerning females. Given that the primary aim of the present studies was to examine pre-meal intended consumption, it was deemed necessary to ask participants about how much they intended to eat prior to consumption in Study 3, rather than afterwards. This was because of concerns over the persuasive nature of hindsight bias (Roese & Vohs, 2012). However, asking participants to rate their intended consumption prior to eating could have caused some participants to report a socially desirable intended consumption amount and therefore affected eating behaviour, so caution is needed in the interpretation of Study 3. In addition, such instructions could have in theory led some participants to believe that consuming all of the ice cream was inappropriate. Thus, it would now be interesting to specifically examine whether this type of instruction has any effect on the amount of food participants consume.

In the present studies we also opted to use a between-subjects design, as opposed to a within-subjects design (i.e. asking the same participant to rate intended consumption for different sized portions). We opted for this approach because when dining in the real world, consumers would normally be provided with a single serving size. However, it seems plausible that participants would be more likely to adjust their intentions if shown different sized portions of the same food (within-subjects). Therefore, it may be the case that the consistent effects of portion size we observed on intended energy consumption would have been weaker if we had used a within-subjects design in our studies. A final limitation is that it is unclear whether the present findings will apply to free living conditions, as well as other food and meal types. Although it should be noted that some effort was made to address this, two types of main meal were examined and a dessert.

Conclusions

The portion size-effect may be observed when measuring pre-meal intended consumption in males. Further work examining the role of pre-consumption decision making in explaining the influence that portion size has on energy intake is now warranted.

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