



# **Overweight and obesity- portion....size matters!**

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# Presentation overview

- Background - Definitions & trends in portion size
- Portion size and energy intake - the evidence
- We eat with our eyes.....
- Double trouble: big portions of energy dense foods
- ....in the eyes of the consumer
- ....the missing gaps

# Terminology

- **Portion size (PS)**

The amount of food/beverage intended to be consumed in a single eating occasion (g/ml)

- **Serving size (SS)**

The amount of food/beverage recommended to be consumed in a single eating occasion (g/ml)<sup>1</sup>

- used for dietary guidance purposes

# Portion Distortion

What you're served



1/2 lb. cheeseburger, French fries, 3/4 cup ketchup, tomato slice and lettuce.  
**1,345 calories**  
**53 grams fat**

What's one serving



1/4 lb. cheeseburger, half the French fries, 2 tablespoons ketchup, tomato slice and lettuce.  
**685 calories**  
**33 grams fat**



The Chicago Partnership for Health Promotion is funded by the USDA Food Stamp Program. The University of Illinois at Chicago Neighborhoods Initiative is the Lead Grant Administrative Hub for CPHP. The USDA, UIC

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# Super Size Me: How the Last Supper became a banquet over 1,000 years



- Wansink & Wansink, 2010
- Computer aided design analysis of 52 paintings of the Last Supper
- Over the past millennium
  - main dish ↑69%
  - plates ↑66%
  - bread ↑23%



# Portion Size: Then vs Now

- Best documented in the US → since the 1970's portion sizes (PS) especially of high energy dense foods have been increasing (out-of-home and in-home eating)
- NB: **Frequency** of eating has also increased (Duffey & Popkin, 2011)
- Paucity of trend data in:
  - Europe (Denmark, Netherland, UK)
  - Australia

# Portion Distortion in USA

## Portion *Distortion*

20 YEARS AGO	TODAY	DIFFERENCE	20 YEARS AGO	TODAY	DIFFERENCE
 <p><b>333 Calories</b></p> <p>Lifting weights for <b>1 HOUR AND 30 MINUTES</b> burns approximately 257 calories* <i>*Based on 130-pound person</i></p>	 <p><b>590 Calories</b></p>	<p><b>257 MORE CALORIES</b></p>	 <p><b>45 Calories</b></p> <p>Walking <b>1 HOUR AND 20 MINUTES</b> burns approximately 305 calories* <i>*Based on 130-pound person</i></p>	 <p><b>350 Calories</b></p>	<p><b>305 MORE CALORIES</b></p>
 <p><b>500 Calories</b></p> <p>Playing golf (while walking and carrying your clubs) for <b>1 HOUR</b> burns approximately 350 calories* <i>*Based on 160-pound person</i></p>	 <p><b>850 Calories</b></p>	<p><b>350 MORE CALORIES</b></p>	 <p><b>210 Calories</b></p> <p>Vacuuming for <b>1 HOUR AND 30 MINUTES</b> burns approximately 290 calories* <i>*Based on 130-pound person</i></p>	 <p><b>500 Calories</b></p>	<p><b>290 MORE CALORIES</b></p>
 <p><b>500 Calories</b></p> <p>Housecleaning for <b>2 HOURS AND 35 MINUTES</b> burns approximately 525 calories* <i>*Based on 130-pound person</i></p>	 <p><b>1,025 Calories</b></p>	<p><b>525 MORE CALORIES</b></p>	 <p><b>55 Calories</b></p> <p>Washing a car for <b>1 HOUR AND 15 MINUTES</b> burns approximately 220 calories* <i>*Based on 130-pound person</i></p>	 <p><b>275 Calories</b></p>	<p><b>220 MORE CALORIES</b></p>

# UK Portion Sizes: 1990's vs Now

- No simple increase in PS over time.....much depends on the food item
- **Within** product categories → wide range of PS, but few consistent trends
- PS of many traditional products have remained fairly constant (notable exception: ready made meals + white sliced bread)
- Both **smaller** (multipacks) and **larger** pack sizes (share-type packs) now available for many products
  - e.g. chocolate confectionery; savoury snacks; crisps

NB: Perception that PS in the UK have widely increased **vs** reality

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# Does portion size matter?

If the amount eaten was determined only by:

- **internal satiation** (amount eaten in one meal)  
and
- **satiety mechanisms** (the effect on subsequent meals)

→ portion sizes of foods served should not affect energy intake

## .....but in practice

- Intervention studies (laboratory and more naturalistic settings) show that people eat more when they confronted with larger portion sizes:
  - at single eating occasions
- **In general** people tend to eat proportionately more as PS increases:
  - PS ↑ 25-100% → EI ↑ 10-25%
- But are the effects sustained over time?

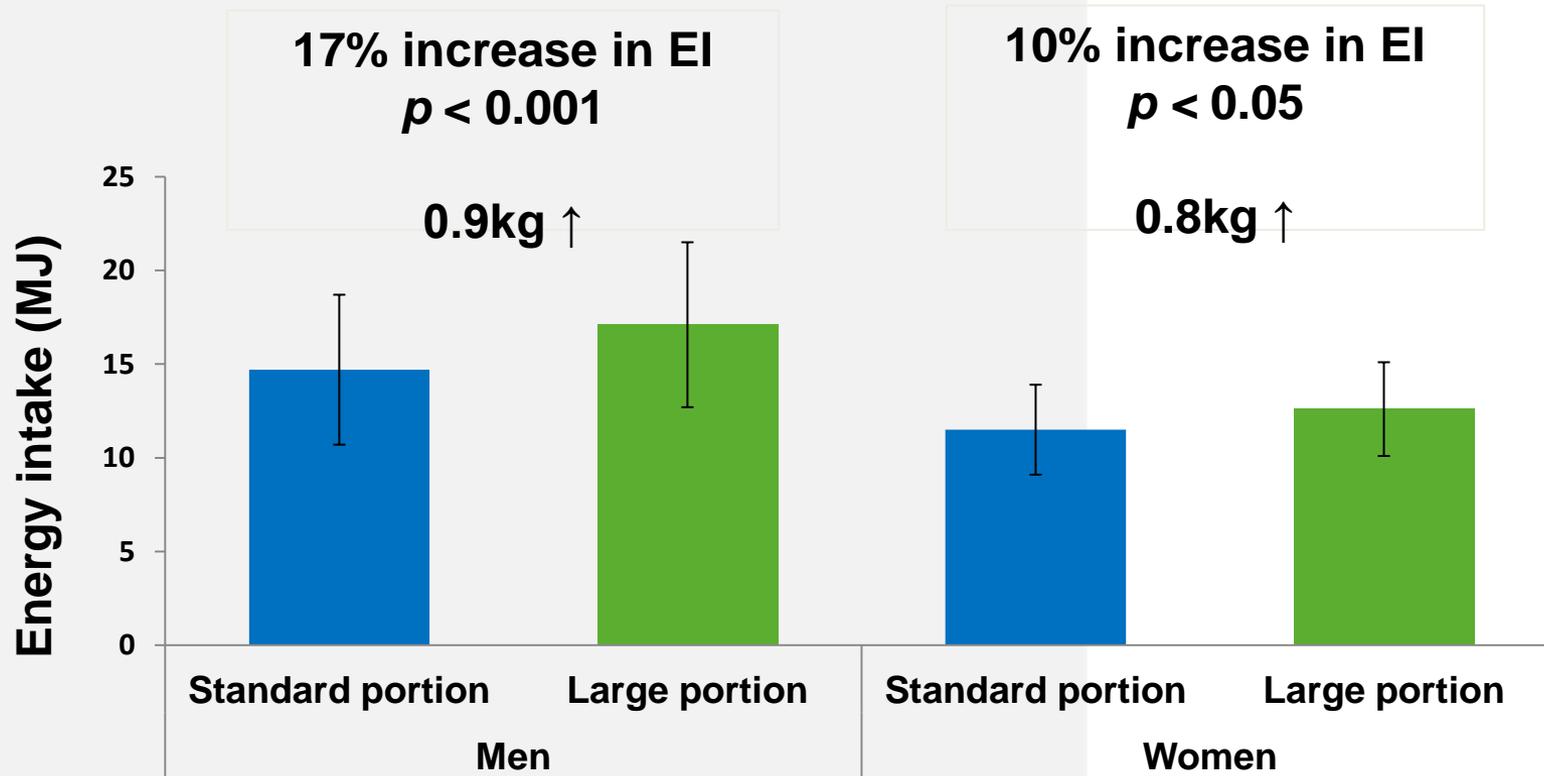


# Investigation of the contribution made by food portion size to food and energy intake

- Food Standards Agency
- Fully residential
- Randomised within subject cross-over design
- n=43 normal weight subjects
- 2 x 4d (same foods and beverages served)
- Standard vs large PS

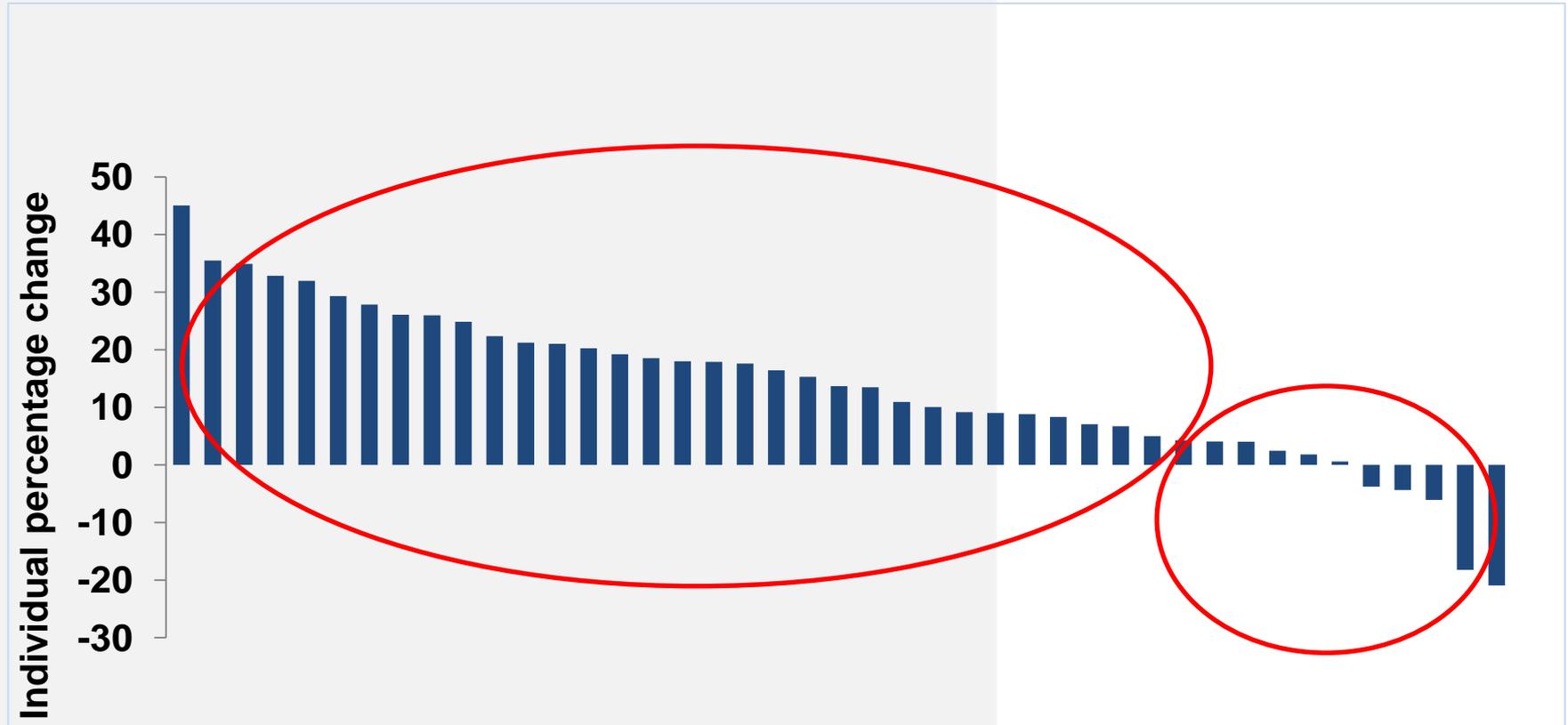
Kelly et al. *Br J Nutr.* 2009; 102(3):470-7.





**Mean (SD) daily energy intake on each portion condition**

# Individual (%) change in energy intake between standard and large portion conditions



# How did subjects rate their appetite?

**BEFORE** eating under the **LARGE** PS condition subjects reported feeling:

- less hungry
- more full
- having less “desire” to eat
- they could eat a smaller amount

**BUT**

- they consumed more food when it was presented to them
- did not report feeling any fuller as a result !!

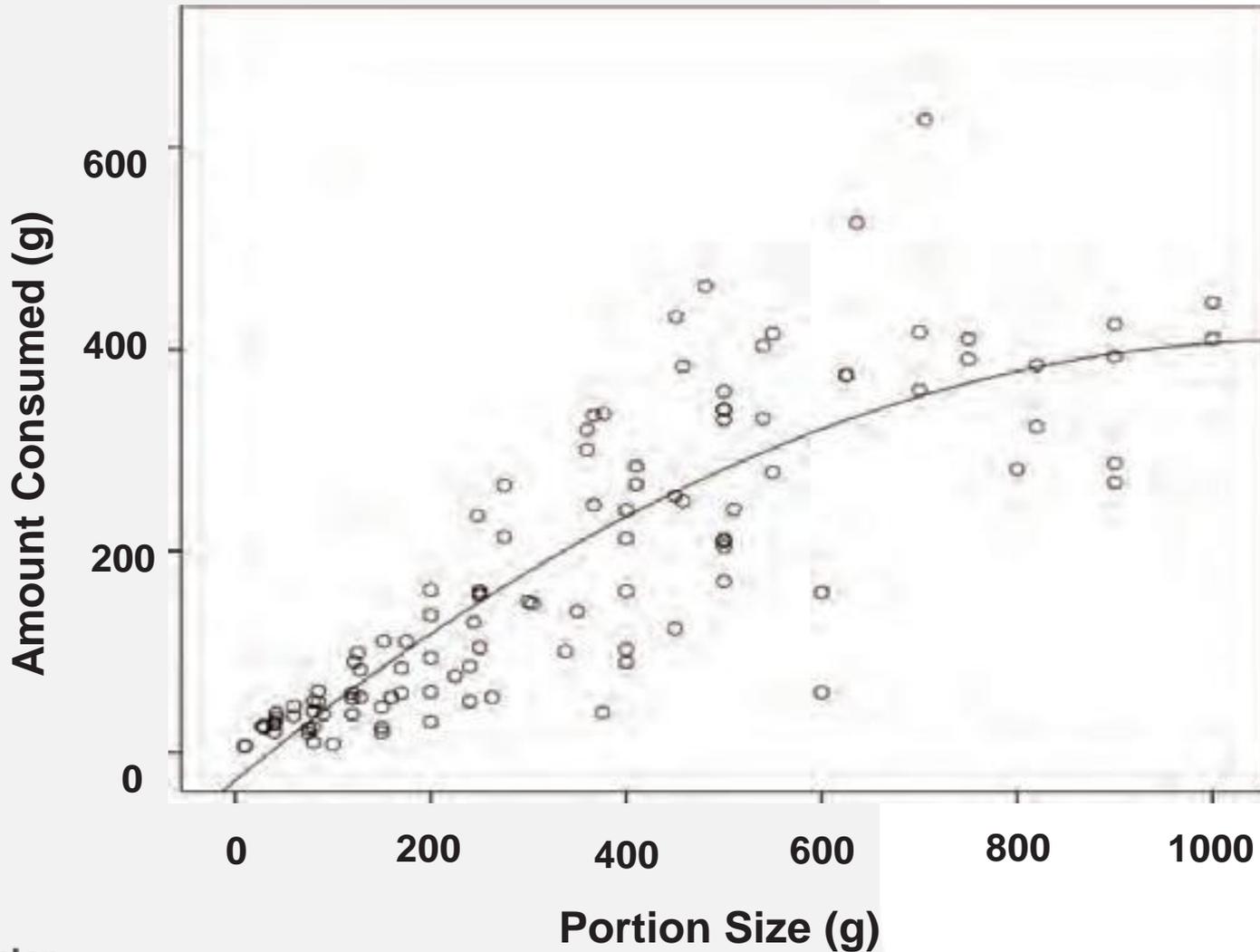
## ....in summary

- Effects of PS are robust and sustained over several days (2-11d) (Rolls *et al*, 2006, 2007; Kelly *et al*, 2009 ; French *et al*, 2014)
- No indication of meal-to-meal compensatory reduction in food intake
- **Single meal** studies – subjects were unaware of their extra energy intake → they do NOT report feeling fuller after eating significantly more food
- **Multi-day** studies → subjects report feeling fuller BUT do not respond by eating less at subsequent meals

### .....conclusion

- Biological satiety signals (in many consumers) are readily over-ridden in the presence of large PS

# Are there limits to the effects of PS on consumption?



# .....PS effects have been observed with

- amorphous food (e.g.) pasta
- packaged and unpackaged snacks
- beverages
- .....even stale popcorn !
- ...and is particularly pronounced with energy dense food .....more later!



# ....overeating in response to large portions occurs irrespective of:

- Weight status
- Socio-economic status
- Sex
- Age
- Degree of:
  - dietary restraint
  - disinhibited eating behaviour



## ....on the other hand

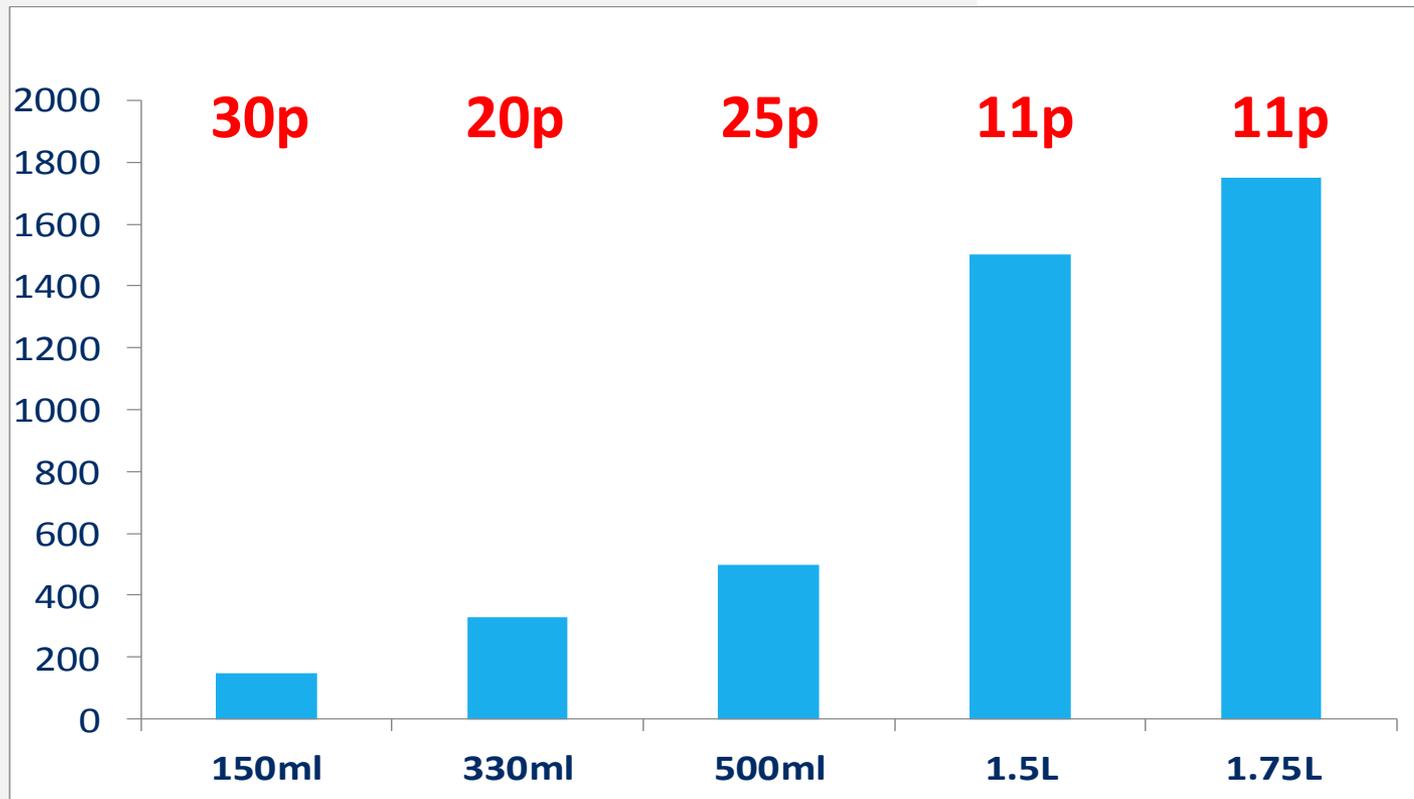
- Smaller portion sizes  
(Freedman & Brochado 2010; Rolls *et al.* 2006)
  - Single serve packets  
(Raynor *et al.* 2009)
  - Calorie controlled portions  
(Stroebele *et al.* 2009; Wansink *et al.* 2011)
- reduced (short term) energy intake



# Increased portion size may be inciting over-eating because:

- (Relatively) cheap for food industries to provide
- Larger portions are seen as “value for money”
- Chronic exposure to larger PS → distorted perception of what is an appropriate serving size
- Consumers have trouble accurately estimating appropriate serving sizes (for their weight and activity level)

# Value-sized pricing (per 100 ml)



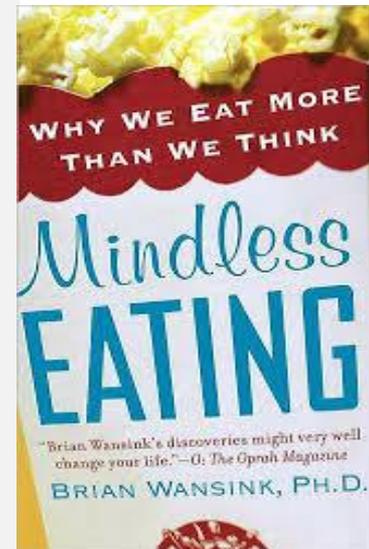


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# We eat with our eyes....not our stomachs!

- Package size
- Plate/serving bowl size
- Nutrition labelling

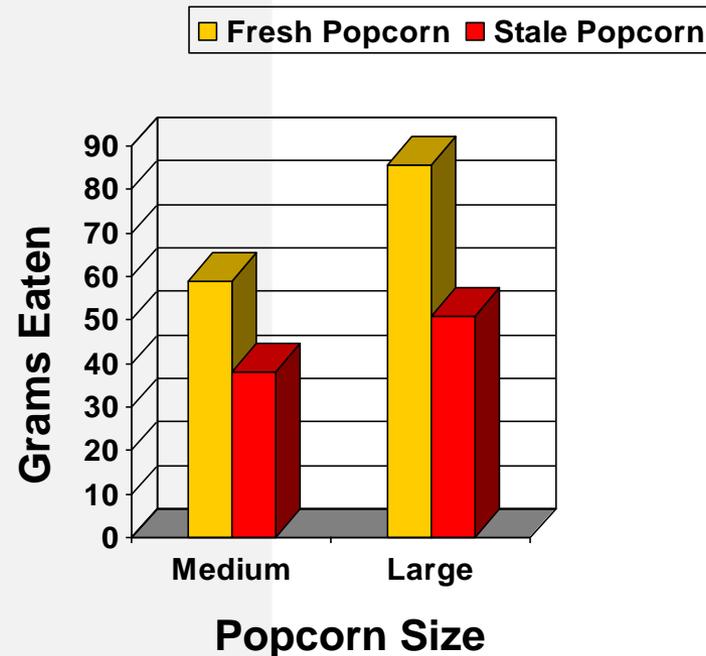


# We Really Do Eat with Our Eyes, Not Our Stomachs

Moviegoers given fresh popcorn ate 45.3% more from large containers.



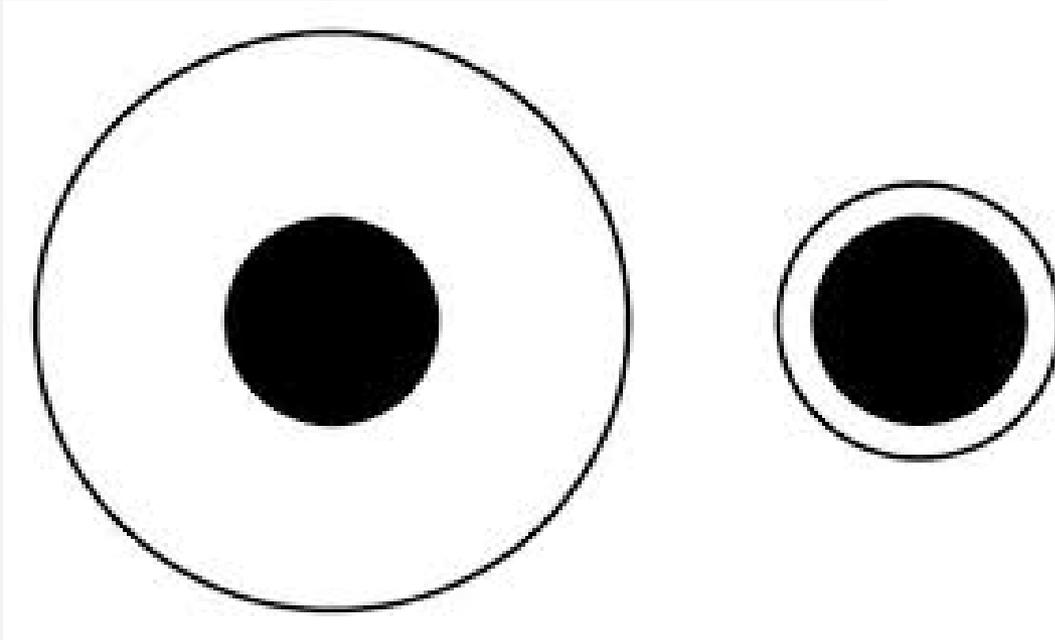
Moviegoers given STALE popcorn still ate 33.6% more from large containers.



# Which plate contains the most food?



# Delboeuf illusion....



Both black circles are the same size...but the illusion leads people to think that the one on the right looks bigger because its outside circle is only slightly bigger

# Ice cream illusions.....

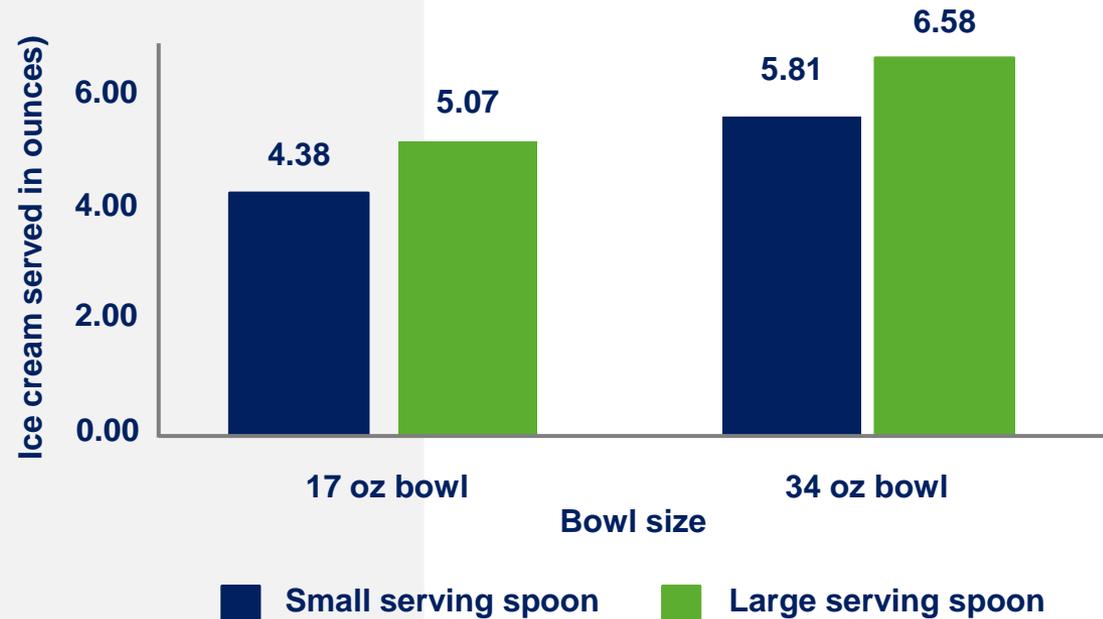
2 x 2 between subject design

85 nutritionists

Larger bowl: ↑ 31%

Larger serving scoop:

↑ 14.5%



# Nutrition labelling....unintended consequences?

- n=47 adults
- Identical lunch meal on 3 separate days
- Different information on energy/fat content
- Food intake sig. increased on low energy/low fat information day
- Could the perceived “healthiness” of foods (inferred by nutritional labelling) have unintended consequences → a license to overeat?

THIS MEAL PROVIDES			
CALORIES <b>668</b>	FAT <b>19.9g</b>	SAT FAT <b>5g</b>	SALT <b>1.5g</b>
33%	28%	25%	25%
OF YOUR GUIDELINE DAILY AMOUNT			

THIS MEAL PROVIDES			
CALORIES <b>334</b>	FAT <b>10g</b>	SAT FAT <b>3.8g</b>	SALT <b>1g</b>
17%	14%	19%	17%
OF YOUR GUIDELINE DAILY AMOUNT			

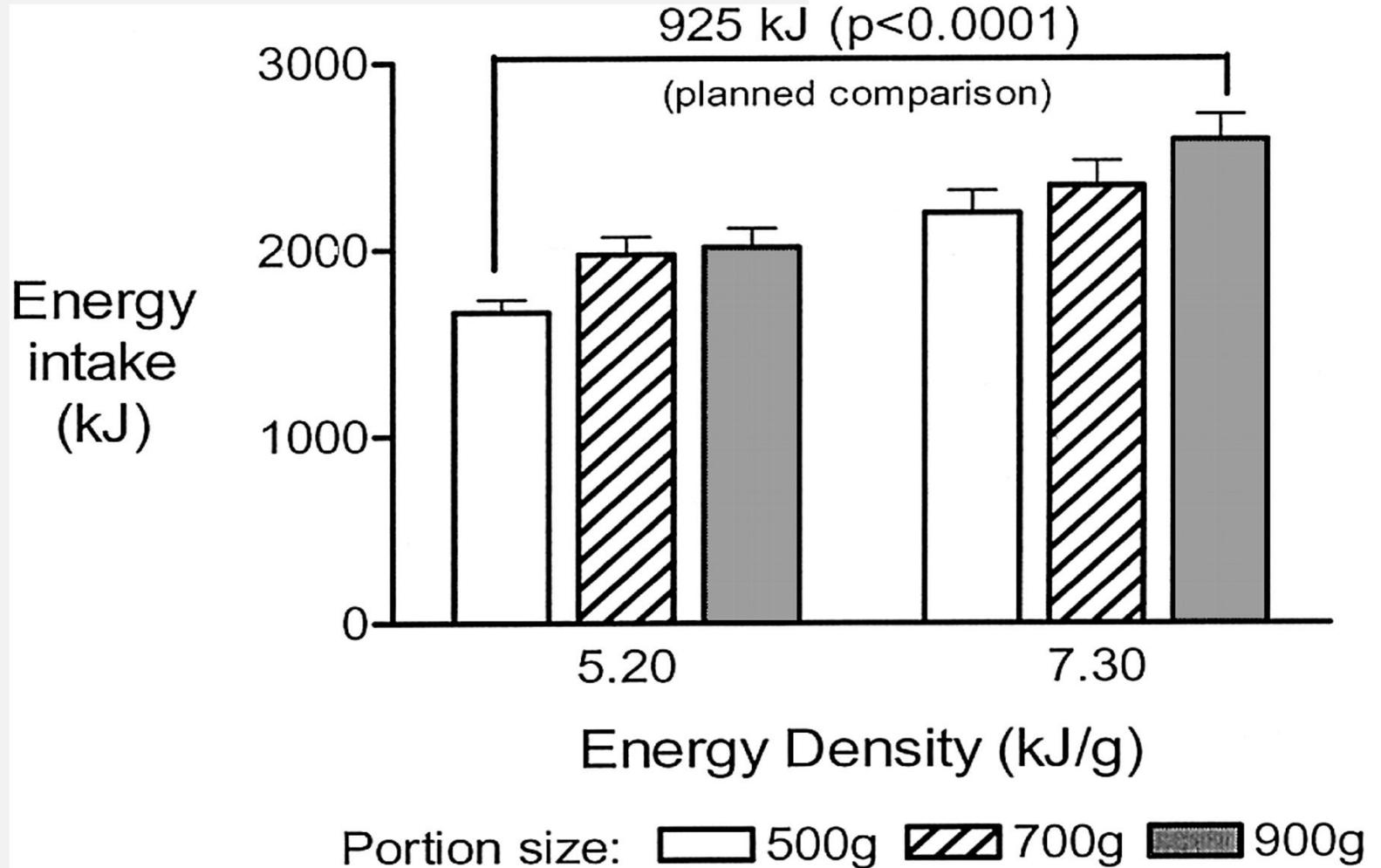
THIS MEAL PROVIDES			
CALORIES <b>1002</b>	FAT <b>58.8g</b>	SAT FAT <b>20.4g</b>	SALT <b>3g</b>
50%	84%	>100%	50%
OF YOUR GUIDELINE DAILY AMOUNT			

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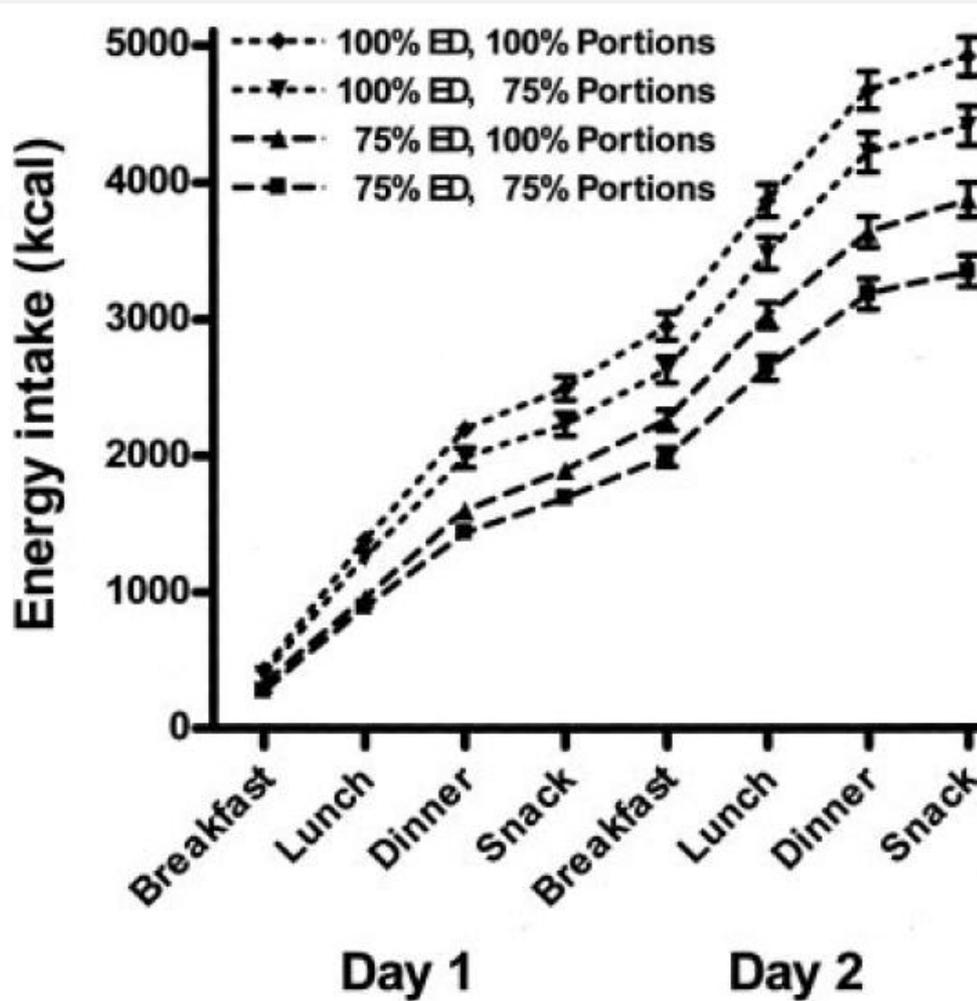
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# Energy intakes (mean SEM) for women (n = 39) by energy density and portion size

JN THE JOURNAL OF NUTRITION



# Portion size & energy density: additive effects



32% sustained decrease in EI  
( $P < 0.0001$ )

24 females; 19-35y  
BMI 18-32kg/m<sup>2</sup>

25% ↓ in PS = 10% ↓ EI

25% ↓ in ED = 24% ↓ EI

# ....implications

- Effects of energy density and portion size **combine** to influence energy intake
- BUT the influence of **energy density** is more robust than **portion size**
- Subjects were more likely to notice changes in portion size than energy density
- Telling consumers to simply “eat less” is unlikely to be effective
- It is not just **large portions** that stimulate over-consumption → rather **large portions of energy dense food**

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- Future research agenda

# Barriers to appropriate portion size control



- 66 Irish adults: 10 focus groups
- **SEVEN** key inter-connected barriers to appropriate portion size control:

## 1. Lack of clarity and irrelevance of suggested serving size guidance

*“30 g of cereal.....that’s like, for a guinea pig! But who is the serving for? You don’t know if it’s for a small petite lady or is it for us lads who play rugby? That can be wrong so how do you judge by that”*

## 2. Guiltless eating

*“ if it’s healthy, I can eat more”*

# Barriers to appropriate portion size control



## 3. Lack of self-control over food cues

*“ I live on my own so like there are a lot of things that you’d buy are designed for two people. Do you know what I mean? And then you’d end up eating three-quarters of it or, probably the whole pack”*

## 4. Distracted eating

*“ I think as well, if you’re having a night in, like a DVD with friends and bowls of popcorn and sweets, no-one’s thinking about portion sizes. It’s kind of spoiling yourself you know”*

## 5. Social pressure

*“ or when you’re there like, eating Chinese food and then you don’t feel like anymore. And then there’s a man aspect comes in....someone’s says ‘finish that you fairy!’”*

# Barriers to appropriate portion size control:

## 6. Emotional eating rewards

*“Well if I’m bored, or if I’m having a really bad day, I’m like right give me the chips and dip - I’m eating the whole bag! So whereas if I was in a good mood and I thought I was being good and active on that day, I wouldn’t eat as much”*

## 7. Portion size habits ingrained from childhood

*“ But I think that’s [portion sizes] set by even your upbringing, because my husband doesn’t eat so much because he was never given large portions but I would eat more because we were obviously given bigger portions when we were young”*

## .... (Some of the) key communication challenges

- Conclusion → PS advice is not well used because it is seen as unrealistic, irrelevant and lacking credibility
- Distorted consumption norms and perceptions
- Unwillingness to compromise on value-for-money, taste and convenience.
- Perceptions that the PS concept is only relevant to dieters and those with special dietary needs
- Poor ability to estimate how much is consumed (particularly large PS)
- PS consumption norms and expectations vary with eating context, e.g. eating out-of-home, snacks, “shared foods”, indulgent foods, “healthy options”
- Distrust the motives of any food industry initiatives in the area of PS



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# ..... The missing gaps

Limited(short-term) data on the impact of smaller PS on appetite and subsequent food intake

Pre-portioned foods (PPF):

- Scarcity of evidence in relation to their impact on overall intake (adults and children)
- Are PPF the optimum mechanic to help consumers manage intake?



# ..... The missing gaps

## Pre-portioned foods (ctd)

- “Tipping points” – will reduction beyond a particular PS lead to consumption of multiple units? Are there differences between food categories?
- Promotional dynamics: understanding how consumers use foods purchased from promotions.
- Proportional pricing: the influence of PS vs consumer perception of value. Can consumers be influenced to buy smaller PS if priced competitively?

# ..... The missing gaps

## Consumer understanding of PS

- Identifying and promoting best practice communications for managing PS
- Identification of the most effective and accessible PS estimation aids/mechanisms that will resonate with consumers

## Behavioural aspects of consumption

- Better understanding of consumer motivations and drivers of portion size choice in a variety of eating contexts
  - to ensure that any guidance on PS control is not naively based on “one size fits all ”