

Restraint and Internal Responsiveness: Effects of Placebo Manipulations of Hunger State on Eating

Todd F. Heatherton, Janet Polivy, and C. Peter Herman
University of Toronto, Toronto, Ontario, Canada

Restrained and unrestrained subjects were given a "vitamin" (placebo) prior to an ad-lib taste test. Subjects were either told nothing about the placebo or told that previous subjects had reported that the vitamin had made them feel either hungry or full. As predicted, restrained subjects, in two separate studies, behaved in accordance with placebo messages, eating more when given "hungry" messages than when given "full" messages. Unrestrained subjects showed an apparent reverse-placebo effect; they ate less ice cream when given "hungry" information than when given "full" information. Hunger ratings did not parallel eating behavior; possible explanations for this discrepancy are considered. We conclude that unresponsiveness to internal hunger state, and an overreliance on external cognitive cues, characterizes restrained but not unrestrained individuals.

Intuition tells us that most individuals eat when they are hungry and stop when they become sated. Disorders of eating, by the same token, are frequently regarded as disturbances of the normal associations between hunger and eating or between satiety and cessation. For instance, insensitivity to satiety sensations—and a concomitant overreliance on external cues—was long held to play a cardinal role in the development of obesity (Schachter, 1968), and the denial of hunger sensations has long been thought to characterize those with anorexia nervosa (Bruch, 1973).

Herman and Polivy (1980) have suggested that insensitivity to internal hunger cues (and an overreliance on external cues) may result when restrained individuals force themselves to ignore or override internal demands in their attempt to reduce food intake. For dieters, unresponsiveness to hunger signals may become habitual, and may generalize to related physical cues, including those associated with satiety. Choosing to ignore one's physical state in favor of cognitive regulation of eating—in keeping with a dietary quota (Polivy & Herman, 1985)—thus results in dieters' losing touch with how hungry they really are and how dependent they have become upon external or cognitive eating cues.

If restrained eaters are mainly responsive to cognitive eating cues, they should be strongly affected by cognitive manipulations of hunger. Doerman and Kronenberger (1981) showed that a cognitive manipulation of perceived stomach state affects obese but not normal-weight individuals; obese subjects ate more peanuts when told that they had just consumed low-expansion methyl cellulose capsules than when they were told they had consumed high-expansion capsules, whereas normal-weight subjects did not respond to the manipulation. Although

methodological difficulties, including the absence of a proper control group, limited the interpretation of these results, a similar placebo design may provide a practical means of examining responsiveness to hunger/satiety sensations in normal-weight restrained and unrestrained eaters.

We thus attempted a cognitive manipulation of hunger with restrained and unrestrained subjects, in which experimental subjects were told that they should expect (on the basis of previous subjects' reports) to feel either hungry or full following ingestion of a vitamin capsule. Control subjects were given no such expectation. Restrained eaters, presumed to be unresponsive to internal state (or more responsive to external cues), were expected to eat in accordance with experimental messages (i.e., more when told that previous subjects reported being hungry and less when told that previous subjects had reported that the pill made them full). Unrestrained subjects were not expected to show a placebo effect as they are presumed to eat in accordance mainly with internal state.

Study 1

Method

Subjects. One hundred and twenty-nine female undergraduates, ranging in age from 18 to 27 years, took part in this study in exchange for credit in an introductory psychology course. Nine subjects had to be discarded from the analyses for failure to follow experimental instructions. On the basis of precedent (Polivy, Herman, & Howard, 1988), those scoring 16 or higher on the Restraint Scale were designated as restrained, and those scoring 15 or lower were classified as unrestrained. Approximately half of the subjects (58) filled out the Restraint Scale on a previous occasion, whereas the remainder filled out the Restraint Scale immediately after the experiment.

Procedure. Subjects were recruited for a study examining the effects of vitamins (actually a lactose placebo pill) on perceptual mechanisms. Following a minimum 2-hr deprivation period, subjects came to the lab, filled out initial hunger ratings, and were told, "This vitamin is a new megavitamin that has recently been developed. It has been tested for safety and is, of course, perfectly safe." They were then given one of three experimental messages:

We would like to thank the Natural Sciences and Engineering Research Council of Canada for their support. We would also like to thank Jonathan Freedman and Patricia Pliner for their valuable comments.

Correspondence concerning this article should be addressed to Todd F. Heatherton, Department of Psychology, University of Toronto, Toronto, Ontario, Canada M5S 1A1.

1. Hungry message: "Probably the only thing people ever mention is that the vitamin gives them an empty sensation in their stomach, as if they hadn't eaten for a while."

2. Full message: "Probably the only thing people ever mention is that the vitamin gives them a full sensation in their stomach, as if they'd just eaten."

3. Control message: (no further information).

All of the subjects were then told that these were "special fast dissolving megavitamin capsules" that would take approximately 5 min to be absorbed into the blood stream. Subjects were assigned to experimental condition by random assignment until 10 subjects were obtained per condition. To complete the experimental design the final few subjects were assigned according to their previously known restraint status. Half of the subjects were also assigned to a preload condition (which was effective but is not relevant to the present article) and received a 15-oz chocolate milk shake. All subjects were then led into a testing room and participated in a taste-rating task typical of those used in restraint studies (see e.g., Herman, Polivy, Lank, & Heatherton, 1987).

Results

An initial analysis revealed that there were no differences between restrained and unrestrained subjects in initial hunger ratings or time of day they participated in the experiment ($t_s < 1$). Further, there were no differences between restrained ($M = 4.03$) and unrestrained subjects ($M = 3.71$; $t < 1$) in hours of food deprivation.

A three-way analysis (ANOVA) (Restraint \times Preload \times Message) revealed a significant interaction between restraint and message condition on amount of ice-cream eaten, $F(2, 108) = 4.18$, $p < .02$. This pattern may be seen in Table 1. Restrained subjects who were told that other subjects had reported that the "vitamin" had made them feel hungry ate more than those who heard that other subjects had reported that the vitamin made them feel full (Duncan's multiple range test, $p < .05$). Unrestrained subjects did not display a placebo effect in this study; if anything, unrestrained subjects displayed a slight tendency ($p < .10$) to eat more when given "full" messages than when given "hungry" messages.

Subjects were asked, in a postexperimental questionnaire, whether the vitamin had made them feel full, hungry, or unchanged. There was slight support for the effectiveness of the "full" message manipulation for restrained subjects. Although 80% of the restrained subjects in the control group reported that the vitamin had no effect on their hunger/satiety state compared with only 10% reporting greater hunger and 10% greater satiety, 60% of restrained subjects in the "full" message condition reported that the vitamin made them feel more full, and only 35% said that it did not have any effect. Only 20% of restrained "hungry" message subjects reported that the vitamin made them feel more hungry, compared with 35% feeling more full and 45% reporting no effect, $\chi^2(4) = 13.33$, $p < .01$. There was no relation between message condition and reported changes in hunger/satiety for unrestrained subjects, $\chi^2(4) = 2.13$, $p > .20$.

Discussion

The data on ice-cream consumption support the hypothesis that restrained subjects, presumed to be reliant on cognitive cues (and unresponsive to internal cues), will show placebo

Table 1
Grams of Ice Cream Eaten by Restrained and Unrestrained Subjects According to Message Condition and Preload State

| Group | Message condition | | |
|--------------------|-------------------|---------|--------|
| | Full | Control | Hungry |
| Restrained | | | |
| Study 1 preload | | | |
| <i>M</i> | 108.40 | 105.78 | 145.87 |
| <i>SD</i> | 50.48 | 55.80 | 63.97 |
| <i>n</i> | 10 | 10 | 10 |
| Study 1 no preload | | | |
| <i>M</i> | 68.19 | 87.83 | 117.07 |
| <i>SD</i> | 37.80 | 35.85 | 113.06 |
| <i>n</i> | 10 | 10 | 10 |
| Study 2 no preload | | | |
| <i>M</i> | 66.84 | 92.43 | 133.97 |
| <i>SD</i> | 32.09 | 29.92 | 40.05 |
| <i>n</i> | 5 | 11 | 7 |
| Unrestrained | | | |
| Study 1 preload | | | |
| <i>M</i> | 112.63 | 78.53 | 76.00 |
| <i>SD</i> | 65.77 | 57.85 | 24.88 |
| <i>n</i> | 10 | 10 | 10 |
| Study 1 no preload | | | |
| <i>M</i> | 148.69 | 133.14 | 106.45 |
| <i>SD</i> | 59.95 | 91.75 | 62.52 |
| <i>n</i> | 10 | 10 | 10 |
| Study 2 no preload | | | |
| <i>M</i> | 139.41 | 146.94 | 75.43 |
| <i>SD</i> | 64.44 | 76.77 | 38.89 |
| <i>n</i> | 15 | 9 | 12 |

effects. Unrestrained subjects, however, behaved in an unexpected manner. Unfortunately, the lack of definitive manipulation checks necessitated caution with respect to this apparent reversal of standard placebo effects. Accordingly, we attempted to replicate these initially provocative results.

Study 2

Method

Subjects. Sixty female undergraduates, ranging in age from 18 to 25 years, took part in this study in exchange for credit in an introductory psychology course. One subject had to be discarded from the analyses for failure to follow experimental instructions. Owing to a relative scarcity of restrained subjects, a cutoff of 15 was used rather than 16. Note that a cutoff of either 15 or 16 is commonly used in the literature (Polivy et al., 1988). Furthermore, using a cutoff of 16 produces the same pattern of results, but with an extremely unbalanced design.

Procedure. All subjects again received a placebo (lactose) vitamin and were given instructions, at random, exactly like those from Study 1 with one minor difference: Subjects were now specifically told that they should expect to experience sensations similar to those of previous subjects. The preload condition was deemed superfluous and was eliminated, so all subjects were effectively in a "no preload" condition. To provide a more adequate manipulation check than that used in Study 1, subjects filled out a "Medical Effects Questionnaire" to ensure that there were no adverse effects from the vitamin. This questionnaire also asked about hunger level; one question had subjects rate hunger on a 7-

point scale, and a second asked them to indicate whether they had become hungrier, fuller or had stayed the same since taking the vitamin. After completing the questionnaire, subjects were led into a testing room and participated in the taste-rating task.

Results

Hunger ratings. Restrained subjects were expected to show a placebo effect on hunger ratings, whereas the unrestrained subjects were not. A 2 (restraint) \times 3 (message condition) ANOVA using the difference scores between initial and pre-eating hunger levels revealed no significant effects or interactions (all $F_s < 1$). There were also no systematic differences in whether subjects reported that the vitamin had made them feel hungrier, fuller or had not had any effect, $\chi^2(4) = 5.32, p > .10$.

Food intake. Restrained subjects were expected to show a placebo effect on amount eaten, eating more ice cream when given the hungry message than when given the full message. Unrestrained subjects were not expected to show a placebo effect. A Restraint \times Message Condition (full, hungry, or control) ANOVA on grams of ice cream eaten revealed a significant interaction between restraint and message condition, $F(2, 53) = 7.99, p < .001$. A test of simple main effects (using Duncan's multiple range test with unequal cell n_s ; Kirk, 1982) revealed a placebo effect for restrained subjects, who ate more ice cream when given a hungry message than when given a full message ($p < .05$) or no message ($p < .05$). Unrestrained eaters ate significantly less ice cream when given a hungry message than when given a full message ($p < .05$) or no message ($p < .05$; see Table 1)¹.

Discussion

The results of the present studies support the contention that restrained eaters are unresponsive to internal state whereas unrestrained eaters are relatively responsive to internal cues, because a cognitive manipulation of hunger resulted in a placebo effect only for restrained subjects. The apparent reversal of standard placebo effects for unrestrained subjects indicates responsiveness to internal state, because a reverse placebo effect is thought to involve overcompensation for the discrepancy between expected and actual internal state (Brockner & Swap, 1983). Thus, having taken a pill that was supposed to make them feel hungry, unrestrained subjects might have noted that they did not really feel any different than they had before taking the vitamin and therefore must have been fuller than they had thought, and subsequently should not eat very much.

It is important to note, however, that the reverse placebo effect in Study 2 was not symmetrical: "Hungry" subjects ate much less than did controls, but "full" subjects did not eat more. An elegant model proposed by Ross and Olson (1981) is able to account for this asymmetric pattern of reverse placebo findings. According to Ross and Olson, reverse placebo effects occur only for secondary assessments (eating, in the present study) and then only when the expected internal state is parallel to or congruent with actual internal state; when the expected internal state runs counter to that which is actually experienced, placebo effects are more likely than are reverse-placebo effects (on secondary assessments). Because subjects were de-

prived and moderately hungry in the present study, the reverse-placebo effect should occur mainly with the "hunger" message. The data from Study 1 lend further support to this explanation. Remember that half of the subjects received a two-milk-shake preload. The only reversals occurred when expected internal state ran parallel to actual internal state for unrestrained subjects. "Told full" unrestrained eaters showed a tendency toward a reverse-placebo effect only in the preload condition, whereas "told hungry" unrestrained eaters showed a tendency toward a reverse-placebo effect only when they were not preloaded (see Table 1).

Despite the placebo and reverse-placebo effects on eating, there were no consistent placebo effects on the direct assessments of hunger ratings for restrained—or unrestrained—subjects. For the unrestrained eaters, the foregoing analysis of eating effects presupposes that they maintain an accurate perception that their internal state has not changed, so there would not be any expected changes on their hunger ratings. Restrained individuals, however, seem to be eating in accordance with an altered internal state, which should be reflected in the hunger measures. Nevertheless, these subjects may be eating the way they do despite (and not because of) their internal state. Perhaps, because they have habituated to chronic hunger sensations, they have no real basis for assessing their hunger on the rating scales. At the same time they may use the pill's alleged effects as a guide for behavior, eating as they were told they ought to; in other words, if restrained subjects felt that other subjects in the study were generally full, then other subjects probably didn't eat very much ("so, I'd better not eat"), whereas if subjects reported generally being hungry, they probably ate a lot, "so I can eat a lot and blame the pill for my (mis)behavior." Finally, it is not unusual to find experimental effects on behavior without parallel effects on self-reports (Pennebaker, 1985). Bem (1972) noted that laboratory manipulations in social psychology have generally found that behavioral changes are more easily produced than are self-report changes.

The distinction between dieters' unresponsiveness and non-dieters' responsiveness to gut sensations should not be overdrawn. There is some evidence that restrained eaters may under certain (extreme) conditions be sensitive to the state of their gut: Herman, Polivy and Esses (1987) demonstrated that dieters respond to intense satiety cues resulting from an extremely large milk shake preload. (Of course, it is possible that dieters were responding more to their "cognitive" awareness of the size of the preload than to their "gastric" awareness.)

¹ Some investigators (e.g., Ruderman, 1986) advocate examining the independent effects associated with the two subfactors of the Restraint Scale, concern for dieting (CD) and weight fluctuations (WF). For both Study 1 and Study 2, neither WF or CD was superior to the full-scale restraint scores in predicting the message by restraint interaction. In both studies WF showed the significant interaction: Study 1, $F(2, 108) = 3.67, p < .05$, Study 2, $F(2, 53) = 6.08, p < .005$; whereas CD did not: Study 1, $F(2, 108) = .65, p > .10$, Study 2, $F(2, 53) = 1.53, p > .10$. This supports our contention (Heatherton, Herman, Polivy, King, & McGree, 1988) that subdividing the Restraint Scale into its subcomponents adds little to our understanding of the behavior of restrained subjects, because neither CD nor WF alone predicted as well as the full scale, and they certainly did not predict better.

As for unrestrained eaters, it should be remembered that although they are evidently capable of detecting their hunger state, this does not mean that their internal state is the sole or even dominant determinant of their eating. After all, the placebo instructions affected unrestrained subjects' eating almost as much as restrained subjects' eating, in the absence of any actual manipulation of internal state. Thus, it is probably prudent to conclude that everyone's eating is affected by external or cognitive cues, but that nondieters also take variations in internal state into account.

Finally, we note the similarity between the present findings and those of a recent study by Cohen, Sherwin, and Fleming (1987), who found that female unrestrained eaters displayed cyclic variation in their craving for sweets—thought to be due to hormonal variation over the course of the menstrual cycle—whereas restrained eaters were insensitive to this internal cue. In summary, the present results are taken as evidence that restrained eaters are unresponsive to internal cues, whereas unrestrained eaters are relatively responsive to these cues.

References

- Bem, D. (1972). Self-perception theory. In L. Berkowitz (Ed.), *Advances in experimental social psychology* (Vol. 6, pp. 1–62). New York: Academic Press.
- Brockner, J., & Swap, W. C. (1983). Resolving the relationships between placebos, misattribution, and insomnia: An individual differences perspective. *Journal of Personality and Social Psychology*, *45*, 32–42.
- Bruch, H. (1973). *Eating disorders*. New York: Basic Books.
- Cohen, I. T., Sherwin, B., & Fleming, A. S. (1987). Food cravings, mood, and the menstrual cycle. *Hormones & Behavior*, *21*, 457–470.
- Doerman, A. L., & Kronenberger, E. J. (1981). Effects of bogus preloads on the eating behavior of obese, normal weight, and below set-point normal women. *Psychological Reports*, *48*, 747–750.
- Heatherton, T. F., Herman, C. P., Polivy, J., King, G., & McGree, S. T. (1988). The (mis)measurement of restraint: An analysis of psychometric and conceptual issues. *Journal of Abnormal Psychology*, *97*, 19–28.
- Herman, C. P., & Polivy, J. (1980). Restrained eating. In A. Stunkard (Ed.), *Obesity* (pp. 208–225). Philadelphia, PA: Saunders.
- Herman, C. P., Polivy, J., & Esses, V. (1987). The illusion of counter-regulation. *Appetite*, *9*, 161–169.
- Herman, C. P., Polivy, J., Lank, C., & Heatherton, T. F. (1987). Anxiety, hunger, and eating behavior. *Journal of Abnormal Psychology*, *96*, 264–269.
- Kirk, R. E. (1982). *Experimental design: Procedures for the behavioral sciences*. Belmont, CA: Brooks/Cole.
- Pennebaker, J. W. (1985). *The psychology of physical symptoms*. New York: Springer-Verlag.
- Polivy, J., & Herman, C. P. (1985). Dieting and bingeing: A causal analysis. *American Psychologist*, *40*, 193–201.
- Polivy, J., Herman, C. P., & Howard, K. (1988). The Restraint Scale: Assessment of dieting. In M. Hersen & A. S. Bellack (Eds.), *Dictionary of behavioral assessment techniques* (pp. 377–380). New York: Pergamon.
- Ross, M., & Olson, J. (1981). An expectancy-attribution model of the effects of placebo. *Psychological Review*, *88*, 408–437.
- Ruderman, A. J. (1986). Dietary restraint: A theoretical and empirical review. *Psychological Bulletin*, *99*, 247–262.
- Schachter, S. (1968). Obesity and eating. *Science*, *161*, 751–756.

Received January 29, 1988

Revision received August 22, 1988

Accepted August 29, 1988 ■