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Does measuring body weight impact subsequent response to eating behavior questions?

Carly R. Pacanowski, PhD RD^{1,2}, Jeffery Sobal, PhD¹, David A. Levitsky, PhD¹, Nancy E. Sherwood, PhD², Chelsey L. Keeler, BS¹, April M. Miller, BS¹, Ashley R. Acosta, BS¹, Natalie Hansen¹, Peter L. Wang, BS¹, Sarah R. Guilbert, BS¹, Arianne L. Paroly¹, Michael Comness, BS¹, and Francoise M. Vermeulen¹

¹Division of Nutritional Sciences, 119 Savage Hall, Cornell University, Ithaca New York 14853 USA

²Division of Epidemiology and Community Health, 300 West Bank Office Building, University of Minnesota, Minneapolis MN 55401 USA

Abstract

If being weighed impacts perceptions of eating behavior, it is important that the order of questionnaires and weighing be considered in research and practice. A quasi-experimental study was performed to examine whether being weighed immediately prior to completing a questionnaire affects responses to eating behavior questions. It was hypothesized that being weighed would serve as a priming stimulus and increase measures of dietary restraint, disinhibition, and hunger. Trained researchers collected a sample of volunteers ($n = 355$) in 8 locations in the United States on two Saturdays in the summer of 2011. Half of the participants were weighed immediately prior to completing the Three Factor Eating Questionnaire (TFEQ), with the remaining half weighed immediately after TFEQ completion. A priori hypotheses were not supported despite replicating known relationships between weight, dietary restraint and disinhibition. Results indicated that being weighed first produced a difference in differences on disinhibition scores between low restraint score (95% CI = 4.65–6.02) and high restraint score (95% CI = 6.11–7.57) compared to being weighed after questionnaire completion ($p = 0.003$). However, this relationship was not significant when modeling restraint as a continuous variable, questioning the use of dichotomization. Being weighed is unlikely to be a strong enough prime to significantly change scores on eating behavior questionnaires for everyone, but may allow differences in restraint status to become more evident. Researchers assessing dietary restraint should be wary of the possibility of producing different results when treating restraint as continuous or dichotomous, which could lead to different interpretations.

Keywords

body weight; priming; disinhibition; restraint; Three Factor Eating Questionnaire

Introduction

Existing data suggests that self-weighing aids weight loss and improves weight maintenance [1–6]. The mechanism through which self-weighing influences body weight has not been determined, and there are a number of reasonable possibilities. Weighing may merely provide information that could guide eating behavior or behaviors involved in changing energy expenditure much like a biofeedback system [7]. Alternatively, any change in weight may either positively or negatively reinforce weighing behaviors that led to the change.

An interesting potential mechanism to account for the effect of self-weighing on weight control is that weighing on a scale may act as a “prime” that affects subsequent responses to environmental stimuli. Though traditionally primes refer to concepts [8] primes can include environmental stimuli that non-consciously activate mental schema and can influence thoughts, perceptions, and behavior [8]. If the act of weighing operates as a prime then it should affect responses to stimuli differently than if weighing did not occur.

The purpose of the present study was to examine the act of weighing as a prime in people completing self-reports of eating behavior. Examples of eating behaviors that were hypothesized to be affected by priming are ‘hunger’, ‘restraint’, and ‘disinhibition’ as assessed by the Three Factor Eating Questionnaire (TFEQ) [9]. One’s subjective perception of their level of regulating their own eating is a fundamentally different concept than the objective behavioral weight measurement that could be used as an indication of the degree of regulation. Subjective perception of the degree of restriction used to maintain weight may be different for those of identical body weight.

There is a debate about the psychological helpfulness or harmfulness of weighing in body weight management [10, 11], but it is not currently clear if weighing primes important personal characteristics like hunger, restraint or disinhibition. It is possible that there are individual differences in how being weighed impacts self-perception of eating behavior. For example, Strimas and Dionne [12] found that self-weighing led to weight gain in restrained eaters and weight loss in unrestrained eaters. Understanding whether the activation of awareness of personal characteristics is affected by weighing in particular populations may help to distinguish between persons that can benefit from weighing versus persons that may be adversely affected.

If being weighed impacts the way people perceive their own eating behavior, this may provide an avenue for understanding why frequent weighing is associated with prevention of weight gain or improved weight control. Furthermore, it is unclear whether the dimensions used in the TFEQ are stable traits or malleable constructs; Lowe & Thomas [13] only cite two studies examining test-retest reliability over periods of longer than a few weeks. If there are significant between group differences in TFEQ subscale score for each of the eating behaviors of interest – restraint, disinhibition, and hunger – this may indicate that these measures are influenced by environmental circumstances. This would mean that the order of when weight measurement is taken during a study, at a healthcare practitioners’ office, or other situations may affect the responses of questionnaires like the TFEQ.

It was hypothesized that TFEQ responses for restraint, disinhibition, and hunger will be higher after being primed by being weighed than the TFEQ responses not primed by weighing. The rationale is that people might not be aware of their weight and be surprised to see their weight, and then use the questions to rationalize or lessen cognitive dissonance between what they expected and the value the scale reported. Most people report their weight to be less than it actually is [14], so the number reflected by the scale will likely be more than what people expect to see. This may create a dissonance between what was believed about one's weight and what the scale reflects the actual weight to be. To balance this dissonance, people may answer TFEQ questions about their eating behavior (e.g. "Dieting is hard for me because I just get too hungry"; "I eat anything I want, anytime I want") affirmatively to help to justify why they weigh more than they thought they did. Answering more items affirmatively would lead to an increased eating behavior score.

To address posthoc hypotheses that this relationship may be evident in subpopulations, further exploratory analyses were conducted to determine whether restraint status and weighing condition affected response to the TFEQ disinhibition subscale questions, as restraint status has been found to moderate similar relationships [e.g. 15]. Sensitivity analyses were conducted using hunger.

Methods

Participants

This study sought to assess the effect of priming in a real world setting using individuals that happened to be walking through the public space of each location during the specified time. Participants (n = 355) were over the age of 18 and roughly half male and half female, and of varying ages and ethnicities.

Materials

Stunkard and Messick [9] developed the Three Factor Eating Questionnaire (TFEQ) to measure three components of eating behavior: 'cognitive restraint of eating', 'disinhibition', and 'hunger'. Cognitive restraint of eating, often termed dietary restraint is the conscious act of controlling one's intake, while disinhibition measures responsiveness to external eating cues and also eating in response to internal emotional cues. Hunger assesses the degree to which a person eats due to believed or actual physiological need. This tool improved upon previous assessments of dietary restraint by acknowledging that the scores were influenced heavily by change in body weight. The TFEQ assesses intentions of the individual as compared to behavioral caloric restriction and weight change. The TFEQ measures the respondent's perception of their eating behavior. The TFEQ has been used widely in the literature; and Lowe and Thomas [13] review its history and applications in different samples.

Research assistants were provided with a typical bathroom scale (American Weigh 330LPW Low Profile Bathroom Scale; Norcross, GA, USA), printed copies of the TFEQ, a clipboard, pens, and an interview script to use when approaching potential participants.

Procedure

A quasi-experimental between-subjects design was employed. Eight research assistants were trained by the PI to approach adults of varying body weights, genders and ethnicities in a public location in one town on two subsequent Saturdays in the summer of 2011. Research assistants were normal weight and of varying genders and ethnicities. Each researcher was randomly assigned to perform either 'weight first' (weigh participant and then ask them to fill out the TFEQ) or 'survey first' (ask participant to fill out the TFEQ and then weigh them) on the first Saturday of data collection. The second Saturday, the other condition was performed. The study was executed between the hours of 1pm and 5pm to avoid overlapping with mealtimes. Research assistants were directed to collect information from 25 people each Saturday. Issues related to confounding were managed during data collection; for example, on the 'survey first' day, the scale needed to be hidden during the survey administration and potential participants in view of a participant being weighed were not recruited because this could bias results since they might realize they were going to be weighed. In the 'survey first' condition, participants were handled by the researcher keeping the scale concealed in a bag and allowing each participant to complete the survey before being weighed. Procedures were approved by the University Institutional Review Board before the study was conducted.

Sampling was completed in 8 different locations: three different sites in Ithaca, New York; and one site at Case Western Reserve Campus, Cleveland Ohio; Holtsville Ecology Center and Park, Long Island New York; Oakland, California; and Princeton, New Jersey. The three Ithaca locations are frequented by demographically different subpopulations.

On each test day people were approached and asked if they were over the age of 18 and would be willing to take 5 minutes to help a researcher. They were then given either the TFEQ survey, or asked if they could be weighed, or the reverse. The survey questions were limited to the TFEQ to minimize the time burden and maximize the participation rate.

Survey data were collected from 355 individuals. Weight information was collected from 343 individuals (12 individuals refused to have their weight measured). Survey responses were entered and summary TFEQ scores were tabulated according to Stunkard & Messick's [9] original publication of the TFEQ.

Restraint, hunger, disinhibition, and weight all approximated a normal distribution. Data were analyzed for missing values. The items from the questionnaire with the largest percentage of missing values were R50 (6.2% missing); D36 (5.4% missing). All other items had less than 4% missing. Scales were constructed by substituting means of non-missing items [16].

Sufficient reliability was achieved in this sample for restraint, disinhibition, and hunger (Cronbach's alpha = 0.86, 0.75, 0.79, respectively). Descriptive statistics were performed on all variables along with t-tests to examine the statistical difference between the scale first condition and survey first condition. Pearson's zero order correlations and multiple regressions were also calculated. Analyses were conducted using SPSS v20.

Results

Means and standard deviations for all measures are displayed in Table 1.

Overall, no significant differences on any of the three TFEQ eating behavior constructs (cognitive restraint, disinhibition, hunger) were found between the weighing first and weighing after condition. The weighing first and weighing after participants also did not differ in weight.

Although overall differences were not found between conditions, others have found that subpopulations are affected to a greater extent [e.g. 15]. To examine potential differences according to restraint status, general linear model was fit to examine the effect of condition, restraint, and the condition by restraint interaction on disinhibition score, while controlling for location and weight. When restraint was modeled as a continuous variable, as would be recommended [17, 18], this interaction was not significant ($p = 0.128$). However, since other priming studies have found a priming effect when dichotomizing restraint, this analysis was also performed when data were stratified according to median restraint (>8 = high restraint, $n = 176$, mean restraint score $\pm$ standard deviation = 13.0 ± 2.9 ; ≤ 8 = low restraint, $n = 179$, mean restraint score $\pm$ standard deviation = 4.5 ± 2.4). When the same general linear model was run using restraint as a categorical variable, the interaction between restraint classification (high versus low restraint) and weighing condition (survey first versus weight first) was significant ($p = 0.048$). A sensitivity test was done replacing disinhibition with hunger as the dependent variable, and the dichotomized restraint by condition interaction was not significant ($p = 0.141$). The weight by condition interaction was not significant in any model.

The significant interaction between restraint status and condition was further investigated using specific contrasts. Figure 1 displays the interaction and the specific contrasts.

The difference in average disinhibition score in high and low restrained participants was not significant in either the survey condition or the weight condition; however, the difference between these differences was significant at $p = 0.003$ as depicted in the figure. In other words, the difference in average disinhibition score between the survey first and weight first groups (about + 0.7 points) in low restrained individuals was significantly different from the difference in average disinhibition score between the survey first and weight first groups (about - 0.7 points) in highly restrained individuals.

Discussion

These findings did not support our initial hypotheses that being weighed would increase responses for restraint, disinhibition, and hunger scores as measured by the Three Factor Eating Questionnaire (TFEQ). Methodologically, it is possible that with a larger sample size, a difference between disinhibition and hunger may have emerged, with the being weighed first condition producing increased scores for these eating behaviors. Substantively, there are a number of possible explanations as to why the findings did not correspond with our hypothesis. Perhaps the most plausible is that although the TFEQ asks questions about eating behavior, the questions assess relatively stable traits as opposed to malleable

behaviors. As psychological traits, the TFEQ scores could be impervious to the more concurrent effects of priming. Overall, it is likely that the ordering of administration of an eating behavior questionnaire and taking weights does not significantly affect responses in most individuals.

In explaining and interpreting these findings, it is important to remember that this study did not measure behavior (e.g. food consumption). When measuring food consumption behavior, Brunner [19] found that presence of a body weight scale decreased chocolate consumption and Brunner and Siegrist [20] found that reporting ones weight before tasting chocolates as compared to after tasting chocolates decreased consumption. In addition, activation of self-regulatory concerns, partially done by self-weighing, caused decreased consumption of potato chips [21]. In this study, it could be that the cognitive dissonance experienced by being weighed is not sufficient to change perceptions of long term eating behavior, but as others have found, the anxiety resulting from the dissonance may have an effect on short term consumption regardless of level of restraint [28]. Alternatively, our primary assumption that people would be surprised to find out their weight may only occur for a subset of the individuals measured. It could be that some of the sample actually expected their weight to be higher than it was and some did not have a preconceived expectation about their weight, attenuating any results from those whose weight was greater than expected.

Some research evaluating effects of food primes has shown that when dichotomizing restraint, restrained individuals, as compared to unrestrained individuals, respond to food primes, such as the smell of food or being instructed to think about food, by consuming more [15]. In a previous study [15], analyses using restraint as a continuous variable were not presented. Wansink and Shimizu found that restrained but not unrestrained eaters were impacted behaviorally by food-related television programs – they consumed more [22]. Those authors stated that restraint was also analyzed as a continuous variable but that results were similar; only dichotomized results were presented. Others have presented results that treat restraint as a dichotomized variable, after noting and providing evidence for a non-linear interaction [23]. In this previous study, it is not clear if the interaction would have been observed using regression.

On the contrary, some researchers use restraint as a continuous measure [24, 25] and do find significant interactions between restraint and prime manipulation on intake. This provides evidence to support the idea that intake is more variable than responses to the TFEQ or the manipulation of weighing is not strong enough to influence eating behavior scores. It is also of note that the authors using intake as their dependent variable tend to suggest that intake is manipulated nonconsciously. It could be that by asking pointed questions about eating behaviors, we are bringing these behaviors to conscious awareness and reducing the nonconscious priming effect. Interestingly, Stroebe and colleagues [23] note that in Study 2 and Study 3, where a manipulation was done prior to participants filling out the Concern for Dieting portion of the Restraint scale, the manipulation did not differentially affect scores. Being that the Concern for Dieting subscale is less than a quarter of the number of items in the TFEQ restraint score, it made sense that an effect might be more apparent using the TFEQ.

The present study found that the difference in disinhibition between highly restrained individuals and low restrained individuals in the survey first condition was significantly different than the difference between highly restrained and low restrained individuals in the weighing first condition. However, this relationship was not statistically significant when modeling restraint as a continuous variable, calling into question the practice of dichotomization, as other researchers have [17, 18]. Nonetheless, it is important to remember that this study examined the effects of the weight prime on a sample that may be more generalizable than samples recruited by laboratory studies, with many more confounding variables. Though the effect was small, and the finding was a difference in differences, it could be that a weak signal is appearing that is supportive of what has been found with restrained eaters in more controlled laboratory situations (see discussion in next paragraph).

Other studies have shown that restrained eaters may react differently than unrestrained eaters when primed with dieting concepts. On a more abstract level, Papies, Stroebe and Aarts [26] found that by priming dieting, they were able to counter the attentional bias restrained eaters showed toward hedonic foods. Similarly, Anschutz, Van Strien and Engels [24] found that commercials including slim models or diet products seemed to reinforce the restraint concept in restrained eaters, enabling them to stick to their dieting goal, while neutral advertisements increased consumption in restrained eaters. The finding that restrained eaters were able to restrain themselves when being primed with dieting was in conflict with many other studies that have shown that dieting stimuli may act as a disinhibitor. For example, Anschutz & colleagues [24] pointed out the distinction between using the Restraint Scale [27] and using the Dutch Eating Behavior Questionnaire to measure restraint; the former is confounded with items assessing overeating and may select for restrained individuals that also overeat. This is an important point to note, as the scale used to measure restraint could explain differential research findings.

The present research has several limitations. As mentioned, to minimize participant response burden, the survey was strictly limited to the TFEQ, as it could be completed in less than 5 minutes. We did not ask about basic demographics including gender, age, and ethnicity. These demographics could be important in elucidating relationships between weight and perceptions of eating behavior, and not including them could be masking some results. Furthermore, the between-subjects design employed in this study does not allow for controlling for other individual factors that may influence the relationship between weighing and TFEQ subscale scores. Also, expected weight was not asked before weighing, and reactions to being weighed were not assessed.

Despite these limitations, the borderline significant interaction between restraint and weighing condition is in line with what others have found [15, 22, 24, 26, 22]. The relationship between a weight prime and perceptions of long term behavior may be weaker than the relationship between a food prime and actual subsequent consumption. Future research looking at specific subpopulations could help to investigate the relationship between weighing as a prime, body weight and perception of eating behavior. If weighing does affect perceptions of behavior or behavior in a subset of individuals, this is important

information to consider when designing research studies or ordering weighing and assessments in a clinical situation.

Veling, Aarts and Papies showed that by having chronic dieters engage in a task that paired an arbitrarily assigned ‘no-go’ cue (e.g. the letter “p” or the letter “f”) with a palatable food, consumption of that food was significantly decreased over a day; this effect was not found in nondieters [29]. In this study, we presented a dieting prime (weighing on a scale) and examined its impact on perceptions of eating behavior. It is possible that dieting cues such as knowing ones’ weight could influence consumption, but future research will need to address this issue.

Conclusion

Despite the lack of effect of weighing on measures of eating behavior, future research would be useful to examine the possibility of an effect of weighing on subsequent eating behavior (e.g. consumption) to explain why frequent weighing corresponds with successful weight loss and or maintenance. Future studies should examine the possibility that this relationship may hold for particular types of individuals (e.g. those that score high on dietary restraint) and examine the role of demographic variables, which limited conclusions able to be made by this study. Employment of a repeated measures within-subject design would be advisable, along with presenting analyses of restraint as both a continuous and categorical variable and if possible discuss the potential for differential interpretations based on analysis strategy.

REFERENCES

1. Burke LE, Wang J, Sevick MA. Self-monitoring in weight loss: A systematic review of the literature. *Journal of the American Dietetic Association*. 2011; 111(1):92–102. [PubMed: 21185970]
2. Gokee-Larose J, Gorin AA, Wing RR. Behavioral self-regulation for weight loss in young adults: A randomized controlled trial. *International Journal of Behavioral Nutrition and Physical Activity*. 2009; 6(10)
3. Klem ML, Wing RR, McGuire MT, Seagle HM, Hill JO. Psychological symptoms in individuals successful at long-term maintenance of weight loss. *Health Psychology*. 1998; 17(4):336–345. [PubMed: 9697943]
4. Levitsky D, Garay J, Nausbaum M, Neighbors L, Dellavalle D. Monitoring weight daily blocks the freshman weight gain: A model for combating the epidemic of obesity. *International Journal of Obesity*. 2006; 30(6):1003–1010. [PubMed: 16446748]
5. Vanwormer JJ, French SA, Pereira MA, Welsh EM. The impact of regular self-weighing on weight management: A systematic literature review. *The International Journal of Behavioral Nutrition and Physical Activity*. 2008; 5(54)
6. VanWormer JJ, Martinez AM, Martinson BC, Crain AL, Benson GA, Cosentino DL, Pronk NP. Self-weighing promotes weight loss for obese adults. *American Journal of Preventive Medicine*. 2009; 36(1):70–73. [PubMed: 18976879]
7. Smith MS. Biofeedback. *Pediatric Annals*. 1991; 20(3):128, 130–134. [PubMed: 2017346]
8. Bargh JA, Chen M, Burrows L. Automaticity of social behavior: direct effects of trait construct and stereotype-activation on action. *Journal of Personality and Social Psychology*. 1996; 71(2):230–244. [PubMed: 8765481]

9. Stunkard AJ, Messick S. The three-factor eating questionnaire to measure dietary restraint, disinhibition and hunger. *Journal of Psychosomatic Research*. 1985; 29(1):71–83. [PubMed: 3981480]
10. Dionne MM, Yeudall F. Monitoring of weight in weight loss programs: A double-edged sword? *Journal of Nutrition Education and Behavior*. 2005; 37(6):315–318. [PubMed: 16242063]
11. O'Neil PM, Brown JD. Weighing the evidence: Benefits of regular weight monitoring for weight control. *Journal of Nutrition Education and Behavior*. 2005; 37(6):319–322. [PubMed: 16242064]
12. Strimas R, Dionne MM. Differential effects of self-weighing in restrained and unrestrained eaters. *Personality and Individual Differences*. 2010; 49:1011–1014.
13. Lowe, MR.; Thomas, JG. Measures of Restrained Eating Conceptual Evolution and Psychometric Update. In: Allison, DB., editor. *Handbook of assessment methods for obesity and eating behaviors*. SAGE; 2009. p. 137-185.
14. Gorber SC, Tremblay M, Moher D, Gorber B. A comparison of direct vs. self-report measures for assessing height, weight and body mass index: A systematic review. *Obesity Reviews*. 2007; 8(4): 307–326. [PubMed: 17578381]
15. Fedoroff IC, Polivy J, Herman CP. The effect of pre-exposure to food cues on the eating behavior of restrained and unrestrained eaters. *Appetite*. 1997; 28(1):33–47. [PubMed: 9134093]
16. Acock AC. Working with missing values. *Journal of Marriage and Family*. 2005; 67(4):1012–1028.
17. Allison DB, Gorman BS, Primavera LH. Some of the most common questions asked of statistical consultants: Our favorite responses and recommended readings. *Journal of Group Psychotherapy, Psychodrama & Sociometry*. 1993; 46(3):83–109.
18. MacCallum RC, Zhang S, Preacher KJ, Rucker DD. On the practice of dichotomization of quantitative variables. *Psychological Methods*. 2002; 7(1):19–40. [PubMed: 11928888]
19. Brunner TA. How weight-related cues affect food intake in a modeling situation. *Appetite*. 2010; 55(3):507–511. [PubMed: 20832440]
20. Brunner TA, Siegrist M. Reduced food intake after exposure to subtle weight-related cues. *Appetite*. 2012; 58(3):1109–1112. [PubMed: 22425649]
21. Do Vale RC, Pieters R, Zeelenberg M. Flying under the radar: Perverse package size effects on consumption self-regulation. *Journal of Consumer Research*. 2008; 35(3):380–390.
22. Shimizu M, Wansink B. Watching food-related television increases caloric intake in restrained eaters. *Appetite*. 2011; 57(3):661–664. [PubMed: 21864600]
23. Stroebe W, Mensink W, Aarts H, Schut H, Kruglanski AW. Why dieters fail: Testing the goal conflict model of eating. *Journal of Experimental Social Psychology*. 2008; 44(1):26–36.
24. Anschutz DJ, Van Strien T, Engels RC. Exposure to slim images in mass media: television commercials as reminders of restriction in restrained eaters. *Health Psychology*. 2008; 4:401–408. [PubMed: 18642997]
25. Papies EK, Hamstra P. Goal priming and eating behavior: Enhancing self-regulation by environmental cues. *Health Psychology*. 2010; 29(4):384–388. [PubMed: 20658825]
26. Papies EK, Stroebe W, Aarts H. The allure of forbidden food: On the role of attention in self-regulation. *Journal of Experimental Social Psychology*. 2008; 44(5):1283–1292.
27. Herman, CP.; Polivy, J.; Herman, CP. Restrained eating. In: Stunkard, AJ., editor. *Obesity*. Philadelphia, PA: Saunders; 1980. p. 208-225.
28. Rotenberg KJ, Lancaster C, Marsden J, Pryce S, Williams J, Lattimore P. Effects of priming thoughts about control on anxiety and food intake as moderated by dietary restraint. *Appetite*. 2005; 44(2):235–241. [PubMed: 15808897]
29. Veling H, Aarts H, Papies EK. Using stop signals to inhibit chronic dieters' responses toward palatable foods. *Behaviour Research and Therapy*. 2011; 49(11):771–780. [PubMed: 21906724]

Figure I.
Differences in disinhibition score by weighing condition and restraint status

Table 1

Mean score ± standard deviation for three eating behaviors and weight

	Weigh First	N	Survey First	N	p-value for difference*
Dietary Restraint	8.6 ± 5.2	170	8.9 ± 4.9	185	0.28 ^a
Disinhibition	6.1 ± 3.4	170	6.0 ± 3.2	185	0.37 ^a
Hunger	5.9 ± 3.5	170	5.6 ± 3.4	185	0.22 ^a
Weight (kgs)	163.5 ± 37.6	164	162.4 ± 36.2	179	0.78 ^b

^a p values are based on one-tailed t-tests

^b p values are based on two-tailed t-tests

* indicates statistical significance at p < 0.05