Moving towards healthier food portion sizes

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Introduction of large portions coincides with the increase in overweight and obesity

Courtesy of B. Rolls

US children and adults eat more than 30 years ago

- Consume larger food portions
  - Most food categories, particularly beverages
  - Away and at home

- Eat more frequently
  - Snacking frequency and size
  - Desserts, salty snacks, candies, sweetened beverages

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Portion size affects intake in adults

Hunger and fullness ratings did not differ

Rolls, Morris & Roe, AJCN, 2002
Portion size affects intake in children

**Reference**

- Increased food intake by 25-60%
- Inadequate compensation from other foods
- Increased energy intake at the meal by 13-39%

**Large (2-2.5X)**

Portion size acts additively with energy density to promote energy intake at meals

LS means (±SEM); different letters signify mean differences, p<0.01.

Fisher, Liu, Birch, Rolls, AJCN, 2007
Adults take larger bites of larger portions

- 2 x 2 design with 30 adults (37 ± 11 y), 14 of whom were overweight (BMI ≥ 25)

With and without blindfolding:

- Burger, Cornier, Johnson, *Presented at TOS Annual Meeting, 2009*

* P < 0.05
Children take larger spoonfuls when more food is available

- 63 children aged 4-6 y seen at a timed dinner meal
- Given 275 g or 550 g of pasta entrée in serving bowl

Covariates: Child gender, ethnicity/race, ate < 2hr before meal, maternal employment, child feeding style, social grouping
**Amorphous Entrées**
Engell et al., 1995
Rolls et al., 2000
Fisher et al., 2003
Rolls et al., 2004
Kral et al., 2004
Fisher, 2007

**Unit Foods**
Rolls et al., 2004
Geier, Rozin, Doros, 2006
Fisher et al., 2007

**Beverages**
Flood et al., 2006
Rolls, Roe, Meengs, 2007

**Snacks**
Rolls et al., 2004
Raynor et al., 2007
Wansink et al., 2001
Wansink et al., 2005

**Fruits and Vegetables**
Rolls, Roe, Meengs, 2004
Rolls et al., 2010
Mathias et al., 2009
Kral et al., 2010
Rolls et al., 2010

**Naturalistic settings**
Fisher et al., 2003
Dilberti et al., 2004
Wansink et al., 2001
Wansink et al., 2005
Do effects of portion size persist over 11 days when all foods are varied?

Courtesy of B. Rolls
The effect of portion size on intake was sustained for 11 days.

Cumulative energy intake (kcal)

Study day

150% portions
100% portions

4928 kcal

Courtesy of B. Rolls

Rolls, Roe, Meengs, *Obesity*, 2007
Larger portion sizes selected/eaten by heavier adults$^{1-4}$

- 3610 Swedish adults, 25-74 y$^3$:  
  - 13% increased obesity risk for each increase in typical portion size

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Experimental studies: Who is most likely to overeat?

Weak to no evidence:

- Weight
- Ethnicity
- Education
- Income
- Restraint, disinhibition
- Age
- Gender


Adult: Rolls et al, AJCN, 2000; Rolls et al, JADA, 2004; Flood, Roe, Rolls, JADA, 2006; Rolls et al., JADA, 2006; Rolls, Roe, Meengs, Obesity, 2007
Children’s portion size preferences shaped by psychosocial factors

4,966 5th grade children shown 3-D portion size models:

- Less parental education
  - Prefer larger portions
  - Greater energy intake
  - Fewer fruit/veg
  - Overweight

- More frequent fast food
  - Prefer larger portions
  - Lower energy intake
  - Greater fruit/veg

- More parental education
  - Prefer larger portions

- Less frequent fast food

Colapinto et al. JADA, 2007
Challenges to & potential strategies for healthful portions
Portion size norms are inflated

Survey of 300 chefs:

76% of chefs surveyed:

Larger plates and portions by chefs <51 years

We serve “regular” portions

Actually served:

83% exceeded USDA standard

90% exceeded USDA standard

Condrasky Ledikwe, Flood, Rolls, Obesity, 2007
Large portions = the better “value”

Roast Beef Sandwich
(white bread, lettuce, onions, tomato, & mayo)

Half sandwich = 267 calories  56 kcal per $
Whole sandwich = 534 calories  92 kcal per $

Better Value!

Consumer education on portion size is difficult to understand

- NHANES (05-06): 47.2% of Americans use serving size information
  - Users consume less energy, fat, sugar

**BUT:**
- Difficult to interpret
  - Particularly for low-literacy and numeracy consumers

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1. Ollberding, Wolf, Content, *JADA*, 2010
Self-control may not be enough

Size-related eating cues:
- Large portions sizes
- Large dishware
- Unit bias

Lowe, *Obesity*, 2003
Technology opportunities

Proportional pricing
Front of pack labeling
Reduce energy density

Large portions = more value
Portion distortion
Select or serve large portion
Passive overconsumption
Intake

Large portions standard
Large marketplace portions
Unclear labeling
Unit Bias
Tableware

Offer wider range of sizes
Decrease portions
Labeling
Point of purchase
Portion controlled packaging

How can we intervene?

Adapted from: Steinhuis, Vermmer, IJBNPA, 2009
Improving consumer education\(^1\)

- Food labels that give guidance\(^2,3\)
  - Greater emphasis on nutrition facts panel
  - Front-of-label guidance

- Point-of-purchase information
  - Calorie information
  - Portion size education
    - Facts
    - Strategies

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\(^1\) Ello-Martin, Ledikwe, Rolls, *AJCN*, 2005
\(^2\) Kessler et al., Developing the Food Label, 2003
\(^3\) Lupton et al., *AJCN*, 2010
Beyond numbers: using visual aids to convey portion size

- Portion size aids can improve estimation
- Lack of standard definition
- Challenging for low-literacy populations
  - Require abstract reasoning

1 Byrd-Brendbenner, Schwartz, J Hum Nutr Diet, 2004
2 Ball, Friedman, Canadian J Diet Prac Res, 2010
3 Jae, Develcchio, J Consum Affairs, 2004

Photo credits: blogs.phillymag.com; foodnetwork.com
Improving consumer education with visual aids

- Contextually referenced visual information
- Minimal cognitive demands
Environment: Targeting size-related cues

- Self-served portion sizes influenced by:
  - Packaging size\(^1\)
  - Dish/glass/bowl size\(^2-5\)
  - Size of unit foods\(^6\)
  - Effects on intake not as clear\(^7,8\)

Environmental: Smaller units

- Success stories
  - Single-serving, portion controlled foods aid weight loss\(^1,2,3\)
  - 100kcal snack packs reduce daily energy among frequent snackers\(^3\)

- How to broaden the appeal?
  - Value in weight loss vs. maintenance
  - “Right size” snacks for kids?

\textit{Consumer Reports Magazine (2008)}: “If you can buy snacks in their regular packages and use an ounce of willpower, your wallet will stay fatter.”

\(^1\) Jeffery et al., \textit{J Consult Clin Psych}, 1993
\(^2\) Hannum et al., \textit{Obesity}, 2004
\(^3\) Raynor et al. \textit{JADA}, 2009
\(^4\) Stroebele et al, \textit{Appetite}, 2009
Other types of unit reductions

- Segmented packaging
  - Separate servings in multi-serve packages
  - Separate multiple servings in single serve packages

- Reductions to the size of unit foods

1 Vermeer, Bruins, Steenhuis, *Appetite*, 2010
Environment: Reducing energy-density

- Product formulation, recipe preparation
- Increase portion sizes options of low ED foods
- Increase proportion of low energy-dense foods

Vegetable energy density 0.4 or 0.8 kcal/g

25% Vegetable
38% Grain
38% Meat

38% Vegetable
31% Grain
31% Meat

50% Vegetable
25% Grain
25% Meat

Rolls, Roe & Meengs, AJCN, 2010

Courtesy of B. Rolls
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Select or serve large portion

Passive overconsumption

Intake

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- Large marketplace portions
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- Tableware

Offer wider range of sizes

Decrease portions

Labeling

Point of purchase

Portion controlled packaging

Steinhuis, Vermmer, *IJBNPA*, 2009
What do real people think will work?

Merchant¹ & consumer perspectives²

Technology opportunities

- Proportional pricing
- Labeling
- Reduce energy density
- Offer wider range of sizes
- Decrease portions
- Point of purchase
- Portion controlled packaging

²:49 participants in 8 focus groups; Vermeer, Steenhuis, Seidell, *Health Educ Res*, 2010
What do real people think will work?

*Merchant*¹ & consumer perspectives²

**Technology opportunities**

- **Proportional pricing**
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PP: Rarely used, concerns about profit
Consumer: Fair, not pushed to consume

²: 49 participants in 8 focus groups; Vermeer, Steenhuis, Seidell, *Health Educ Res*, 2010
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*Merchant*¹ & consumer perspectives²

**Technology opportunities**
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- **Point of purchase**
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**PP:** Value of information, but difficult to define  
**Consumer:** Readable, visible presentation

²:49 participants in 8 focus groups; Vermeer, Steenhuis, Seidell, *Health Educ Res*, 2010
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Merchant¹ & consumer perspectives²

Technology opportunities

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PP: Cited as a potential strategy to address value
Consumer: Cited importance of value in purchasing

¹: 22 representatives of point-of-purchase settings; Vermeer, Steenhuis, Seidell, Health Policy, 2009
²: 49 participants in 8 focus groups; Vermeer, Steenhuis, Seidell, Health Educ Res, 2010
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**PP:** Suggested divisible portions, doggie bags as strategies  
**Consumer:** Cited difficulty of self-control

²: 49 participants in 8 focus groups; Vermeer, Steenhuis, Seidell, *Health Educ Res*, 2010
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PP: Patronizing, bad service
Consumer: Healthful, but limits freedom

²: 49 participants in 8 focus groups; Vermeer, Steenhuis, Seidell, *Health Educ Res*, 2010
What do real people think will work?

Merchant\textsuperscript{1} & consumer perspectives\textsuperscript{2}

Technology opportunities

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PP: Meets demands, but requires shelf space
Consumer: Choice, less waste, less paternalistic

\textsuperscript{1}:22 representatives of point-of-purchase settings; Vermeer, Steenhuis, Seidell, \textit{Health Policy}, 2009
\textsuperscript{2}:49 participants in 8 focus groups; Vermeer, Steenhuis, Seidell, \textit{Health Educ Res}, 2010
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²: 49 participants in 8 focus groups; Vermeer, Steenhuis, Seidell, *Health Educ Res*, 2010
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