

Restrained eaters consume more food only if they are impulsive and male.

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## Abstract

This study utilised the preload paradigm to evaluate whether dietary restraint, impulsivity, or their interaction significantly predicts heightened food consumption among male and/or female participants. Following a high calorie preload, 79 participants aged 18 to 40 (53 females and 26 males) completed a deceptive taste test and questionnaires measuring restraint and impulsivity levels. A series of hierarchical regressions were run, controlling for self-rated hunger levels. A significant negative association between level of restraint and food consumption post-preload was found for males, but this relationship was not significant for female participants. The hypothesis that impulsivity would directly predict heightened food consumption was not supported for either gender. However, impulsivity was found to significantly moderate the relationship between restraint and food intake in the male sample, but not the female, providing partial support for this hypothesis. Potential reasons for this gender-specific interaction effect of impulsivity and restraint for food consumption are discussed. More broadly, present findings highlight the need for further consideration of the role of impulsivity in undermining food intake of restrained eaters. Future research should also consider how preload effects may differ across gender.

*Keywords:* Preload, Restraint, Impulsivity, Gender; Food consumption

## **1. Introduction**

Dieting is characterised by the intention to restrict food intake (Herman & Mack, 1975), and is a commonly attempted method for weight reduction (Wardle & Beales, 1987). Despite the intention to reduce intake, there is evidence that dieting and bingeing co-occur (Polivy & Herman, 1985), and that dietary restriction predicts weight gain (Snoek, van Strien, Janssens, & Engels, 2007). The preload paradigm is a common experimental method used to investigate the link between restraint and episodes of overeating.

The preload paradigm involves monitoring of participant food consumption of unhealthy yet desirable foods after consuming a forced preload (energy-dense food or liquid; Herman & Polivy, 2005). Preload studies are often conducted under the pretence of a taste perception experiment to ensure participants are unaware that their overall food consumption is being measured (e.g., Jansen, 1996; Adams & Leary, 2007). Studies have found significant variation in the amount of food that people consume post-preload, with some evidence that restrained eaters consume more than unrestrained eaters (e.g., Herman & Mack, 1975; Herman & Polivy, 1975). Restraint theory explains this counter-intuitive finding by stating that violations in dieting rules lead to excessive food consumption (Snoek et al., 2007).

Despite earlier support, more recent studies investigating this counter-regulation effect have yielded inconsistent results. These inconsistent findings may be partially attributed to use of distinct measures of restraint that tap into different aspects of overeating (Lowe & Thomas, 2009). The Restraint Scale (RS; Polivy, Herman, & Warsh, 1978), which has most consistently found the counter-regulation effect (Herman & Mack, 1975; Herman & Polivy, 1975; Rotenberg & Flood, 2000), seems to conflate several aspects of overeating (restriction, disinhibition, and guilty eating), and is not a pure measure of restraint (Heatherton, Herman, Polivy, King, & McGree, 1988). In contrast, other restraint measures from the Dutch Eating Behavior Questionnaire (DEBQ; van Strien, Frijters, Bergers, & Defares, 1986) and Three Factor Eating Questionnaire (TFEQ; Stunkard & Messick, 1985), which are purer measures of restraint success (Heatherton et al., 1988; van Strien, Cleven & Shippers 2000), have typically failed to predict post-preload consumption (e.g., van Strien et al., 2000; Wardle & Beales, 1987).

Due to issues of conflation, it is unclear why RS scores positively associated with food consumption in past studies. One possibility is that success of attempted

restraint depends on another personality trait (impulsivity), which refers to a person's tendency to act with insufficient forethought, planning, or control (Solanto et al., 2001). Limited available evidence suggests that impulsivity both directly predicts overeating (Guerrieri, Nederkoorn, Stankiewicz et al., 2007; Guerrieri, Nederkoorn, & Jansen, 2007), and moderates the restraint-food consumption relationship (Guerrieri Nederkoorn, Schrooten, Martijn & Jansen, 2009; van Koningsbruggen, Stroebe, & Aarts, 2013). However, previous studies investigating dietary restraint and impulsivity have been predominantly conducted using female participants (e.g. Jansen et al., 2009; Guerrieri et al., 2009), and the single study that included male participants (van Koningsbruggen et al., 2013) analysed the sample as a whole rather than testing for gender differences in the prediction of food consumption.

Therefore, the aim of the current study is to extend on prior research by re-evaluating the effects of dietary restraint, impulsivity, and their interaction on food consumption for male and female participants, separately. Although previous studies asked participants to refrain from eating for a specified period prior to participation (e.g., Polivy, Herman, Younger, & Erskine, 1979; Rotenberg & Flood, 2000), equalizing time since last meal does not guarantee that individuals have comparable hunger levels at time of testing. Therefore, the present study instead used self-rated hunger level, as per Lowe and Maycock (1988), as a covariate to control for the possibility that hunger levels conflate attempts to measure individual differences in post-preload food consumption.

Based on aforementioned evidence, it was hypothesized that impulsivity would have a direct effect on food consumption, and that the effect of restraint on food consumption would depend on co-occurring level of impulsivity. Specifically, impulsive individuals would consume more post-preload (Hypothesis 1), and individuals with higher restraint would also eat more post-preload, but only if they were also impulsive (Hypothesis 2). In the absence of prior research testing gender differences, it was anticipated that the influences of impulsivity and restraint on food consumption would generalize across genders.

## **2. Method**

### **2.1. Subjects**

The sample comprised 79 normal weight participants aged 18 to 40 ( $M=24.65$ ,  $SD=6.08$ ), 53 female (Age:  $M=25.62$  years,  $SD=6.72$ ) and 27 male (Age:  $M=22.65$

years,  $SD=3.91$ ). Females were significantly older ( $t_{(74.65)}=-2.47, p = .016$ ) and reported significantly lower levels of impulsivity than males ( $t_{(77)}=-2.12, p = .041$ ). Gender differences were non-significant for food consumption ( $p = .298$ ), restraint ( $p = .091$ ), and hunger level ( $p = .435$ ).

## 2.2. Materials

2.2.1 Preload. A 250ml glass of chocolate milk (200 kcal, 19% protein, 58% carbohydrate, and 23% fat). Previous studies have shown that this preload amount is sufficient to elicit the counter-regulation of eating behaviour (Herman & Mack, 1975; Herman, & Polivy, 2005).

2.2.2 *Deceptive Taste Test*. 50g bowls of both ‘Arnott’s brand Barbeque Shapes’ (260 kcal), and equivalent ‘ALDI supermarket brand Barbeque Snackos’ (256kcal; both a type of savoury biscuit), and 100g bowls of both ‘M&M’s’ (486kcal) and ALDI supermarket brand equivalent ‘Munchers’ (476kcal; both a type of chocolate candy in a crisp shell).

## 2.3. Measures

2.3.1. Restraint scale from the Dutch Eating Behaviour Questionnaire (DEBQr; van Strien et al., 1986). Ten items (e.g., “Do you try to eat less at mealtimes than you would like to eat?”) are ranked on a 5-point Likert scale and scores range from 10 to 50, with higher scores indicative of greater levels of restraint. Cronbach’s alpha was .86.

2.3.2. Barratt Impulsivity Scale (BIS short form; Spinella, 2007). Fifteen items (e.g., “I do things without thinking”) are ranked on a 4-point scale and scores range from 15 to 60, with higher scores indicative of higher impulsivity. Cronbach’s alpha was .81.

2.3.3. Current hunger level. A single item (“How hungry are you right now?”) was asked prior to the preload. Participants responded on a 10-point Likert scale (1 = not at all, to 10 = extremely).

## 2.4. Procedure

This study was part of a larger study approved by the university ethics board.

Participants were recruited through university notice boards and social media to be part

of a taste test study evaluating food preferences. Participants were tested individually in an office at a time of mutual convenience. Participation involved (in the following order): (1) A standardised statement was read to participants explaining the taste test experiment and the aim of the taste test study (2) consuming a preload (milkshake), (3) participating in a taste test wherein they were asked to taste and rate the desirability of four foods (presented together in the order of snakos, shapes, munchers, and M&Ms), and (4) filling out a questionnaire with measures of restraint, impulsivity and hunger. Prior to excusing him/herself from the room under the pretense of needing to complete another work task, the experimenter told participants they could eat the remaining food in the taste test as it would be thrown out. The experimenter returned 15 minutes later, and the participant was asked if they knew the purpose of the study, was debriefed and her/his bowls were weighed in order to ascertain how much s/he ate *ad libitum*.

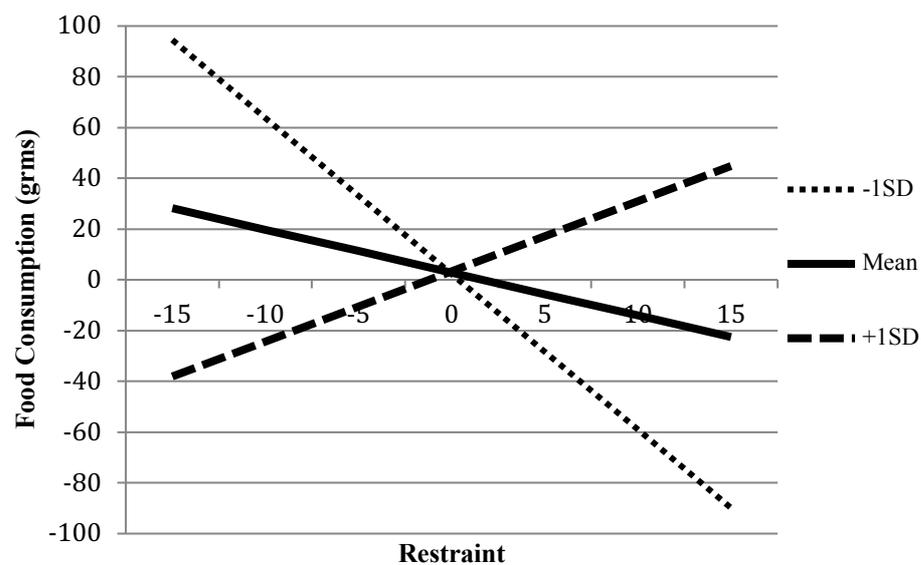
### 3. Results

Less than 5% of data were missing, and were replaced using expectation maximisation (Nelwamondo, Mohamed, & Marwala, 2007). No outliers were identified and assumptions of normality were met. The average female consumed 51.77g ( $SD=37.86$ ) of food, had a restraint score of 27.32 ( $SD=7.53$ ), an impulsivity score of 29.47 ( $SD=5.28$ ), and reported their hunger level as 4.85 ( $SD=2.44$ ). The average male in the sample ate 61.88g ( $SD=45.00$ ) of food, had a restraint score of 24.12 ( $SD=8.40$ ), an impulsivity score of 33.23 ( $SD=8.25$ ), and reported their hunger level to be 5.29 ( $SD=2.10$ ). Further, only 4% ( $n = 3$ ) correctly identified the purpose of the study. The majority of participants believed the study was a taste test as advertised ( $n = 61, 77\%$ ), and the remainder indicated that they were unsure about the real aim of the study ( $n = 15, 19\%$ ).

Hypothesis testing was conducted using separate hierarchical regressions for males and females (Table 1). Step 1 regressed amount of food consumed on hunger level. Hunger level significantly predicted food consumption for males and females, accounting for 7% and 15% of variance, respectively.

Restraint and impulsivity main effects were added to the model at Step 2 and did not significantly improve either model's  $R^2$ . Restraint did not have a significant unique contribution to the model for females, but uniquely contributed 17% of variance in food consumption for males. Impulsivity was found to be a non-significant unique contributor in both models.

The interaction between restraint and impulsivity was introduced at Step 3. The predictive power of the model significantly improved for males, but not for females. The strongest unique contributor for females was hunger level ( $sr^2 = .07$ ), while for males restraint had the largest squared semi-partial correlation ( $sr^2 = .17$ ), although its effect should be interpreted with caution as the restraint-impulsivity interaction was significant for males. Post hoc probing (Preacher, Curran, & Bauer, 2006) of this interaction revealed that the negative association between restraint and food intake was significant at low levels of impulsivity ( $t = -4.32, p < .001$ ), weakened in strength at the mean for impulsivity ( $t = -2.19, p = .017$ ), and changed to a significant positive association at high levels of impulsivity ( $t = 1.85, p = .035$ ; see Figure 1).



**Figure 1.** Simple slopes analysis at impulsivity levels of: 1 SD above the mean, at the mean and 1 SD below the mean.

**Table 1**

Hierarchical regression of Hunger level, DEBQr and BIS

Steps	Female						Male					
	R <sup>2</sup>	F <sub>change</sub>	df	β	sr <sup>2</sup>	r	R <sup>2</sup>	F <sub>change</sub>	df	β	sr <sup>2</sup>	r
Step 1	.07	3.56*	1,51				.15	4.29*	1,24			
	Hunger Level			.26*	.07	.26*				.39*	.14	.39*
Step 2	.08	0.26	2,49				.31	2.43	2,22			
	Hunger Level			.26*	.07	.26*				.35*	.14	.39*
	DEBQr			-.07	.00	-.08				-.37*	.17	-.41*
	BIS			.07	.01	.04				-.10	.04	-.19
Step 3	.09	0.72	1,48				.49	7.35**	1,21			
	Hunger Level			.27*	.07	.26*				.47**	.14	.39*
	DEBQr			-.09	.01	-.08				-.50**	.17	-.41*
	BIS			.07	.00	.04				-.06	.04	-.19
	DEBQr x BIS			-.12	.01	-.09				.46**	.04	.19

\*p&lt;.05, \*\*p&lt;.01, one-tailed.

#### 4. Discussion

Although previous studies have shown that those who score high on the Restraint Scale eat more following a food preload (e.g., Herman & Mack, 1975; Herman & Polivy, 1975; Rotenberg & Flood, 2000), findings from studies using purer measures of restraint (e.g., DEBQ-R) suggest that this counter-regulation effect is not due to restraint efforts *per se* (van Strien et al., 2000; Wardle & Beales, 1987). Given that some - but not all - individuals who overeat report diminished impulse control (Fernández-Aranda, et al., 2006), the present study tested the possibility that counter-regulation among restrained eaters is moderated by impulsivity. As the role of impulsivity in preload food consumption has primarily been tested in female populations, the present study also explored potential gender differences in the roles of restraint and impulsivity for predicting food consumption.

Consistent with the notion that the DEBQ-R measures successful dieting (Lowe & Thomas, 2009), participants who more strongly identified as restrained eaters ate less post-preload, although this effect was more pronounced for male participants in the present study. However, present findings also show that, for males at least, restrained eaters who were low on impulsivity eat less post-preload, whereas restrained eaters with elevated impulsivity scores actually eat more. Thus, although impulsivity did not directly predict food consumption, present findings suggest that it may indirectly influence food intake by undermining attempts to diet among those who identify as restrained eaters.

It is unclear why this moderation effect was only apparent for male participants, as past studies have demonstrated this effect in female samples (Guerrieri, Nederkoorn, Stankiewicz, et al., 2007; Yeomans, Leitch, & Mobini, 2008). One plausible explanation is that increased variability in the impulsivity variable for males facilitated more meaningful separation of individuals into levels of impulsivity (high, moderate, and low). Allied to this, the average level of impulsivity was higher for males in the present study, meaning that more male participants were likely to have high impulsivity. Such an explanation also fits with results of the post-hoc probing of the interaction effect for males; the relationship between restraint and food consumption only became positive at high levels of impulsivity. Further research is needed to determine the replicability of this gender difference.

Present findings should be placed within the context of differences in design from previous studies. First, this study included self-rated hunger level as a covariate

instead of instructing participants to abstain from food prior to testing (e.g., Guerrieri, et al., 2009; Herman & Polivy, 1975). Given the likelihood that equalizing time since last meal fails to ensure that individuals have comparable levels of hunger at time of testing, the present study suggests that asking participants about hunger level is easy to incorporate into the existing preload paradigm and, moreover, may control considerable noise that otherwise confounds measurement of the food consumption outcome.

Second, previous studies involving impulsivity and the preload paradigm have ensured participants ample time to consume food without distractions from experimental requirements (e.g., Guerrieri et al., 2009; van Koningsbruggen et al., 2013). The sequential nature of this experiment, outlined to participants, allowed individuals very little time to sit with nothing but the food in front of them. This may have resulted in participants, especially those who are impulsive, not eating as much as they would have. With this considered, the interaction found in males between dietary restraint, impulsivity and food consumption carries greater significance.

In summary, present findings support the notion that co-morbid personality factors (in particular, impulsivity) influence the amount of food that restrained eaters consume post-preload manipulation. The interaction found between restraint, impulsivity and food consumption in males has significant implications for this field of research as it demonstrates the potential utility of the preload paradigm to investigating eating behaviours in males. Future research should focus not only on clarifying the relationship between impulsivity, restraint, and food consumption, but also consider introducing male participants into their studies. Confirmation of observed gendered effects is needed.

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