Obesity - a Psychology Disorder?
Environment, appetite, & behavioural control

Biopsychology of Obesity

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Outline

• Appetite control basics

• Appetite expression and obesity – regulatory and reward mechanisms
  • BMI Food cues and cravings

• Potent effects of the food environment
  • Effects of adverts on all children but magnitude related to weight status

• Dieting and Energy Restriction
  • Food cues, cravings and biology of appetite

• Psychology (finally..)
  • QoL, stigma, past and contemporary events
  • Stress, mood and coping
  • Depression, obesity and SES

• Inhibitory Control
FOOD AND APPETITE CONTROL

Regulatory and Hedonic Systems

Hunger, Satiety and Reward
Components of appetite

**Hunger**: The drive to consume, eliciting and sustaining a behavioural response (eating) to a biological need (with a strong situational component)

**Wanting**: The motivation to consume a specific food, manifesting explicitly (craving) or implicitly (food cue responsiveness)

**Liking**: The sensory pleasure elicited by contact with food contributing to the hedonic motivation to consume (**wanting**)

**Satiation**: Processes during a meal that generate the negative feedback leading to its termination (**within-meal inhibition**) (strengthened by meal volume and weakened by palatability)

**Satiety**: The end state of satisfaction. Further suppression of the drive to consume and post meal intake (**between meal inhibition**)
Regulatory control (satiety) and reward:

Dual System Model of CNS integration

Homeostasis: Negative Feedback

Inhibitory control

Responsiveness to food cues

Reward driven eating

Satiety

Hedonic Drive: Positive Feedback
Why is appetite important?
Interaction between biology and environment in the control of energy intake in body weight

- **Biological Regulation**
  - CNS Homeostatic Regulation
  - Fat Stores (TONIC)
  - Satiety Signals (EPISODIC)
  - All Under Genetic Influence

- **Appetite**
  - CNS
  - Hedonic Systems

- **Eating Behaviour**
  - ENERGY INTAKE

- **Environmental**
  - Culture
  - Food Supply
  - Situation
  - Nutrition

By Blundell Cica 1993 modified by Finlayson
APPETITE EXPRESSION AND OBESITY

Individuals with obesity tend to demonstrate weaker regulatory control of eating behaviour. Moreover, appetite regulation is more likely to be overwhelmed by environmental cues to over-consume.
Behavioural phenomena associated with adiposity

Inadequate impact of ingestants

• Often increases in eating rate and a failure to develop normal satiation during the course of a meal
• After consumption demonstrate weakened satiety responsiveness
• Physiological weakness – cause and / or consequence of abnormal behaviour?

Less control of ingestion

• Greater responsiveness to food cues
• Heightened hedonic responses to palatable food
• Experiences of uncontrolled hunger and greater disinhibition of eating behaviour
• Food ‘addiction’?
FOOD CUES AND THE POWER OF FOOD

Food-cues (exposure to the sight or smell of food) can have a powerful effect on appetite and elicits a cephalic response.

Internal food cues may be hunger, cravings, or emotions and feelings throughout the day. External food cues include the sight or smell of food, certain activities, people eating or talking about food around you, or other learnt associations.

Individuals differ in their reactivity to food cues. Externality theory (Schachter 1968) argues that the obesity (and overeating) occurs because individuals are less sensitive to internal hunger and satiation cues, and more sensitive to external cues, including the sensory characteristics of food.

Power of Food Scale (PFS) measures reactions to the presence of food in the environment.

PFS score suggests degree of vulnerability to an obesogenic food environment (filled with readily available, high-calorie, highly palatable food). It correlates with greater food cravings and consumption and is associated with BMI.

Each domain (abstract, proximal, or consumed) correlates with BMI

PFS may be more strongly related to overeating tendencies among overweight and obese individuals than to BMI *per se*. 
FOOD CUE REACTIVITY

• Individuals with obesity are more reactive to food cues (Castellanos et al, 2009) i.e. their attention is more easily grabbed and held by these cues.

• When hungry, these effects become more potent “attention grabbing”, an effect more pronounced in overweight/obese participants (Nijs et al, 2010).

CRAVINGS

• High BMI correlates with cravings while dieting (Delahanty et al, 2002).

• Subjective cravings in overweight individuals associated with food cue responsiveness (Werthamnn et al, 2011).

• Increased BMI is associated with more frequent craving, and craving for specific foods was associated with increased intake of them (Chao et al, 2014).
THE FOOD ENVIRONMENT
EARLY EFFECTS OF POTENT FOOD CUES

Adverts and Children’s food choices and overall intake
Evidence of weight status differences at early age
Food promotion and childhood obesity: Impact on Policy

(a). Number of Adverts Recognised.

(b). Amount of Food Eaten After Presentation of Adverts.

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Food commercials increase preference for energy dense foods, particularly in children who watch more television.
Obese children recognised more food adverts than toy but all children responded to them by increasing gram intake and altering food choice (including shifting to HFSS foods).
Modified design
Energy intake analysis

FA exposure increased intake in all children

However, the increased was greater in the obese children (155%) and the overweight children (101%) than the NW children (89%).

Weight status effects can be very obvious especially in older children
The Influence of Television Food Commercials on Children's Food Choices: Evidence from Ventromedial Prefrontal Cortex Activations

Annabel S. Bruce, PhD; Stephen W. Pratt, PhD; Jonathan Ha, PhD; J. Bradley C. Cherry, J1; Tammy L. Link, PhD; and Gary R. Sarge, PhD

Objective: To investigate how food commercials influence children's food choices.

Study design: Twenty-three children aged 6-11 years were exposed to brand-name food commercials, followed by questionnaires on their food preferences.

Results: Our results show that watching food commercials significantly influences children's food preferences, leading to a higher likelihood of selecting advertised foods.

Conclusion: Children are more likely to prefer advertised foods after watching commercials, indicating a need for regulations to limit the influence of media on children's food choices.

**REWARD**

Food Adverts reinforce reward activation in children's brains.

**INHIBITORY CONTROL**

Food Adverts drive hedonic reward activation with inhibitory control.

Obese children show less brain reactivity in areas of the brain associated with food regulation and decision-making compared to healthy weight children. This suggests that obese children may be more vulnerable to the effects of food advertising.
DIETING AND ENERGY RESTRICTION

Psychology of Deprivation and Physiological Consequences of Energy Deficit
The Challenge of Dieting
Psychology of Deprivation and Physiological Consequences of Energy Deficit

- Obsession with food, increased response to food cues, cravings, loss of concentration and dysphoric mood all contribute to failure in dieting.

- Energy restriction and weight loss reduce satiety hormone levels – so change may outlast the diet.

1. Increase in preoccupation with food.
2. Relentless thoughts of food and eating inhibited concentration on usual daily activities.
3. Serious difficulties in adhering to the diet when confronted with unlimited access to food.

Hunger is a barrier to and a consequence of dieting.
Biological mechanisms act to increase appetite

After weight reduction, the brain is stimulated to increase caloric intake by changes in levels of circulating hormones:

1. **Ghrelin**
2. **Leptin**
3. **GLP-1 / PYY**

- **Appetite**
- **Preference for energy-dense foods (high fat/sugary foods)**

References:
Food cue reactivity, cravings in dieters

Food cue responsiveness

• Hunger predicts EEG response to\(^1\) and heightens perception of food cues.\(^2\)
• Lower food cue reactivity predicts more successful weight loss in dieters.\(^3,4\)

Cravings

• Dieters experience stronger cravings that are harder to resist and typically
  for the foods being restricted.\(^5\)
• Trait (not state) cravings discriminate between successful and unsuccessful
  dieters.\(^6\)

Therefore, FCR and cravings act as barriers to weight loss success

But if we could change FCR and reduce cravings? (training?)

Interaction between biology and environment in the control of appetite and energy intake in obesity

**Biological Regulation**
- Fat Stores (TONIC)
- Satiety Signals (EPISODIC)
- CNS Homeostatic Regulation

**Appetite**
- Drive To Eat
- Implicit processing
- Weaker effect of energy intake on wanting
- Weaker inhibitory control

**Eating Behaviour**
- Energy Density
- Palatability

**Passive & Active Over-consumption**

**Environmental**
- Culture and Societal Practices
  - Snacking, eating out / alone
- Food Environment
  - Cheap, ready prepared, easy available
  - Extensive and poorly controlled
- Branding and promotion
- Food Formulation
  - HFSS (High Fat, Sugar, Salt)
- Portion Size
  - Steadily increasing
- Nutrition information and Knowledge
  - Labelling and education

**Food Production and Availability**

Blundell Cica 1993 adapted by Finlayson
PSYCHOLOGY OF OBESITY

Stigma, Live Events, Stress and Coping

Depression, Obesity and SES
Obesity negatively affects quality of life

- Sleep apnoea
- Decreased mobility
- Joint pain
- Urinary incontinence
- Anxiety
- Depression
- Impaired fertility

Anti-obese prejudice starts young

Children as young as six will designate ‘fat’ individuals as lazy, dirty, stupid, ugly, liar and cheat\(^1-3\)

The Medical Profession (Practitioners & Students)

Negative attitudes toward the obese exist within the health care profession \((\text{same key character deficits ascribed by children!})\)

The idea still persists they are weak willed & medics are reluctant to perform examinations\(^5,6\)

Hill & Silver (1995)\(^4\)

• 180 boys & girls (aged 9) rated 4 silhouettes (2 lean, 2 obese)

• Children rated the obese silhouettes significantly as:
  • Having fewer friends (thin girl rated as most popular)
  • Doing less well at school
  • Less healthy (obese boy least healthy)

Hebl & Xu (2001)\(^7\)

• Physicians in US asked to evaluate the medical chart of normal, overweight and obese men and women. Physicians:
  • Less likely to spend time with the obese
  • Obese rated negatively on 12 of 13 indices

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Discrimination: Society and Prospects

- Scenarios using obese and normal weight actors in have demonstrated subjects will reliably discriminate against the obese actor
- Obese students seeking accommodation were more likely to fail landlord interviews (Karris, 1977)
- Sale assistants in shoe stores reliably reacted more slowly to the arrival of an obese customer in the shop (Klesgas et al. 1990)

  Karris (1977) J. Soc. Psychol. 101: 159-60
  Klesgas et al. (1990) Int. J. Obesity 14: 525-35

- When matched for social status and education it was found that obese women in white collar professions earned significantly less (Sarlio-Lähteenkorva et al., 2004)
- Potential employee’s who attended a job interview accompanied position near a ‘perceived’ obese partner were less likely to be given a job (Kebl et al.; 2003)
- Such prejudice may, along with worse health, part explain the higher prevalence of depression seen in the obese

Personal circumstance plays a role in weight gain as well as mental health issues

1. **Current events**: Traumatic life events such as relationship break-ups or widowhood or other forms of loss can effect body weight (Jeffry & Rick, 2002; Eng et al, 2005).

2. **Past trauma**: Serious and sustained abuse and neglect may focus self care behaviour in adulthood.
   - Childhood maltreatment/neglect predict excessive weight gain in adolescence (Hessey et al, 2006; Bentley & Widom, Lissau, 2009 & Sorensen, 1994).
   - Childhood physical/sexual abuse associated with obesity in women (Midei et al, 2010).
   - Childhood bullying, rejection or emotionally abuse is associated with obesity in men (Gundstad et al. 2006).
   - Physical and verbal abuse up to 18 years old associated with later obesity (Williamson et al. 2002).
   - Severity rather than the type of trauma is associated with the likelihood of becoming obese (D'Argeno et al. 2009).
Stress, Mood and Weight Management

- The effects of stress and mood on dietary restraint and weight management success are widely acknowledged phenomenon (McElroy et al, 2004; Greeno & Wing, 1994).
- In pairs of identical twins discordant for body weight, the difference in visceral fat accumulation between siblings is associated with psychosocial stress (Marniemi et al, 2002).
- Repeated exposures to stressful life situations are associated with a greater preference for energy dense and nutrient dense foods rich in sugar and fat (Torres & Nowson, 2007).

Stress management and
appropriate / in appropriate
coping mechanisms critical factors
Stress, mood, dietary restraint and weight management
Coping as a mediator?
Hopelessness is related to both Drinking to Cope, and Eating to Cope

Both coping strategies were associated with AUDIT scores and unhealthy food consumption, respectively.

AUDIT scores and unhealthy food consumption were not related to one another in a significantly meaningful way (Reaves et al., unpublished).

Figure 1. Associations between depression, coping motives and behavioural outcomes. Data are unstandardized regression coefficients. *p < .05, **p < .01, ***p < .001, NS = non-significant, p > .05
1. Obesity at baseline increased the risk of onset of depression at follow up. Association more pronounced in Americans than Europeans and for disorder than for symptoms.

2. Overweight increased the risk of onset of depression at follow-up. This association was significant among adults but not among younger persons.

3. Baseline depression increased the odds for developing obesity. But baseline depression (symptoms and disorder) was not predictive of overweight.

**Conclusion:** a reciprocal link between depression and obesity.
How does socio-economic disadvantage influence body weight?: The mediating role of psychological distress and maladaptive coping strategies (Stewart, Christiansen & Hardman)

Significant indirect effect of lower socio-economic status on higher BMI via increased psychological distress and increased emotional eating, $b(\text{SE}) = -.02 (.01)$, $95\% \text{ CI} = -.040$ to -.006

Fig 1. Serial multiple mediation analysis with Socio-economic status as the independent variable (IV), BMI as the dependent variable (DV), and psychological distress and emotional eating as the first and second mediators, respectively. Values are unstandardized regression coefficients (SEs in parentheses) and associated p-values. Bracketed association = direct effect (controlling for indirect effects).

Adults (N = 150), Aged 18 to 65 years from a range of socio-economic backgrounds. Cross sectional design
Binge Eating Disorder (BED), OVERWEIGHT & OBESITY

15-30% of patients in weight control clinics could meet DSM IV BED criteria

**Nature of the Binge**
Food typical includes sweet, high-calories foods characterised by:
- hedonic pleasantness
- forbiddenness
- ease of rapidly consumption

**Triggers of a binge**
- Dysphoric mood
- Negative affect
- Stress (food = comfort and relief)
- Potent stressors → interpersonal
- Intense hunger
- Presence of food
- Food Craving
- Alcohol ingestion

BED sufferers can have varying degrees of obesity and a long history of attempting to diet and restrict daily food intake.

But in weight control clinics obese BED sufferers tend to have a greater degree of obesity.

Obese BED sufferers also have high degrees of:
- self loathing
- disgust with body size
- depression
- anxiety
- somatic concern
- interpersonal sensitivity

Extreme lack of control
INHIBITORY CONTROL FOR FOOD INTAKE

Impairments, cravings and BMI
Training and healthy eating behaviour
What is inhibitory control?

- The ability/inability to stop, change or delay an inappropriate response, in the environment (Logan et al, 1986)

**Inhibitory control and food**

- Exposure to high-calorific food cues reduces ability to inhibit behaviour in healthy weight, and overweight individuals
- Associations between impairments and craving for food and BMI – possible risk factor for obesity (Jones et al, in prep)
Inhibitory control

Satiety

Cravings

Homeostasis: Negative Feedback

Boosts

Impaired

Persistent

Increased BMI

Hedonic Drive: Positive Feedback
Training inhibitory control

- If food-specific inhibition deficits are a risk factor, can we train individuals to inhibit to food cues?
- By repeatedly presenting signals to inhibit an approach we can change individuals response from approach to avoid

Effects in the real world

- Repeated training via the internet reduce unhealthy snacking and BMI (Veling et al 2014, Lawrence et al, 2015). This is Promising

- However, outcomes are often self-reported (which carry bias) and interventions are tested in healthy-weight individuals who are not motivated to lose weight (Jones et al, in prep.)

- There is a need for replication in individuals who are motivated to lose weight, using objective outcomes
ADJUNCT
Personalised Inhibitory Control Training
Problem foods / Problem Situations

Inhibitory control

Satiety

Cravings

Homeostasis: Negative Feedback

Improved weight Management Outcomes

Reduced in number and strength

Hedonic Drive: Positive Feedback

Strengthened

BOOSTS

Improved weight Management Outcomes

Reduced in number and strength
Summary

- Weaker regulatory control and a liability for that control to be overwhelmed by environmental cues is associated with elevated BMI
- Elevated cue reactivity and cravings associated with high BMI and cravings linked to overconsumption
- Adverts for food provide a potent illustration of this effect in children of differing weight status
- Dieting and energy restriction also impact on food cue reactivity and craving and this may further compromise appetite control
- There is a Psychology of obesity
  - Obesity impact on quality of life and stigma plays a role. Discrimination has real impact
  - Stress, mood and coping style as also critical and may mediate the link between social economic status, depression and obesity

_BUT ARE INDIVIDUALS WITH OBESITY PSYCHOLOGICAL DISORDERED?_
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