Sensory preferences, eating behavior and obesity in young children

Kees de Graaf
Preferences and obesity in children

- The development of preferences
- Overweight and eating behavior in adults
- Overweight and eating behavior in children
- Discussion
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Development of preferences

- Inborn preference for sweetness
- Inborn aversion to sour and bitter
- Mechanisms for learning preferences:
  - Exposure
  - Flavor-energy learning
  - Flavor-flavor learning
  - Socal mechanisms
- Stability of preferences
Stijn, 6 years later in Australia
Effect exposure in utero and during lactation

- 46 mothers in last trimester of pregnancy
- Daily 300 ml water or carrot juice, 4 days per week for 3 consecutive weeks. During last trimester of pregnancy or during first two months of lactation.

<table>
<thead>
<tr>
<th>Group</th>
<th>Beverage Consumed During:</th>
<th>Preference Test at Weaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>CW</td>
<td>Carrot (CARROT) WATER</td>
<td>Carrot-Flavored vs Plain Cereal</td>
</tr>
<tr>
<td>WC</td>
<td>WATER Carrot (CARROT)</td>
<td>Carrot-Flavored vs Plain Cereal</td>
</tr>
<tr>
<td>WW</td>
<td>WATER WATER</td>
<td>Carrot-Flavored vs Plain Cereal</td>
</tr>
</tbody>
</table>

Mennella et al., 2001
### A. Intake

<table>
<thead>
<tr>
<th>Group</th>
<th>Proportional Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>CW</td>
<td>0.60</td>
</tr>
<tr>
<td>WC</td>
<td>0.55</td>
</tr>
<tr>
<td>WW</td>
<td>0.50</td>
</tr>
</tbody>
</table>

### B. Negative Facial Expressions

<table>
<thead>
<tr>
<th>Group</th>
<th>Proportional Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>CW</td>
<td>0.65</td>
</tr>
<tr>
<td>WC</td>
<td>0.60</td>
</tr>
<tr>
<td>WW</td>
<td>0.70</td>
</tr>
</tbody>
</table>

Mennella et al., 2001

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**Effect exposure on intake/ facial expressions**

[Bar chart showing intake and negative facial expressions for CW, WC, and WW groups.

Bar A represents intake with bars for CW, WC, and WW at 0.60, 0.55, and 0.50 respectively.

Bar B represents negative facial expressions with bars for CW, WC, and WW at 0.65, 0.60, and 0.70 respectively.

The chart illustrates how exposure affects intake and facial expressions.]
Expression of hunger and satiety
Energy-taste conditioning

More preferred

Less preferred

10 child, 4 y; 8 x 150 kcal with maltodextrine

H+ = Hi bugu/Lo choc

T+ = Lo bugu/Hi choc

Birch, McPhee, Steinberg, Sullivan, 1990
7 months, disliked vegetables, effects exposure

Maier et al, FQP 2007
Neophobia as function of age: % picky eaters

Bron: Rigal 2008
Zeinstra et al, Children’s hard wired aversion to pure vegetable tastes. A failed flavour nutrient study

- 7-8 y old children
- Low intakes vegetables juices
- Strong flavour, with no reinforcement → unacceptable
Association between food choice at 2 y and preference rating at age 4-22 y for animal products and cheeses

Choice at 2 y in nursery

Nicklaus et al, FQP, 2004
### Effect vanilla flavored bottle-milk on preference 30-40 y later

- **Preference**
- **Feeding History**
  - **Breast Fed**
  - **Bottle Fed**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Preference</th>
<th>Feeding History</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pure ketchup</td>
<td>71%</td>
<td>33</td>
</tr>
<tr>
<td>Vanillin added</td>
<td>29</td>
<td>67</td>
</tr>
</tbody>
</table>

Haller et al, 1999; Chem Sens, 24:465-67
Acquisition of preferences

- Preferences are learned very early in life
- Preferences are remarkably stable
- Period 0 - 5 y is crucial
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Overweight; liking vs. wanting

Hill & McCutcheon, 1975
Mela & Sacchetti. Sensory preferences for fats: relationships with diet and body composition; AJCN 1991;53: 908-915

FIG 4. Relationship between percent body fat and sensory preference for fat among male (□) and female (●) subjects.
Fischer & Birch; Fat preferences and fat consumption of 3-5 y children are related to parental obesity. J. Am. Dietetic. Assoc. 1995

![Graph showing the correlation between parental body mass index and fat preference.](image)
Table 3  Positive answers to statements concerning food preferences, eating habits and tendency to overeat among the obese and lean co-twins (%)

<table>
<thead>
<tr>
<th>Statements</th>
<th>Obese (n = 23)</th>
<th>Lean (n = 23)</th>
<th>Statistical significancea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concerning special food preferences</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I prefer fatty foods</td>
<td>52</td>
<td>17</td>
<td>0.005</td>
</tr>
<tr>
<td>I prefer sweet foods</td>
<td>39</td>
<td>30</td>
<td>0.41</td>
</tr>
<tr>
<td>Concerning eating habits</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I eat plenty of food at one sitting</td>
<td>61</td>
<td>22</td>
<td>0.013</td>
</tr>
<tr>
<td>I nibble along the day</td>
<td>22</td>
<td>9</td>
<td>0.26</td>
</tr>
<tr>
<td>I fast and then eat plenty of food without a break</td>
<td>13</td>
<td>4</td>
<td>0.32</td>
</tr>
<tr>
<td>I eat mostly in the evening and at night time</td>
<td>30</td>
<td>22</td>
<td>0.56</td>
</tr>
<tr>
<td>I eat mostly alone</td>
<td>35</td>
<td>17</td>
<td>0.16</td>
</tr>
<tr>
<td>Concerning tendency to overeat</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I eat and drink easily more than I actually need of:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>sandwiches, pastries, pies etc</td>
<td>70</td>
<td>35</td>
<td>0.011</td>
</tr>
<tr>
<td>ice cream, desserts etc</td>
<td>52</td>
<td>22</td>
<td>0.035</td>
</tr>
<tr>
<td>alcoholic beverages</td>
<td>22</td>
<td>4</td>
<td>0.046</td>
</tr>
<tr>
<td>sweet cakes (doughnuts, Danish pastries etc)</td>
<td>61</td>
<td>39</td>
<td>0.10</td>
</tr>
<tr>
<td>sweets</td>
<td>57</td>
<td>39</td>
<td>0.16</td>
</tr>
<tr>
<td>soft drinks</td>
<td>17</td>
<td>9</td>
<td>0.41</td>
</tr>
</tbody>
</table>

aMcNemar test.
Overweight $\rightarrow$ higher consumption energy dense foods

Fig. 2. (a) Weight (g) per portion taken from three different ED classes by obese and normal-weight women. Standard portion sizes by guidelines [12]. (b) Percentages of EI from the different ED categories of food. *$P<.01$, compared to the normal-weight women [12].

Figure 1  Mean energy content of foods (kJ) having different perceived taste qualities, as reported eaten by lean and obese subjects. NS — not statistically significant.

Fig. 2. Number of crackers eaten by obese and normal weight subjects as a function of preference ratings and time of testing.

**Obesity and Salivation**

![Graph showing change in salivation from baseline over trial blocks for non-obese and obese subjects.](image)

**Fig. 1.** Salivary responses to lemon yogurt in obese and non-obese subjects across five blocks of two trials.
Fig. 1. Grams of ice cream eaten as a function of ratings of its taste. (Numbers in parentheses denote $n$ for each point.)
Reward system at overweight is less active

Stice, Spoor, Bohon & Small, 2008
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Overweight children eat more after ‘food cues’

Jansen et al, Eating Behav 2003; 197-209
Overweight children habituate slower than non-overweight children.

Temple et al; Physiol Behav 2007; 250-4
Food enjoyment in UK 8-11 y children

Carnell et al, AJCN 2008; 88: 22-9
FIGURE 1. Mean eating rates and SEs over the 4 quarters (Q) of the mealtime for 3 weight groups (overweight or obese, lower normal-weight, and higher normal-weight).

Overweight and eating behavior in children

- Association overweight and eating behavior:
  - Overweight: more responsive to food cues and palatable foods, less sensitive for satiety
  - Higher eating rate!
  - Eating pattern already present in childhood
  - Results from genetic predisposition and an obesogenic eating environment
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Discussion

- Eating behavior is learned early in life and remarkably stable
- Our eating environment facilitates overweight, also in children
- Slow food, mindfulness
- Palatable foods with a high satiety value!!!!

- Learning; (sensory signals <-> metabolic consequences) the great scientific challenge for the coming years

- Challenge for science, society, government, and industry
Thank you for your attention