Nudging and sustainable changes towards healthier food choice

Nathalie Martin

Consumer Science & Applied Nutrition, Nestlé Research Center, Lausanne, Switzerland

ILSI Europe Annual Symposium
27 March 2018, Brussels.
Strategies to change dietary behaviors

TRADITIONAL POLICY STRATEGIES
→ education
→ bans, economic incentives

BEHAVIORAL STRATEGIES
→ conscious
→ unconscious
Strategies to change dietary behaviors

TRADITIONAL POLICY STRATEGIES
→ education
→ bans, economic incentives

BEHAVIORAL STRATEGIES
→ conscious
→ unconscious
Thirty-two evidence-based behavioural strategies to control the amount of food consumed and self-reported use for each strategy of the study populations involved.

1. When grocery shopping, make a list in advance and do not deviate from it when you are in the supermarket. Do not be tempted by special deals and offers (bundle promotions such as buy-two-get-$1-off or buy-one-get-one-free).
2. Don't buy jumbo-sized packages (e.g., 30% extra or the largest package) and do not buy large quantities at once.
3. Don't taste free samples at shops.
4. Don't consume the total amount of a package or container of food but determine the amount of a 'normal' serving size to eat.
5. When preparing a meal, decide what a normal serving size of the ingredients per person is beforehand. Don't use the whole package automatically, but take the number of people who will be eating into account.
6. Just serve yourself once/only have one serving.
7. Decide on the amount of food you will serve and limit the total amount.
8. Eliminate the frequent purchase of tempting foods (sweets and/or snacks), but buy such foods occasionally.
9. Don't buy tempting foods (sweets and/or snacks) for events in the future or unexpected occasions (e.g., visitors) that you will be tempted to eat.
10. Store tempting foods (such as sweets and candies) well packaged, out of sight and out of reach.
11. Don't store (tempting) foods in several places such as in the glove compartment of the car or the desk drawer at work. Keep these places snack-free!
12. Don't eat or put food in your mouth because it is 'just there' or because you passed by.
13. Don't eat directly from the refrigerator or pantry.
14. When preparing a meal, don't snack on the ingredients.
15. When making a sandwich, don't snack on the ingredients.
16. When getting a soda or juice, don't drink out of the glass when you pour a glass.
17. When eating palatable and tempting foods, determine a normal serving in advance and store the rest of the package out of sight and reach.
18. When at a party put yourself out of reach of tempting foods.
19. Don't keep the leftovers of the appetizer (e.g., bread, and snacks) on the table during the main course but clear away these foods.
20. Do not keep the leftovers of the main dish on the table after you've finished eating.
21. When having dinner, serve yourself in the kitchen and avoid dishes, sauces or bottled drinks at the dining table. Only put healthy foods such as salads, vegetables or a carafe of water on the dining table.
22. Make it a habit to leave something on your plate when you stop eating.
23. Control your food consumption by limiting your daily intake to the main meals and restricting the moments you will eat in between to a maximum of three times a day.
24. Avoid other activities such as watching television, reading or driving a car when eating.
25. Avoid eating during work-related activities such as meetings, working at your desk or making telephone calls.
26. Take your time when eating your meal.
27. Notice when you are satisfied and if so, stop eating.
28. Stop eating when you have had enough/are satisfied, even if you have not cleared your plate.
29. When eating out or ordering takeaway food, decide in advance the serving size to eat. Often the portions of these foods are too much for one person.
30. When eating out, only order a maximum of two dishes or share one or more dishes with someone else.
31. When there is a choice of portion size, pick the smallest one.
32. When going to a buffet, serve yourself small amounts of the dishes. Take into account that the total amount you are taking should fit on one plate.
Strategies to change dietary behaviors

TRADITIONAL POLICY STRATEGIES
→ education
→ bans, economic incentives

BEHAVIORAL STRATEGIES
→ conscious
→ unconscious
General increase in portion size

Large portions introduced by decade; bars display midpoint Year.

Number of large-size portions introduced:
- 1965: 1
- 1975: 1
- 1985: 2
- 1995: 3
- 2005: 5

Young & Nestlé, 2012

US and UK posters illustrating changes in portion, package, and tableware sizes since the 1950s.

INCREASES IN PORTION SIZES

1993 → NOW

STEAK AND KIDNEY PIE (short crust, individual):
- 1993: 160g, 425kcal
- NOW: 240g, 640kcal
50% INCREASE

SLICE OF WHITE BREAD (large loaf, medium slice):
- 1993: 36g, 85kcal
- NOW: 40g, 95kcal
11% INCREASE

CHICKEN CURRY WITH RICE (frozen):
- 1993: 200g, 305kcal
- NOW: 250g, 460kcal
52% INCREASE

THE NEW (AB)NORMAL

Nielsen & Pokin, 2003

Marteau et al, 2015

Snack + 60%  Drink + 52%

20 years [1977-1997]
A closer look into the PORTION SIZE effect

People consume more food when offered larger portions or packages as well as when using larger table ware items.

**Figure 7. Summary effect sizes (standardised mean differences) in subgroups of studies (consumption outcomes)**

<table>
<thead>
<tr>
<th>Subgroup</th>
<th>N</th>
<th>SMD (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Product type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food</td>
<td>86</td>
<td>0.38 (0.20, 0.46)</td>
</tr>
<tr>
<td>Tobacco</td>
<td>6</td>
<td>0.25 (-0.14, 0.65)</td>
</tr>
<tr>
<td>- Study design</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between-subjects</td>
<td>27</td>
<td>0.64 (0.47, 0.80)</td>
</tr>
<tr>
<td>Within-subjects</td>
<td>65</td>
<td>0.23 (0.16, 0.28)</td>
</tr>
<tr>
<td>- Target of manipulation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tableware</td>
<td>12</td>
<td>0.29 (0.07, 0.51)</td>
</tr>
<tr>
<td>Package</td>
<td>10</td>
<td>0.54 (0.27, 0.80)</td>
</tr>
<tr>
<td>Portion</td>
<td>58</td>
<td>0.37 (0.26, 0.48)</td>
</tr>
<tr>
<td>Individual unit</td>
<td>6</td>
<td>0.33 (0.07, 0.58)</td>
</tr>
<tr>
<td>Package with individual unit</td>
<td>3</td>
<td>0.22 (-0.13, 0.56)</td>
</tr>
<tr>
<td>- Participants</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adults</td>
<td>70</td>
<td>0.44 (0.33, 0.54)</td>
</tr>
<tr>
<td>Children</td>
<td>22</td>
<td>0.21 (0.10, 0.31)</td>
</tr>
<tr>
<td>- Outcome</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mapping to manipulated food</td>
<td>25</td>
<td>0.52 (0.36, 0.70)</td>
</tr>
<tr>
<td>Mapping to a wider set</td>
<td>48</td>
<td>0.31 (0.21, 0.41)</td>
</tr>
</tbody>
</table>

Hollands et al, Cochrane Review, 9, 2015
What are the sensory modalities we consider?

**VISION**
- Size
- Number of items
- Shape/volume
- Color

**OLFACITION**
- Odours
- Aromas

**TASTE**
- Bitterness
- Sweetness

**TOUCH**
- In mouth texture
- Viscosity
- Chewiness/hardness

Visual and texture characteristics are the most important drivers of food choice AND AMOUNT CONSUMED.
FOCUS ON VISUAL CUES

VISION
- Size
- Number of items
- Shape/volume
- Color

OLFACTION
- Odours
- Aromas

TOUCH-In mouth texture
- Viscosity
- Chewiness/hardness

TASTE
- Bitterness
- Sweetness
Quantity consumed increases when the portion size increases

When larger amounts are served, greater amounts of all components of a meal (soup, pasta, bread, ice cream, sandwiches, fruits & vegetables) are consumed


Pack size effect: the size of portions chosen and consumed increase when food is presented in larger packages.

Increasing the crisp pack size led to +300 Kcal without compensation at next meal ⇒ Underestimation of food quantity in large packs.
## Sustainability of the portion size effect?

<table>
<thead>
<tr>
<th>Study (Year)</th>
<th>Intervention</th>
<th>Duration</th>
<th>Sample</th>
<th>Results</th>
<th>Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rolls et al. (2006). J. Am. Diet. Assoc</td>
<td>3 portion sizes of all meals and snacks (100%, 150%, 200%) crossover design lab study</td>
<td>2 days</td>
<td>32 adults</td>
<td>Sustained increase of daily energy intake for larger portions: 50% (100%) portion increase led to 16% (26%) E intake increase</td>
<td>artificial environment: 3 main meals in the lab + 3 snacks outside lab artificial setting: all foods provided</td>
</tr>
<tr>
<td>Rolls et al. (2004). Am J Clin Nutr</td>
<td>2 portion size of all meals and snacks (100%, 75%) crossover design lab study</td>
<td>2 days</td>
<td>24 women</td>
<td>Sustained reduction of daily energy intake for smaller portions: 25% portion decrease led to a 10% E intake decrease</td>
<td>artificial environment: 3 main meals in the lab + snack outside lab artificial setting: all foods provided</td>
</tr>
<tr>
<td>Mary et al. (2009). British J. Nutr.</td>
<td>2 portion size of all foods and bev. crossover design lab study</td>
<td>4 days</td>
<td>43 adults</td>
<td>Sustained increase of daily energy intake for larger portions: 10% (women) to 17% (men) increase</td>
<td>artificial environment: subject fully residential in the Human Intervention Unit artificial setting: all foods provided</td>
</tr>
<tr>
<td>Stroebele et al. (2009). Appetite</td>
<td>2 portion size of snacks: 100 kcal or standard size packages in home</td>
<td>7 days</td>
<td>59 adults</td>
<td>Sustained reduction of snack energy intake for portion-controlled 100 kcal snack packs: 187g less snack / week on average</td>
<td>naturalistic environment: home/ad libitum consumption artificial setting: all snacks provided</td>
</tr>
<tr>
<td>Rolls et al. (2007). Obesity</td>
<td>2 portion size of all meals and snacks (100%, 150%) crossover design lab study</td>
<td>11 days</td>
<td>23 adults</td>
<td>Sustained increase of daily energy intake for larger portion: 50% portion increase led to 423 kcal increase (no ↑ for fruits &amp; veg).</td>
<td>artificial environment: 3 main meals in the lab + snacks outside lab artificial setting: all foods provided</td>
</tr>
<tr>
<td>French et al. (2014). Obesity.</td>
<td>3 lunchbox size: 400, 800, 1600 kcal control: no lunch box randomised controlled trial workplace</td>
<td>6 months</td>
<td>233 adults</td>
<td>Sustained reduction in energy intake for smaller lunch boxes over 6 months *Weight change not significantly different among groups</td>
<td>naturalistic environment improved setting: just food for lunch provided, daily intake measures</td>
</tr>
</tbody>
</table>

→ with larger portions, no evidence of downregulation  
→ with smaller portions, people do not fully compensate

Lack of long term studies in naturalistic context
Are there other visual sensory attributes than size impacting portion selection and consumption?

**WHAT ABOUT THE SHAPE OF THE FOOD**

<table>
<thead>
<tr>
<th>Ideal portion size (mL)</th>
<th>80</th>
<th>90</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>c</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ab</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ab</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The height of a food is a key dimension people use as a simplifying visual heuristic to estimate food quantity.

The sustainability of such impact needs to be evaluated.
Influence of the number of units on quantity consumed

Number is key. Consequently the size of each unit can be reduced to reduce food intake while maintaining satisfaction
WHAT ABOUT THE IMPACT OF COLOUR?

Impact of variety on portion selection & intake controversial

Lack of long term studies in naturalistic context on reducing variety without impacting satisfaction
FOCUS ON TEXTURE

VISION
Size
Number of items
Shape/volume
Color

OLFACTION
Odours
Aromas

TOUCH-In mouth texture
Viscosity
Chewiness/hardness

TASTE
Bitterness
Sweetness
Impact of texture on intake is mediated by the eating rate

Intake of a liquid is higher than a semi liquid and semi solid

Eating rate seems to play a key role on food intake

Role of the eating rate on intake. Increased viscosity decreases eating rate and intake through longer oro-sensory exposure.

**Figure 2**  *Ad libitum* intake in grams ± s.d. and in energy intake (kJ) of the liquid, semi-liquid and semi-solid test products in study 1, real-life setting (n = 108). For the calculation of energy intake a mean energy value of 416 kJ per 100 g was used, which is the average energy content over all test products.

**Figure 3**  *Ad libitum* intake in grams ± s.d. and in energy intake (kJ) of the liquid and semi-solid test products under the different experimental conditions in study 2 (N = 49). For the calculation of energy intake a mean energy value of 416 kJ per 100 g was used, which is the average energy content over all test products.

Impact of solid foods in mouth texture on food intake

Harder textures lead to lower energy intake
Meal texture can be adapted to reduce food intake

Measure of behaviors (number of bites, swallows, chews, bite size, eating rate, oral exposure time, intake)
Subjective hunger, fullness, sensory properties


Bolhuis, Forde, Cheng, Xu, Martin, de Graaf. 2014. Slow food: Sustained impact of food texture on energy intake over the course of the day. PlosOne, 9.

SYSTEMATIC REVIEWS DEMONSTRATE THE IMPACT OF CHEWING, BITE SIZE AND EATING RATE ON INTAKE

The link between these variables and perceived satiety or appetite hormones is not obvious

Hogenkamp et al., 2013, Trends in Food Science, 34.

Ad libitum intake is lower when consuming foods
• with solid vs liquid textures
• with smaller bites
• higher number of chews
• low eating rate

S. Miquel-Kergoat et al. / Physiology & Behavior 151 (2015) 88-96

Lack of long term studies in naturalistic context
What about the impact of the other sensory modalities?

- **OLFACTION**
  - Odours
  - Aromas

- **VISION**
  - Size
  - Number of items
  - Shape/volume
  - Color

- **TOUCH**
  - In mouth texture
  - Viscosity
  - Chewiness/hardness

- **TASTE**
  - Saltiness
  - Umaminess

Olfactory cues trigger appetite & choice but have limited impact on amount consumed.

Effect of taste on food intake is controversial.

Effect of the other sensory modalities on food intake is controversial.
Conclusion and perspective

- Consistent effects reported for food visual (size, shape, variety) and texture (viscosity, chewiness) properties on portion selection and intake

  → opportunities for sensory driven food design to promote healthier eating behaviors

- However, most interventions show limitations
  - Short term
  - Laboratory and not ecological environments
  - Limited set of factors
  - Limited set of output variables

- Can we design new interventions?
  - Long term to ensure sustainability of the impact
  - Real world field experiments for more consumer centricity
  - Combination of factors for enhanced efficiency
  - Holistic approach considering the overall diet
What does the extended literature says about behavior change sustainability?

Recent systematic reviews of nudging strategies show short term impact.

The efficacy of nudge theory strategies in influencing adult dietary behaviour: a systematic review and meta-analysis

Arno and Thomas BMC Public Health (2016) 16:676

Abstract

**Background:** Obesity has become a world-wide epidemic and is spreading to countries with emerging economies. Previously tested interventions are often too costly to maintain in the long term. This leaves a need for improved strategies for management of the epidemic. Nudge Theory presents a new collection of methods, deemed “nudges”, which have the potential for low-cost and broad application to guide healthier lifestyle choices without the need for restrictive regulation. There has not yet been a large-scale examination of the effectiveness of nudges, despite several policy making bodies now considering their use.

**Methods:** To address this gap in knowledge, an adapted systematic review methodology was used to collect and consolidate results from current Nudge papers and to determine whether Nudge strategies are successful in changing adults’ dietary choices for healthier ones.

**Results:** It was found that nudges resulted in an average 15.3% increase in healthier dietary or nutritional choices, as measured by a change in frequency of healthy choices or a change in overall caloric consumption. All of the included studies were from wealthy nations, with a particular emphasis on the United States with 31 of 42 included experiments.

**Conclusions:** This analysis demonstrates Nudge holds promise as a public health strategy to combat obesity. More research is needed in varied settings, however, and future studies should aim to replicate previous results in more geographically and socioeconomically diverse countries.

**Keywords:** Nudge, Obesity, Cost-effective, Nutrition, Diet, Choice architecture
Finally, compensatory effects of nudging need to be considered and tested further. Two studies suggested that consumers compensate for healthier choices by making less healthy subsequent choices (Olstad et al., 2014; Wisdom et al., 2010). However the presence of compensatory effects is not always evident in the research investigating the role of nutrition information for influencing healthfulness of choices. Hoefkens, Lachat, Kolsteren, Van Camp, and Verbeke (2011) found no evidence of compensatory effects, and Hoefkens, Pieniak, Van Camp, and Verbeke (2012) indicated that prior health knowledge influences the effectiveness of point-of-purchase nutrition information. Nudging may influence the target health behavior, but consumers may then overconsume or indulge to compensate for the prior healthier decision, depending on their level of prior nutrition knowledge (Hoefkens et al., 2012). Compensatory behavior needs to be further investigated in the nudging literature, to ensure that healthier choices are not compensated for with less healthy subsequent behavior.
What does the extended literature says about behavior change sustainability?

However potential compensatory behaviors underevaluated

Environmental interventions for altering eating behaviours of employees in the workplace: a systematic review

J. Allan¹, D. Querstorff², K. Banas³ and M. de Bruin¹

Summary

Environmental, or ‘choice-architecture’, interventions aim to change behaviour by changing properties/contents of the environment and are commonly used in the workplace to promote healthy behaviours in employees. The present review aimed to evaluate and synthesize the evidence surrounding the effectiveness of environmental interventions targeting eating behaviour in the workplace. A systematic search identified 8157 articles, of which 22 were included in the current review. All included studies were coded according to risk of bias and reporting quality and were classified according to the emergent typology of choice-architecture interventions. More than half of included studies (13/22) reported significant changes in primary measures of eating behaviour (increased fruit/veg consumption, increased sales of healthy options and reduction in calories purchased). However, only one study produced a small significant improvement in weight/body mass index. Many studies had a high or unknown risk of bias; reporting of interventions was suboptimal; and the only trial to measure compensatory behaviours found that intervention participants who ate less during the intervention ate more out with the workplace later in the day. Hence, we conclude that more rigorous, well-reported studies that account for compensatory behaviours are needed to fully understand the impact of environmental interventions on diet and importantly on weight/body mass index outcomes.
What does the extended literature says about behavior change sustainability?

However potential compensatory behaviors underevaluated

Nudging consumers towards healthier choices: a systematic review of positional influences on food choice

Bucher et al.,
British Journal of Nutrition (2016), 115, 2252–2263

Abstract

Nudging or ‘choice architecture’ refers to strategic changes in the environment that are anticipated to alter people’s behaviour in a predictable way, without forbidding any options or significantly changing their economic incentives. Nudging strategies may be used to promote healthy eating behaviour. However, to date, the scientific evidence has not been systematically reviewed to enable practitioners and policymakers to implement, or argue for the implementation of, specific measures to support nudging strategies. This systematic review investigated the effect of positional changes of food placement on food choice. In total, seven scientific databases were searched using relevant keywords to identify interventions that manipulated food position (proximity or order) to generate a change in food selection, sales or consumption, among normal-weight or overweight individuals across any age group. From 2576 identified articles, fifteen articles comprising eighteen studies met our inclusion criteria. This review has identified that manipulation of food product order or proximity can influence food choice. Such approaches offer promise in terms of impacting on consumer behaviour. However, there is a need for high-quality studies that quantify the magnitude of positional effects on food choice in conjunction with measuring the impact on food intake, particularly in the longer term. Future studies should use outcome measures such as change in grams of food consumed or energy intake to quantify the impact on dietary intake and potential impacts on nutrition-related health. Research is also needed to evaluate potential compensatory behaviours secondary to such interventions.
Thank you