Body weight status, eating behavior, sensitivity to reward/punishment, and gender: relationships and interdependencies

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Introduction

- Obesity is typically associated with eating behavior (Bellisle et al., 2004), but recent studies also found relationships with personality traits like reward responsiveness (Davis et al., 2008).
- This study’s goal was to quantify the individual and joint contribution of eating behavior (dietary restraint, disinhibition of eating, hunger) and obesity-relevant personality traits (self-report reward/punishment sensitivity) to BMI variance explanation.
- A special focus was on gender-dependent effects.
- Further, the relationship between body mass index (BMI) and eating behavior (especially dietary restraint) seems to be more complex than previously described. We aimed at modeling this relationship.

Methods

QUESTIONNAIRES

TFEQ Three-Factor Eating Questionnaire (Stunkard and Messick, 1985), measures three dimensions of eating behavior:
1) CR (cognitive restraint, intent to control food intake)
2) DIS (disinhibition, overeating tendencies)
3) L/H (hunger, food intake in response to feelings of hunger)

BIS/BAS Scales: quantifies responsiveness of the behavioral inhibition (BIS measure of sensitivity to punishment) and activation system (BAS measure of sensitivity to reward) (Carver and White, 1994)

SUBJECTS

two cohorts of healthy subjects (age 18-46, BMI 18-47):
(1) TFEQ-only TFEQ assessed, n=326 (181 men)
(2) TFEQ-plus: subgroup of the former; also BIS/BAS assessed, n=192 (110 men)

Results

1. BMI modeling based on eating behavior (TFEQ)

- regressors included in the model (significantly correlating with BMI): CR, DIS, CR', CR'DIS, gender, age
- BMI variance explanation: ~ 23%

Figure 1: Interaction of DIS and CR on BMI (TFEQ-only cohort, n=326). CR attenuates the effect of DIS on BMI.

Partial correlation of BMI\(r = 0.203\) (p<0.005; adjusted \(R^2\) change = 0.163). Dots indicate percentiles of BMI (20.2, 21.8, 24.9, 30.7 and 35.3 kg/m²). Colors indicate percentiles of CR (1, 3, 6, 9, 13).


2. BMI modeling based on eating behavior (TFEQ) & sensitivity to reward (BIS) and punishment (DIS)

- regressors included in the model: CR, DIS, CR', CR'DIS, BIS, BAS; gender, DIS, BIS, BAS; gender, age
- BMI variance explanation: ~ 27% (women: ~ 32%; men: ~ 25%)

Figure 2: Opposing relationships between BMI and BIS in women and men (TFEQ-plus cohort, n=192). The relationship of BIS and BMI is moderated by gender (women: positive association, men: negative associations similar for BIS).

Partial correlation of BMI (age as covariate) with BIS is 0.214 in women (p=0.012) and 0.195 in men (p=0.118). Dashed lines indicate 95% confidence interval.

Figure 3: BMI variance explained by final regression model in men and women. Depicted are squared part correlations of all variables of the final BMI model (TFEQ-plus cohort, n=192).

3. Quadratic interaction of BMI, DIS on CR

model of interdependencies between restrained eating, overeating and weight status

Figure 4: Inverted U-shaped relationship between BMI and CR moderated by DIS (TFEQ-only cohort, n=326). The curvilinear relationship is well pronounced for low levels of DIS but there is no strong curvilinear relationship for high levels of DIS.

Partial correlation of BMI\(\text{DIS} = 0.185\) (p=0.016; adjusted \(R^2\) change of 0.063). Dots indicate percentiles of DIS (20.2, 21.8, 24.9, 30.7 and 35.3 kg/m²). Colors indicate percentiles of CR (2, 4, 6, 8, 10).

Discussion

Just two measures of eating behavior - the individual level of overeating tendencies together with the level of conscious efforts to restrict food intake - explained already 23% of BMI variance. Exploring the apparent non-linear relationship between CR and BMI revealed an inverted U-shaped association moderated by the level of DIS. In other words, the curvilinear relationship between BMI and CR was well pronounced for low levels of DIS whereas there was no strong quadratic relationship with higher levels of DIS. We concluded that dietary restraint is

low in normal weight individuals with a low level of DIS as food restriction is not necessary. With higher BMI dietary restraint becomes necessary as losing weight or avoiding further weight gain are supposedly more frequent. Obese individuals, as the model indicates, might not be able to raise sufficient self-control resources to restrain eating. With heightened overeating tendencies (higher level of DIS), normal weight individuals presumably increase conscious efforts to restrict food intake in order to maintain weight. Overweight and obese individuals, on the other hand, do not adequately adapt their eating behavior. Eating seems to be dominated by an uncontrolled eating style. The reverse relationships between BMI and CR in men (negative association) and women (positive association) might be due to gender related differences regarding the value of palatable food, with heightened motivation for hedonic food particularly in women (Cepeda-Benito et al., 2003). Gender differences regarding the relationship between BMI and DIS might result from differences in emotional eating, with hedonic eating serving as a way to compensate negative emotional especially in women (van Strien et al., 2013).


Thomas Beier, The O’Brain Project - The Interplay of Brain and Behavior in Obesity

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