Psychosocial influences on eating behavior

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Disclosure statement

• No conflicts of interest to declare.
Nutrition >> Eating behavior

Precision nutrition >> best achievable diet, and best ways to support an individual to achieve it
The biopsychosocial model

- Influence on eating behavior
- Influence on eating behavior of associated factors (food insecurity, stress)
- Types of eating behavior
- Prevalence
- Relationships with diet
- Relationships with food environment
- Relationships with intervention outcomes
- Implications for diet?
- Non-diet implications?
- Other behavioral strategies?
The biopsychosocial model

- Types of eating behavior
- Prevalence
- Relationships with diet
Appetitive characteristics

• What are appetitive characteristics?
  – Early emerging, enduring dispositions toward food, or eating styles, that differ between individuals
  – E.g. Food cue responsiveness
    • How responsive one is to external food cues e.g. sight of food
  – E.g. Satiety responsiveness
    • How responsive one is to internal cues e.g. gut hormones

Carnell & Wardle, 2008 Proc Nut Soc
### Child Eating Behavior Questionnaire (CEBQ)

**Wardle et al., 2001 J Child Psychol & Psychia**;
**Carnell & Wardle, 2007 Appetite**

<table>
<thead>
<tr>
<th>Avoidant</th>
<th>Enjoyment of food (Factor 4; 7% variance)</th>
<th>Desires to drink (Factor 5; 5% variance)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>My child enjoys eating</td>
<td>If given the chance, my child would always be having a drink</td>
</tr>
<tr>
<td></td>
<td>My child loves food</td>
<td>If given the chance, my child would drink continuously throughout the day</td>
</tr>
<tr>
<td></td>
<td>My child is interested in food</td>
<td>My child is always asking for a drink</td>
</tr>
<tr>
<td></td>
<td>My child looks forward to mealtimes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Desire (Factor 6; 4% variance)</td>
<td>Emotional undereating (Factor 6; 4% variance)</td>
</tr>
<tr>
<td></td>
<td>My child eats less when s/he is upset</td>
<td>My child eats less when s/he is upset</td>
</tr>
<tr>
<td></td>
<td>My child eats less when s/he is angry</td>
<td>My child eats less when s/he is angry</td>
</tr>
<tr>
<td></td>
<td>My child eats less when s/he is tired</td>
<td>My child eats less when s/he is tired</td>
</tr>
<tr>
<td></td>
<td>My child eats more when s/he is happy</td>
<td>My child eats more when s/he is happy</td>
</tr>
<tr>
<td></td>
<td>Emotional overeating (Factor 7; 3% variance)</td>
<td>My child eats more when anxious</td>
</tr>
<tr>
<td></td>
<td>My child eats more when annoyed</td>
<td>My child eats more when annoyed</td>
</tr>
<tr>
<td></td>
<td>My child eats more when worried</td>
<td>My child eats more when worried</td>
</tr>
<tr>
<td></td>
<td>My child eats more when s/he has nothing else to do</td>
<td>My child eats more when s/he has nothing else to do</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Avoidant</th>
<th>Food responsiveness (Factor 3; 9% variance)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>My child’s always asking for food</td>
</tr>
<tr>
<td></td>
<td>If given the chance, my child would always have food in his/her mouth</td>
</tr>
<tr>
<td></td>
<td>Given the choice, my child would eat most of the time</td>
</tr>
<tr>
<td></td>
<td>If allowed to, my child would eat too much</td>
</tr>
<tr>
<td></td>
<td>Even if my child is full up, s/he finds room to eat his/her favourite food</td>
</tr>
</tbody>
</table>

**FOOD APPROACH**

- **FOOD AVOIDANT**
| 1 'Enjoyment of food' | My baby seemed contented while feeding  
|                        | My baby enjoyed feeding time  
|                        | My baby loved milk  
|                        | My baby became distressed while feeding (R)  |
| 2 'Food responsiveness' | If given the chance my baby would always be feeding  
|                        | Even when my baby had just eaten well s/he was happy to feed again if offered  
|                        | My baby could easily take a feed within 30 minutes of the last one  
|                        | My baby was always demanding a feed  
|                        | If allowed to my baby would take too much milk  
|                        | My baby frequently wanted more milk than I provided |
| 3 'Slowness in eating' | My baby fed slowly  
|                        | My baby finished feeding quickly (R)  
|                        | My baby took more than 30 minutes to finish feeding  
|                        | My baby sucked more and more slowly during the course of a feed |
| 4 'Satiety responsiveness' | My baby got full up easily  
|                        | My baby got full before taking all the milk I thought s/he should have  
|                        | My baby found it difficult to manage a complete feed  
|                        | My baby had a big appetite |

**Baby Eating Behavior Questionnaire (BEBQ)**

Llewellyn, van Jaarsveld, Johnson, Carnell & Wardle, 2011 Appetite
<table>
<thead>
<tr>
<th>AEBQ scales</th>
<th>Internal reliability (n = 954)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hunger&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.751</td>
</tr>
<tr>
<td>Food responsiveness&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.753</td>
</tr>
<tr>
<td>Emotional over-eating&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.904</td>
</tr>
<tr>
<td>Enjoyment of food&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.859</td>
</tr>
<tr>
<td>Satiety responsiveness&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.753</td>
</tr>
<tr>
<td>Emotional under-eating&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.896</td>
</tr>
<tr>
<td>Food fussiness&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.877</td>
</tr>
<tr>
<td>Slowness in eating&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.884</td>
</tr>
</tbody>
</table>

Adult Eating Behavior Questionnaire (AEBQ)
Appetitive characteristics – Prevalence (CEBQ, AEBQ)

- **CEBQ-SR**
  - M=2.99, SD=.7
  - n=326, 2-12y

- **CEBQ-FR**
  - M=2.67, SD=.88
  - n=326, 2-12y

- **CEBQ-EOE**
  - M=2.13, SD=.87
  - n=325, 2-12y

- **AEBQ-SR**
  - M=2.68, SD=.96
  - n=474

- **AEBQ-FR**
  - M=3.14, SD=.85
  - n=474

- **AEBQ-EOE**
  - M=2.78, SD=1.1
  - n=474

Relationships with diet?
Appetitive characteristics – Relationships with weight/adiposity

- Systematic review and meta-analysis in children aged 1-18y
- 20 countries, 14 languages, 314 full-text articles
- 57 (46 cross-sectional, 11 longitudinal) met inclusion criteria (measure fidelity, non-overlap in samples) = n=36,535 1-14y
- Cross-sectional data – robust associations w adiposity
  - Food approach, +ve (FR r=0.22; EF r=0.17; EOE r=0.15; DD r=0.10)
  - Food avoidant, -ve (SR r=-0.21; SE r=-0.15; FF r=-0.08; EUE r=-0.09)

Less data available for AEBQ but seems to follow similar pattern, potentially with weaker weight associations for FR & SR, but stronger weight associations for EOE.
Appetitive characteristics – Relationships with diet
SR>>lower SE foods>>lower weight?

- Syrad et al (2016, AJCN) CEBQ at 16mo, 3d diet diaries at 21mo in n=1102
  - Higher SR -- smaller meal size
- Fildes et al (2015, IJBNPA) CEBQ at 3-4mo, food prefs in n=1044 & n=167
  - Higher SR+SE+FF -- lower FV liking
- Carnell et al (2016, Appetite) CEBQ at 4-5y, lunch intake over 5 days
  - Higher SR -- lower lunch intake, less FV %,
- Vilela et al (2018, Appetite) CEBQ at 7y, FFQ 4+7y in n=4537
  - Higher SR+FF – less increase in diet variety
- Vilela et al (2019, Appetite) CEBQ at 7y, FFQ 4+7y in n=1359
  - Higher SR – higher eating frequency 7y
[Unpub]
- AEBQ-SR positively correlated w frequency of intake of sweets, savory snacks, fast food, sugar-sweetened beverages

Similar findings for AEBQ. Need to consider both appetite and food preferences/habits when developing personalized nutrition plans.

Where do appetitive characteristics come from?
The biopsychosocial model

- Influence on eating behavior
Appetitive characteristics – Heritability (8-11y)

Satiety Responsiveness

H=0.63

Enjoyment of Food

H=0.75

EOE and EUE show more environmental influence (4y) (Herle et al, 2018).
Personalized nutrition? These behaviors emerge early and are genetically determined to some extent and may be hard to change. May need to work with them rather than against them.
The biopsychosocial model

- Types of eating behavior
- Prevalence
- Relationships with diet
Binge eating

Binge-Eating Disorder
Recurrent (1/week) and persistent (≥ 3 months) binge-eating episodes in the absence of compensatory behaviors, accompanied by marked distress

Subthreshold Binge-Eating Disorder
Recurrent binge-eating episodes below the threshold of diagnostic criteria

Binge-Eating
Subjective experience of loss of control while eating a reportedly objectively large amount of food

Loss of Control Eating
Subjective experience of loss of control while eating, irrespective of reported amount of food consumed

2.8% lifetime prevalence in USA
1/3 of children and adolescents with ov/ob

Stress
Anxiety

Tanofsky-Kraff, Schvey & Grilo, 2020 Am Psychol
Personalized nutrition? Different measures are available to assess eating behaviors. Some may be more appropriate than others but may all tap into an underlying continuum of ‘uncontrolled eating’.
The biopsychosocial model

- Types of eating behavior
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- Relationships with diet
- Relationships with food environment
- Relationships with intervention outcomes
Appetitive characteristics affect how individuals respond to the food environment (portion sizes)

N=100 5-6y, non-Hispanic black
4 x dinner conditions of varying portion size

Children with low Satiety Responsiveness most vulnerable to effect of large portion sizes on increasing intake.

Mooreville et al, 2015 Obesity
Children’s appetitive characteristics affect maintenance of weight loss in behavioral obesity treatment.

Children with overweight or obesity, N=150, mean age 10.4y, 67% girls, family-based behavioral weight loss treatment.

Child appetite affects intervention outcome – children with high food responsiveness and emotional eating find it harder to maintain dietary changes.

*Boutelle et al, 2021 Appetite*
Binge eating in adults influences weight loss from dietary intervention.

4-y data from Look AHEAD, RCT of intensive lifestyle intervention vs diabetes support & education. N=4901 adults with T2D/ov/ob. All diets hypocaloric but varied in protein. Assessed appetite over past week at baseline and 6mo.

Least weight loss at 4y

Binge eating affects intervention outcome – those with consistent binge eating have poorer weight loss outcomes after 4y of intervention.

Personalized nutrition? Eating behaviors may affect how individuals respond to their dietary environment and how well they adhere to dietary recommendations. Need to assess and take into account.
The biopsychosocial model

- Influence on eating behavior of associated factors (food insecurity, stress)
Food insecurity and delay discounting for food

DD = the degree to which an individual is inclined to pick a reward (food/non-food) which is smaller+sooner vs. larger+later

Marshmallow Test

One now… …or two in 15 mins?

Mean Food Delay Discounting Values [transformed]

<table>
<thead>
<tr>
<th></th>
<th>Small</th>
<th>Medium</th>
<th>Large</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food Secure</td>
<td>0.6</td>
<td>0.5</td>
<td>0.4</td>
</tr>
<tr>
<td>Food Insecure</td>
<td>0.5</td>
<td>0.4</td>
<td>0.3</td>
</tr>
</tbody>
</table>

* Significant difference

Food insecurity affects decision making in relation to food – women with food insecurity are more likely to opt for smaller, sooner food rewards.
Psychosocial stress influences reinforcing value of food

RVF = the motivation to obtain food, or how hard/long someone will work to obtain food, in contrast to how hard/long they will work for an alternative reinforcer.

N=429 adults, 272F, 157M, May-June 2020
Assessed COVID pandemic-associated stress and willingness to work (finger taps) for hypothetical delivery of portion of preferred food from various food categories.

Motivation for sweet snacks, fruit and fast foods > motivation for savory snacks and vegetables.

Higher COVID-related stress, greater food motivation.

Psychosocial factors affect food-related decision making and may be important to consider in context of personalized nutrition recommendations.
The biopsychosocial model

- Implications for diet?
- Non-diet implications?
- Other behavioral strategies?
Regulation Of Cues (ROC) treatment (children, adults; obesity, overeating, binge eating)

- Appetite Awareness Training (AAT)
- Cue Exposure Treatment for Food (CET-Food)

Boutelle, Manzano & Eichen, 2020 P&B
Summary and remaining questions

• Appetitive characteristics, which show genetic influence, influence diet and weight in children and adults >> need to understand more about development through the life course

• Appetitive characteristics may influence the effect of food environment factors or interventions on diet and weight >> need to consider individual differences in population and intervention research

• Considering an individual’s appetitive as well as physiological characteristics may help increase the impact of personalized nutrition >> need to directly assess effect of such combined interventions
Acknowledgements

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