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The Self-Regulation of Eating

Theoretical and Practical Problems

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In this chapter, we attempt to impose a self-regulatory framework on eating. Eating is normally regarded as a highly regulated activity, as it must be if it is to serve its biological function. Of course, closer examination reveals that eating is not as well-regulated as one might imagine. Moreover, it turns out that the regulation of eating is often opposed by the self-regulation of eating, which naturally creates all sorts of personal and theoretical problems. In this chapter, we consider the extent to which eating (and its cousin, weight) are regulated, and how that regulation is achieved. The bulk of the chapter is devoted to self-regulation, successful and unsuccessful, including a survey of the empirical evidence and a consideration of various models of self-regulation and self-regulation failure. We conclude that there is still much to be learned.

REGULATION OF EATING

Because eating is essential to life, it is not surprising that it is part of a well-regulated system. Before they can do almost anything else, infants cry to express their hunger and cease crying when they are fed. For infants, regulation requires the assistance of another person, who provides the food; but as we get older, the principle remains the same: We feel hunger; we seek out and consume food; we experience a satisfying satiation; and eventually, as nutrients are depleted over time, we once again feel hunger and the cycle recurs.

This rendition of the regulatory cycle is drastically oversimplified; moreover, it obscures several difficult questions about how elements of the cycle work. For instance, what is the hunger signal, and how is it conveyed from the periphery to the brain (not to mention to consciousness)? Do we eat only enough to eliminate our current hunger, or enough to forestall anticipated hunger? Why do we occasionally overeat? What is the sa-

tiety signal, and how does it operate? Why does it not always operate reliably? How vulnerable is the regulatory system to perturbations such as emotional and social influences on intake? In short, how well-regulated is the system, and how does the regulation occur?

Bruch (1961) argued that even in infants, the regulatory system may become seriously deranged through the mother's mismanagement of feeding. For instance, if the mother misinterprets the infant's pain cry as a hunger cry (or vice versa), she may feed the infant inappropriately. Not only will such inappropriate feeding perturb normal caloric regulation, but it may lead to long-term misreading of hunger signals by the developing child and eventuate in obesity or eating disorders.

In a more familiar example of misregulation, the social facilitation of eating (de Castro & de Castro, 1989; see Herman, Roth, & Polivy, 2003, for a review), people tend to eat considerably more in groups than when alone. We do not have adequate space to explore the various explanations that have been offered for this phenomenon; suffice it to say, none of them postulate that people in groups face an increased caloric demand. In short, the additional food consumed in groups is truly excessive and violates basic regulatory principles; either that, or people eating alone eat insufficiently, again violating basic regulatory principles.

Whether or not the regulatory system operates smoothly, in most cases it operates fairly automatically. We do not mean to suggest that eating is a reflex; rather, eating normally starts and stops in response to hunger and satiety cues. When our eating is affected by social or emotional factors, the influence again is relatively spontaneous. We do not deliberate much about whether to eat more in groups or less when we are depressed; we just do it, often without even being aware that we are doing it. To this extent, all eating is regulated, albeit not necessarily consciously, and not always in a nice, neat, negative-feedback loop.

REGULATION VERSUS SELF-REGULATION OF EATING

Self-regulation opposes regulation. Self-regulation is undertaken when our normal or typical regulatory processes do not accomplish what we want. When we cannot count on automatic regulation to get us where we want to go, we must deliberately alter the regulatory landscape, introducing new interventions designed to remedy the situation. Just as we do not normally think about our breathing, unless it poses a problem for us, we also do not normally think about our eating, unless it becomes problematic. Self-regulation represents our attempts to solve that problem, whatever it may be.

SELF-REGULATION *QUA* WEIGHT LOSS

Where is it that we want to go in terms of food intake? Why not just let our intake follow its natural course and rely on hunger to let us know when to start and stop eating? Reliance on natural regulation is problematic for several reasons.

As we have already implied, hunger and satiety do not operate as efficiently as one might imagine. Consider hunger. We may count on hunger signals to let us know when we need food, but such signals may arise at an inopportune time, either when food is not immediately available, or when eating is not an option. This problem is exacerbated by the fact that eating a relatively small amount of food is often sufficient to eliminate hunger. If we were to eat only when under the direct influence acute hunger signals, and stop

when such signals ceased, then we would eat relatively small meals, because these small meals would eliminate hunger signals, at least for a while. But we would then find ourselves experiencing hunger repeatedly throughout the day; the amount of food required to eliminate hunger signals is considerably less than is that required to prevent the onset of hunger signals for an appreciable period of time (allowing us to spend our time doing things other than eating every hour or so). So we must eat more than is necessary simply to stave off acute hunger. But how much more? We might eat until we felt full, which would maximize the time between meals. The problem with eating until we are full is that for many of us, that much food is more than we are willing to eat, for one reason or another. Plus, it takes some time for the gut to feed information back to the brain that satiety has been reached; by the time we experience clear satiety signals, we may already have eaten too much, to the point where the feedback, when it eventually arrives, is aversive.

The discomfort of a distended stomach aside, why might we be "unwilling" to eat in a way that maximizes the intermeal interval? One practical reason is that our mealtimes are dictated by factors other than hunger and satiety. Mealtimes, in fact, tend to be coordinated to a schedule that is more responsive to social and work requirements than to strictly nutritional considerations. Thus, there is no point in eating enough breakfast to forestall hunger for 7 or 8 hours if we are going to have lunch in 4 or 5 hours anyway. Another reason for not maximizing our intake at a given meal—a reason that for many people supersedes all others—is that we believe (probably with some justification) that eating maximally is not conducive to slenderness. This is a different kind of reason than the previous ones we have considered, because it introduces a truly extraneous element into the calculations. Rather than accepting the demands of our bodies, but trying to make minor adjustments to maximize physiological comfort and mundane convenience, we may oppose the demands of our bodies, because they conflict with some other personal agenda. In a nutshell, our bodies are concerned about (1) short-term regulation of energy and (2) maintaining a reserve of energy for emergencies. We, however, may be intensely concerned about our appearance. A slim physique may be unachievable if we eat all that our bodies demand, so we may deliberately eat less, even though our bodies demand more. For the most part, the self-regulation of eating is tantamount to dieting, just as "weight control" is a euphemism for weight loss. Some people are unconcerned about losing weight; indeed, there are even some people—mostly scrawny teenage boys—who want to gain weight, if the added weight takes the shape of muscles. Still, for the vast majority, self-regulation of eating means eating in an unnatural, mindful way designed to achieve (or perhaps maintain) weight loss.

Deliberately eating less than what the body demands has several consequences. For one thing, it means that one may become chronically hungry. Although even a diet meal will satisfy immediate hunger, it will not do so for long, so hunger is likely to reappear sooner. This situation is parallel to the one discussed earlier, in which the eater eats only enough to satisfy immediate hunger. The difference is that the dieter does not allow herself to eat whenever hunger arises; rather, she must wait until the next scheduled (and inadequate) meal. Even if the dieter adheres to the diet, things do not always go as planned. Weight loss induces in the body various defensive reactions designed to counteract the attempt to reduce weight. Such defenses—most notably, changes in metabolism—make it increasingly difficult to continue to lose weight, even with the same spartan diet that initially produced weight loss. Some of the defensive changes experienced by dieters are more subtle: fatigue makes it more difficult to maintain one's customary activity level; changes in taste make certain high-calorie foods more attractive (e.g., "negative alliesthesia," a process whereby eating a meal reduces the hedonic value of sweets, is sup-

pressed by weight loss, so that for dieters, postmeal sweets remain sweeter). These defensive adjustments, then, occur at both physiological and behavioral levels. In either case, they force the dieter to impose an even tighter self-regulatory regimen if further weight loss is to be accomplished.

It is worth remembering that self-regulation of intake is a means to the end of self-regulation of weight. People rarely worry about regulation of intake for its own sake. It is usually a matter of appearance, or health, or some other goal beyond intake itself. Still, the means can sometimes become an end in itself. In order to lose (i.e., down-regulate) weight, one must eat less (i.e., down-regulate intake). (Of course, one could try to lose weight by other means [acupuncture, food combining, exercise, drugs, etc.], but the most frequently used method is caloric restriction. Indeed, many of these "alternative" methods are really just other ways of making it easier for one to eat less.)

DIETING AS A SELF-REGULATORY STRATEGY

How exactly do people who are eager to achieve slimness by means of caloric restriction organize their attempt? A reduction in caloric intake, after all, might be achieved in all sorts of ways. For instance, one might set a target for a certain (reduced) number of calories per day, as seen in many diets. But obviously that is not the only way that one might achieve a caloric reduction. Instead of reducing one's daily caloric quota by, say, 15%, one might simply eat normally for 6 days of the week and fast on the seventh. From a purely psychological point of view, perhaps it is easier to eat nothing at all than to eat sparingly. After all, to eat sparingly entails exposure to appetite-stimulating food cues, whereas fasting allows one to avoid food cues, which may make restriction easier. Most diets do not involve fasting, but as a self-regulatory issue, why exactly is fasting not more popular?

Even if we rule out fasting, there are all sorts of self-regulatory choices to be made. The typical diet prescribes a daily caloric quota, but why is the quota specified on a daily basis? Why not weekly, monthly, or yearly? There are good psychological reasons for adopting a daily quota (see Herman & Polivy, 2003, for an extended discussion), but a daily quota also presents problems for successful self-regulation, as we see later when we discuss self-regulatory failure.

Taking this issue to the other extreme, might it not be easier to regulate intake if we were to manage intake in a more microscopic way, say, by specifying an hourly intake quota? Such a quota does not map easily onto the typical meal pattern in our (or any other) culture, so perhaps it is unrealistic. But there is clearly an option of partitioning the daily quota among the (three?) meals that most people eat. Still, do we want the calories to be apportioned equally across the meals? Many people prefer a smaller breakfast and/or lunch, which allows them to eat more later in the day (and spend the day looking forward to eating more). Self-regulatory problems may arise in this scenario as well, as indeed is the case for all scenarios. Our point here is simply that usually more than one self-regulatory strategy is available to reach any particular goal. The choice of strategy is often made without a great deal of thought about its implications for self-regulatory success.

Although many diets specify (daily) caloric quotas, other weight-loss diets do not demand an explicit caloric sacrifice. These "all-you-can-eat" diets operate on alleged "secret," or at least arcane, nutritional principles. You can eat all you want as long as you stay away from (certain) carbohydrates; or you can eat all you want as long as you load

up on (certain) carbohydrates. Some foods (e.g., fruits) can be eaten without limit and/or other foods (e.g., potatoes, chocolate) must be avoided at all costs. We are not critiquing the nutritional merits of these various diets (other than to point out that insofar as they are successful, it is usually because they indirectly induce dieters to consume fewer calories than they otherwise would). Our major concern here is to consider the implications of such restrictive–permissive diets for self-regulatory success.

Obviously, being allowed to eat all you want has great appeal for veterans of explicit caloric-restriction diets. Having to stop eating after consuming a certain number of calories may be terribly frustrating. Still, the all-you-can-eat diets are not quite as permissive as they appear at first glance. The emphasis is on eating all you want, but close behind comes the condition that certain foods—even entire categories of foods—are forbidden, even in small amounts. How frustrating is that, empirically? We revisit this issue when we review the literature on self-regulatory failure—more specifically, diet breaking.

SOCIAL NORMS AND SELF-REGULATION

One can set self-regulatory goals by reference to calories or to specific foods; such goals are matters for the individual to decide, either in isolation or in consultation with a diet coach, book, or some other authority. In practice, however, the particular intake choices that one makes may depend less on the rules prescribed by authorities than on the behavior of one's eating companions. Our analysis of social influences on eating (Herman et al., 2003) indicates, first, that social influences are extremely powerful, often overriding other influences on eating, including one's prior intentions or goals. Second, the influence exerted by one's eating companions is of a specifically regulatory sort; that is, people appear to use the intake of their eating companions as a regulatory guide. Studies of modeling, in which an experimental confederate eats more or less and the naive participant eats correspondingly more or less, suggest that we regulate our intake with reference to the intake of others. Note that using the behavior of others as a guide for regulating one's intake does not make much sense in terms of satisfying one's own specific physiological needs; nor does it make much sense for dieters to abandon their caloric or other regulatory scheme and simply follow the example of others. Yet people, dieters and nondieters alike, do follow the example of others.

Although people do follow others' example, they tend to follow at a slight distance. The modeling that occurs is not simply a matter of matching one's intake to that of the companion; closer examination suggests that the naive participant often tends to eat slightly less than does the confederate. It is as if the goal of the eater is to eat less than the other person; accomplishing this goal may be all that is required to convince the eater that he or she has consumed an appropriate amount. Herman and colleagues (2003) suggest that, for some people, the real (regulatory) goal is to avoid excessive intake, and that "excessive" is defined situationally as "more than the companion eats." Eating less than (or no more than) the confederate eats, therefore, serves as a socially based regulatory strategy. Another group of people, according to Herman and colleagues, aim not to avoid excess but to eat minimally, with "minimal" (like excessive) eating defined socially. Eating less than the companion thus qualifies as minimal eating. Distinguishing between the goal of avoiding excessive eating and the goal of eating minimally cannot be accomplished in experimental situations involving a single confederate; multiple confederates who eat different amounts are required. Still, both goals use a situation-specific social definition of appropriate eating, based on the companion's intake. Insufficient attention

has been paid to the behavior of other people as the basis for regulation of eating, possibly because it makes so little biological sense—either for dieters or for normal eaters—to allow others to dictate their intake. Our view of the regulation of eating has long been confined to models in which people regulate on the basis of either their internal physiological signals or their own cognitive calculations of appropriate foods (or amounts of foods) to eat. We must expand our view to include the role of others' intake as a regulatory force and recognize that self-regulation may be tantamount to regulation by others.

Before leaving this topic, we should add that using the intake of others as a standard may "regulate" our intake not just by providing intake guidelines. Extensive research (see Herman et al., 2003, for a review) suggests that when we eat in the presence of noneating observers, our intake is suppressed (e.g., Polivy, Herman, Hackett, & Kuleshnyk, 1986). Obviously, we cannot eat less than someone who is not eating at all, but we certainly do "down-regulate." In one interesting, apparent exception to this generalization, Herman, Polivy, and Silver (1979) found that dieters did not eat minimally in the presence of a noneating observer; rather, they ate "sensibly," in that they ate more after a large preload than after a small preload. This "sensible" pattern, which, as we shall see, is uncharacteristic of dieters, was probably due to one additional feature of this study: Participants were instructed to fill themselves up, which precluded minimal eating. Instead, dieters and nondieters alike ate in accordance with what they considered to be appropriate intake norms, enforced by the presence of the observer.

SELF-REGULATORY FAILURE

The seeds of conflict have already been sown. If we consider the models of self-regulation of intake that we have already introduced, it is evident that the goals implicit in the various models may not coincide. The demands of the formal diet, for instance, may not coincide with the intake norms of our eating companions. If we stick to our diet, we may offend our companion. (Remember, the more we eat, the more our companion can eat without eating excessively, so we are likely to be pressured by our companion to "just have a little more.") But if we adhere to the social norm, then the limits imposed by the weight-loss diet may well be exceeded. Only in the case of "dieters" whose diets consist of eating no more than do their eating companions can these two self-regulatory principles be reconciled satisfactorily.

Although the potential exists for conflict between competing self-regulatory principles, the most common and well-appreciated threat to self-regulation arises when a single self-regulatory principle is challenged and defeated by circumstances. Our research program over the past three decades has documented the difficulties of dieting (see Polivy & Herman, 2002). As we have seen, some of the difficulties of dieting occur even when the dieter manages to adhere to a self-regulatory regimen; the development of anabolism (i.e., a more conservative metabolism) as weight loss progresses represents the most well-known hindrance to achieving the ultimate weight-loss goal. It is important, however, to distinguish between this anabolic threat to diet success—a threat that emerges even as, and precisely because, self-regulation succeeds—and self-regulatory failure. Self-regulatory failure destroys the diet not by counteracting its physiological effects but by defeating the attempt to cut back on calories in the first place.

Our very first study of dieters (Herman & Mack, 1975) forced us to start thinking in terms of self-regulation and self-regulatory failure. We had not begun with the intention

of studying these phenomena; we had been looking for parallels between the behavior of normal-weight sorority girls and the obese males whom Schachter had been studying (see Schachter & Rodin, 1974, for a review). Schachter had demonstrated that whereas normal-weight individuals were responsive to preload size (i.e., eating more after a small preload and less after a large preload), obese individuals were relatively unresponsive to preload size and seemingly oblivious to this "internal cue." When we tested the effects of preloading experimental participants with 0, 1, or 2 milkshakes (7.5-ounces each), we found that whereas many of them "regulated," subsequently eating in inverse proportion to preload size, others (who eventually came to be known as "restrained eaters") ate more after the 1- or 2-milkshake preload than after no preload at all. This result did not conform to our expectation, namely, that this latter group (like the obese group) would display an absence of regulation by not responding differentially to preload size. Instead, we had uncovered a new pattern, "counterregulation," that demanded a new interpretation. Eventually, we concluded that members of this anomalous group must have been attempting to inhibit their intake (hence the label "restrained eaters"), and that the forced milkshake consumption had disrupted this attempt.

We argued at the time that the forced preload had undermined the restrained eaters' motivation to diet. The rich milkshake had exceeded their caloric quota for the day, and once the diet was ruined, further attempts to restrict intake served no purpose. (We called it the "what-the-hell" effect.) In short, our interpretation of self-regulatory failure was motivational: We assumed that the restrained eaters could have continued (i.e., maintained the ability) to exert self-control when confronted with palatable food, but after the forced preload, there was no point in doing so. Only much later (see later discussion) did we begin to entertain other interpretations.

Note some of the perplexities raised by our interpretation, even accepting a motivational perspective. For one thing, it is absurd to argue that once one's diet has been broken, there is no point in exercising further self-control. Even if one's caloric quota for the day has been exceeded, does it not make sense to compensate for this excess rather than abandon all self-control? If a person exceeds her quota by 200 calories, is that not better than exceeding it by 2,000 calories? According to the perverse logic of the dieter, apparently not. The dieter tends to think in all-or-none terms: Once the diet is broken, it matters little whether one has exceeded it by a lot or a little. At least in part, this irrational calculation stems from the fact that dieters are aware of how much they should eat to satisfy the diet, but they do not have a self-regulatory plan for what happens if and when the diet is broken. A single self-regulatory failure could, in principle, trigger a secondary or "backup" self-regulatory plan, but dieters are generally so invested in the initial plan that no contingency plans are ever developed.

A second perplexity, related to the first, is raised by the assumption that diets should operate diurnally. As we saw earlier, diurnal self-regulation appears to be the norm for dieting (as for many other self-regulatory human activities), but ultimately, it is arbitrary. Excess calories consumed today still "count" tomorrow, in the sense that they contribute to one's continuing weight problem. As long as one has not achieved one's weight-loss goal, one should remain motivated toward it. Why does a milkshake undermine that motivation, especially when everyone knows that the diet will be resumed tomorrow morning, and the consequences of today's postmilkshake binge must be "tacked on" to the diet, probably extending the need to diet for several days? We conclude that if dieters act as if their motivation to diet has been undermined, it may be more than the milkshake per se that contributes to this undermining.

Finally, and again related to the foregoing issues, the milkshake preload, rich as it

may be, does not necessarily exceed the caloric quota for the day. An 8-ounce milkshake does not contain *that* many calories, and if it is consumed early in the day, it is quite likely that it is still mathematically possible, by restricting one's subsequent intake, to adhere to the daily allowance. Maybe something else is going on, in addition to quota-busting.

VARIATIONS ON THE THEME OF SELF-REGULATORY FAILURE

Preload Studies

Much of our research has been devoted to exploring various other experimental conditions that lead restrained eaters to (temporarily) abandon their restraint. Some of these variations are extensions of the preloading paradigm; others attack restraint from entirely different angles.

The first preload-variation study (Polivy, 1976) demonstrated that it was not the actual number of calories in the preload that determined whether dieters would "lose control"; rather, it was what they *believed* about the richness of the preload. Participants' beliefs about whether the preload (in this case, pudding) was high or low in calories were manipulated orthogonally to the actual caloric content of the pudding. Perceived calories exerted more control than did actual calories, and restrained eaters who believed that they had consumed a high-calorie preload were more likely to become disinhibited, whether or not that belief was correct. This finding, which has been replicated (Knight & Boland, 1989; Spencer & Fremouw, 1979; Woody, Costanzo, Leifer, & Conger, 1981), indicates that the preload operates through a cognitive (not physiological) mechanism; the dieter is making a calculation pertaining to calories.

We speculated that a rich preload produces disinhibition and subsequent overeating because the preload precludes success at adhering to the daily diet requirements. In most of the studies, that failure is induced by a prior forced preload. If the forced preload were merely anticipated, rather than already consumed, how might that affect the dieter? If the dieter were assured that the impending preload would sabotage the diet before the day was done, then the chances of dietary success would be as negligible as if the preload were already ingested. And indeed, such appears to be the case. Some studies (Ruderman, Belzer, & Halperin, 1985; Tomarken & Kirschenbaum, 1984) have found that anticipating a preload later in the day produces disinhibition and overeating in restrained eaters.

The vulnerability of dietary restraint to disruption by caloric considerations seems to know no bounds. Urbszat, Herman, and Polivy (2002) demonstrated that anticipation of a weeklong diet, starting first thing tomorrow, leads dieters to overeat today. In this case, these researchers argued, the anticipated deprivation may "justify" the prediet overindulgence; another possibility is that, among dieters, the connection between overindulgence today and compensatory deprivation planned for tomorrow is so strong that it may operate reciprocally, with deprivation planned for tomorrow triggering (compensatory) overindulgence today.

Yet another variation on the disinhibitory power of the preload is evident in situations in which the preload is merely encountered rather than consumed. When dieters are exposed to rich, palatable food, but not required (or even allowed) to eat it, and when this exposure to attractive food cues (including smell and indulgent thoughts) extends for several minutes, dieters become more likely to overeat when subsequently given access to palatable food. These studies (Fedoroff, Polivy, & Herman, 1997, 2003) are typically interpreted as evidence of craving as a precipitant of disinhibition. It is not that the diet has

been (or will necessarily be) broken; rather, the urge to eat, stimulated by focused concentration on food cues, becomes overwhelming. Note that, in this case, exposure to the preload does not ruin the diet by exceeding the caloric quota for the day; rather, this exposure undermines the diet by making the prospect of eating more attractive than the prospect of not eating. Normally, the dieter's self-regulatory inhibitions are enough to allow her to resist temptation; but sometimes, either because of the sustained power of the tempting food cues, or because of cue-induced cravings at the physiological level, or both, self-regulatory inhibitions fail. Later, we consider more systematically how these various interpretations map onto various models of how self-regulation works in dieters.

Recently, we asked another question about preloads, namely, what is the smallest preload that will produce disinhibited eating? In two studies (Herman, Reisz, & Polivy, 2003), we found that a rich milkshake preload as small as 1 ounce will disinhibit dieters' subsequent eating as effectively as will a preload of 10 or 15 ounces. This finding challenges the notion that it is an accumulation of excessive calories that undermines the diet and renders further restraint during the same day useless. Instead, it may be that a very small amount of a forbidden food will suffice to break a diet. This diet-breaking hinges on the (somewhat magical) notion that some foods, in any quantity, are intolerable. If a diet does not allow a certain type of food, then any amount of that food ruins the diet, and disinhibition will ensue.

Finally, it is important to recognize that when self-regulation failure induces disinhibited eating, this disinhibited eating may proceed in a fashion devoid of self-regulation, but it is not necessarily immune to other (more reliable) regulatory influences. Herman, Polivy, and Esses (1987) showed that whereas a large, rich preload disinhibited eating in restrained eaters, an extralarge preload (twice as large as the large preloads used in prior studies) did not cause restrained eaters to eat any more than they did in the control (no-preload) condition. We believe that in the extralarge-preload condition, restrained eaters were disinhibited, in the sense that they were no longer adhering to their original self-regulatory plans, but because the preload was so huge, they were near the limit of physical capacity and literally could not eat much more. Physical capacity, of course, is a "natural" regulator of intake and should not be confused with self-regulation, which is an "unnatural" regulator not grounded in—and usually opposed to—one's automatic physiological processes.

Whether natural regulators invariably kick in eventually to constrain disinhibited eating is arguable. For instance, some anecdotal evidence indicates that individuals displaying bulimia nervosa occasionally disregard even the physical-capacity regulator and end up eating beyond capacity, to the point where their stomachs literally burst. Another natural regulator is the palatability of the available food. Even when disinhibited, people should be responsive to the taste of food. Nevertheless, some reports (see Herman & Polivy, 1996, for a discussion) indicate that bulimics binge on food universally regarded as unpalatable; in their eating frenzy, some bulimics appear to disregard palatability considerations. This unnatural disregard for palatability may not characterize all bulimics, but it is worth remembering. Moreover, disregard for palatability is not necessarily confined to bulimics. Polivy, Herman, and McFarlane (1994) found that disinhibited dieters were insensitive to a manipulation of palatability of available food. Although the disinhibition in this study was not induced by preloading, and the manipulation of palatability was not extreme (no truly "inedible" food, such as bulimics are occasionally reputed to eat, was offered), at least some tentative evidence indicates that natural regulatory (along with self-regulatory) influences may be disrupted following disinhibition. The

dynamics and the factors (if any) that control eating once disinhibition has occurred have only begun to be explored.

Other Studies

As mentioned earlier, Polivy and colleagues (1994) induced disinhibition in restrained eaters using a trigger other than preloading—in this case, anxiety. Several studies have explored the role of emotional arousal as a disrupter of dietary restraint. (Interestingly, just as preloading suppresses eating in unrestrained eaters, while disinhibiting eating in restrained eaters, distress suppresses eating in unrestrained eaters, while disinhibiting eating in restrained eaters.) Distress has been manipulated in many ways, most often in the form of fear (e.g., McKenna, 1972) or anxiety (e.g., Herman, Polivy, Lank, & Heatherton, 1987), but also in the form of acute depression (e.g., Baucom & Aiken, 1981). Anxiety obviously does not exert its effect on self-regulation by ruining the diet; the anxious dieter has not eaten any more than has the nonanxious dieter before encountering whatever food is available for subsequent overeating. From the beginning, we (Herman & Polivy, 1975) assumed that anxiety undermines the diet through a different mechanism, that the anxious dieter rearranges her priorities, so that whereas adhering to the diet successfully remains calorically possible, the dieter no longer cares so much about dietary success; coping with distress is more important, and eating is one way to cope with distress. The notion that emotion regulation is the basis for overeating is nicely captured by Tice, Bratslavsky, and Baumeister (2001), who demonstrated that overeating can be prevented if one is convinced that eating will not improve one's emotional state. Nevertheless, it remains possible that distress may induce disinhibited eating without engaging distress-management mechanisms (see later discussion). Also, the phenomenon has been refined empirically (Heatherton, Herman, & Polivy, 1991), with the discovery that certain types of distress (e.g., ego threat) are more effective in inducing disinhibition than are others (e.g., physical threat). Whatever the underlying mechanism may be, distress does interfere with self-regulation, just as preloading does; these disrupters of self-regulation can substitute for each other, such that if the dieter is preloaded, then anxiety does not produce any additional overeating, and if the dieter is anxious, preloading does not produce any additional overeating (Herman, Polivy, Lank, & Heatherton, 1987).

Finally, we have found that alcohol, at least under certain circumstances, can produce self-regulatory failure (Polivy & Herman, 1976a, 1976b). It will come as no surprise to the reader that alcohol leads to disinhibition (see Hull & Sloane, Chapter 24, this volume), but the precise mechanism underlying the effect remains in dispute, despite millennia of human experience of the phenomenon.

Intoxicants, emotional distress, and diet-threatening preloads all interfere with the self-regulation on which the dieter depends. Empirically, the disruption of self-control by exposure to these conditions or situations is well established, with only some minor details unresolved. What remains to be established, however, is precisely how these experimental (or natural) manipulations exert their effects. We have casually alluded to some interpretations of how these disrupters undermine and often defeat self-regulatory strategies. We now focus on this question more systematically.

MODELS OF SELF-REGULATION AND SELF-REGULATION FAILURE

Attempts to impose self-regulation on eating, which in most cases amount to attempts to restrict intake, can be understood most simply as the exercise of self-control. We have argued (Herman & Polivy, 1980) that the advent of research on restrained eating represents a significant change in our understanding of controls on eating. Prior research focused on "internal" (physiological) and "external" (environmental) controls but ignored self-control. Obviously, restrained eaters, insofar as they are successful, are resisting both internal and external cues promoting intake; even if they are not successful, or are successful only for a while, dieters are attempting to exercise self-control. Our introduction of self-control as an oppositional force in eating, however, was intuitive and did not specify exactly how self-control operated.

General Self-Regulatory Models

Formal models of self-regulation (e.g., Carver & Scheier, 1982; see Carver, Chapter 2, this volume) specify the goal, assessment of progress toward the goal, and adjustments implemented when progress toward the goal is inadequate. Such models help to explain how dieters approach the long-term goal of weight loss (or possibly weight maintenance), but they are not very helpful when it comes to the more proximate goal of intake regulation in the short term. For one thing, the short-term goal of the dieter tends to be negative: The objective is to avoid eating certain amounts or certain foods. Assessing progress toward a negative goal is difficult, if not impossible, for there really is no progress. One either commits the error or succeeds in avoiding it, with little or no grey area. Feedback that one is succeeding—that one has not (yet) failed—is difficult to act on, especially when the behavior being shaped is a nonbehavior (i.e., not eating). Perhaps because of the negative orientation of the dieter's intake goals, it is especially difficult to sustain success. Moreover, after failure occurs, there is no provision for how to behave. One cannot "make a correction" for having broken one's diet. The reader might argue that dieters certainly can make a correction for their errors by compensating (undereating) for the remainder of the day. As we have seen, however, this compensatory option does not appear to be available to most dieters, who seem to regard dietary success on a given day in the same way that they would regard defending their virginity; it cannot be repaired once it is lost. (Dieters have an advantage over virgins in that they can start over fresh the next day.)

If a model such as that of Carver and Scheier were pursued in the interpretation of short-term dietary restraint, we would be forced to specify more precisely exactly what behaviors the dieter is exhibiting when resisting temptation. This resistance—often conceptualized as an effort of will—is difficult to conceptualize in behavioral terms. Also, one would have to specify the sorts of useful feedback the dieter obtains while pursuing his or her restrictive goal; at the moment, we do not have a clear notion of what feedback the dieter receives or uses. Nor do we have a clear sense of the dieter making adjustments in his or her behavior as a means of more closely approaching the goal. The only feedback of which we, as researchers, are aware is that the diet has been broken, in which case, it is too late to expect to observe compensatory adjustments. We do not mean to suggest that mapping the dieter's goal-directed behavior onto an act–test–adjust model of regulatory control is inappropriate, but, simply, that for the time being it is difficult; doing so would require a much more subtle analysis of what the dieter is doing when resisting temptation or not eating.

Delay of Gratification

Another approach to self-control—one that appears to map quite directly onto the dieter's situation—is represented by Mischel's work on delay of gratification (Mischel, Cantor, & Feldman, 1996; see Mischel & Ayduk, Chapter 6, this volume). Mischel's research appears to be especially pertinent in that it is concerned with acute influences on consummatory behavior. Obviously, we all (try to) delay gratification in the service of long-term goals, but the gratifications that we deny ourselves present themselves in the here and now, and the task boils down to a series of proximate challenges. In Mischel's laboratory studies, success (delay) or failure (capitulation to temptation) is a single-episode phenomenon. The fact that the temptation often takes the form of palatable food brings the parallel closer.

Mischel has focused on factors that enhance or impede delay. For instance, we all know that resistance to temptation may be enhanced if the tempting object is rendered less salient; indeed, ancient behavior therapy recommendations for dieting (e.g., Stuart, 1967) have emphasized distancing oneself from the tempting stimulus, either by removing the temptation from one's environment (e.g., keeping tempting snacks out of sight) or removing oneself from the tempting environment (e.g., staying out of the kitchen). A simple extension of this notion is to reduce the temptingness of the stimulus by psychological means, even while staying in close proximity to it. Mischel demonstrates that delay can be enhanced if the object of temptation is construed in such a way as to reduce its sensory allure (Mischel, Shoda, & Rodriguez, 1992). A chocolate bar can be construed as a log (or worse). Such reconstrual appears to be effective, but we have to wonder how long it can be sustained; a chocolate bar, to paraphrase Freud, is sometimes (in fact, always) a chocolate bar. An alternative tactic to enhance resistance to temptation (Herman & Polivy, 1993) does not require denying that a chocolate bar is what it is, nor does it require denying that it would be delicious; it simply requires making salient the equally true proposition that a chocolate bar represents a significant caloric threat: "It tastes good, but it's not good for me." If the dieter can focus on the negative aspects of the stimulus, while perhaps still acknowledging that the stimulus instantiates both positive and negative features, then perhaps the angel on one shoulder will win the argument with the devil on the other, even though the devil has a good argument. The real threat here, we believe, arises when the dieter's ability to attend to the angel's argument ("Watch out for those calories!") is reduced by distraction. If the dieter's mental energy is depleted or devoted to some more urgent task, the devil is likely to win the argument, if only because the argument can then proceed on a noncognitive level. The distracted dieter does not *think* about the food but merely reacts to its sensory properties in an almost decorticate way. At the sensory level, temptation will always triumph. Resistance requires a clear focus on the downside of consuming a desirable treat, and this downside is fairly abstract: The consequences of self-regulatory failure are to be found somewhere off in some vague future, whereas the pleasure of capitulation is immediate.

Eating Hijacked by Salient External Cues

The conflict between sensory- and self-control of behavior is articulated clearly in Heatherton and Baumeister's (1991) analysis of binge eating. They postulate that distress—particularly those forms of distress that pose a threat to one's ego or self-esteem—renders self-awareness aversive (because it is aversive to contemplate a besieged self) and prompts the individual to "escape" from self-awareness. Aspects of the "self" that are

discarded during this escape include one's long-range goals (e.g., weight loss, in the case of dieters). Not only is the goal of weight loss (temporarily) abandoned, but the escape from self is a flight into the not-self, more specifically, the immediate environment of sensory stimuli. It is almost as though the individual descends to a lower level of consciousness, devoid of abstract ideals and goals, and dominated by salient cues demanding an unmediated, reflexive response. In the presence of palatable food, and having lost sight of long-range objectives, the distressed dieter is easy prey for forbidden food.

The idea that distress renders the individual more vulnerable to the sensory allure of food was proposed earlier by Slochower (1983). She argued that certain diffuse types of distress make the individual more "external" (responsive to environmental cues). When the distressed eater is in the presence of salient food cues, overeating will ensue. Slochower's prescient analysis was restricted to the obese, however, and she did not focus on distress-induced externality as a threat to self-regulatory control, if only because her analysis retained Schachter's internal–external framework rather than the inhibition–disinhibition framework that is a prerequisite for a fully realized self-regulatory analysis.

Other models pertinent to self-regulation have emphasized conditions under which behavior is "captured" by salient cues. Steele and Josephs (1990) proposed that alcohol narrows the individual's attentional field, so that behavior comes under the control of most salient cues in the immediate environment. Ward and Mann (2000) extended the "alcohol myopia" model and proposed that a cognitive load of any sort will reduce available cognitive resources and have the net effect of focusing attention more narrowly on salient stimuli (e.g., palatable, forbidden food that is enticingly available to dieters). Ward and Mann found that imposition of a memory task led to disinhibition of eating among restrained eaters.

These models emphasizing the narrowing of attention (and behavioral control) to salient stimuli may be quite directly applied to disinhibited eating under conditions of distress and alcohol intoxication. In both instances, the individual's cognitive resources are depleted: In the case of distress, the impairment is created by the need to devote a certain proportion of resources to coping with the distress; in the case of alcohol, the loss of cognitive resources may be a direct pharmacological effect. In either case, it is not difficult to explain disinhibition of eating in dieters. Whether these models can account for the disinhibition that occurs in response to a forced preload is more debatable. Conceivably, being forced to consume a rich preload is a disturbing experience for the dieter, and we can reconstrue the preload manipulation as a distress manipulation. Still, no direct evidence indicates that preloading has a negative emotional impact on dieters. (We might even argue that a forced preload is a positive event; one gets to eat a fondly desired, forbidden food, while avoiding blame for the episode, because one has no choice in the matter.)

Self-Regulatory Strength

A somewhat different rendition of the impairment of self-regulatory ability is the self-regulatory strength model (Baumeister, Bratslavsky, Muraven, & Tice, 1998; Baumeister & Vohs, 2002; Muraven, Tice, & Baumeister, 1998), which proposes that effective self-regulation demands a certain degree of self-regulatory strength. Like muscular strength, self-regulatory strength can be depleted in the short term by exertions of self-control, although in the long term, repeated exertions of self-control (like regular exercise) supposedly increase one's self-regulatory strength. This metaphor can explain why having to

exert self-control in one situation may impair self-regulation in another immediately thereafter. Some evidence (Kahan, Polivy, & Herman, 2003; Vohs & Heatherton, 2000) suggests that such may be the case for restrained eaters: Exertions of self-control, whether or not they are related to inhibiting eating, may make it more difficult to inhibit eating immediately thereafter. Whether repeated efforts over time to resist tempting food strengthen one's self-regulatory abilities (with respect to food or other temptations) remains an unanswered question. Although the details of this model are vague, it has some intuitive explanatory appeal, once again emphasizing threats to self-regulatory capacity.

Desire

Most of the attempts to account for self-regulatory failure in dieters that we have examined locate the main source of the problem in the dieter's impaired capacity to resist temptation. Owing to a lapse in motivation, attention, or self-regulatory strength (willpower) and/or perhaps to temporarily losing sight of long-range goals, the dieter can no longer summon the resources necessary to fend off the desire for palatable food. This analysis of the problem seems reasonable, as far as it goes; but we must remember that there is more than one element in the equation that predicts successful resistance to temptation. Obviously, the fewer the resources that one brings to the resistance effort, the less likely it is to succeed, but, by the same token, not all temptations demand the same amount of resistance. Some temptations are more tempting than others, and the prediction of self-regulatory success should take that fact into consideration. Loewenstein's analysis of self-control (e.g., Hoch & Loewenstein, 1991; Loewenstein, 1996) emphasizes fluctuations in desire, with the probability of self-control success varying inversely with the intensity of desire at the visceral level. If the hungry individual displays less resistance to forbidden food, is it because hunger depletes the resources necessary for resistance, or because hunger renders the forbidden food even sweeter? It may be that the "resistance resources" remain constant but the temptation to be resisted becomes more desirable, overwhelming the resources that formerly were capable of sustaining resistance to less intense temptations. A rich dessert is easier to resist when it is merely described verbally on the menu than when it is glistening right in front of you on your plate. This analysis finds empirical support in the previously described studies by Fedoroff and colleagues (1997, 2003).

CONCLUSIONS

Consideration of the magnitude or intensity of temptation simply reminds us that resistance to temptation is a dynamic process, and that success at a task depends both on our ability and on the difficulty of the task, either of which can in principle be manipulated independently. This perspective, although obvious in a way, also makes clear how far we are from a truly comprehensive analysis of self-regulatory success and failure. The final model will have to include both the state of the dieter and the power of the tempting stimulus. Neither factor is easy to measure independently; most models assume that the "other" factor is held constant, while the factor of interest is varied. Until we achieve much more systematic (and noncircular) assessments of both the ability to resist and the power of the temptation, we will be unable to escape the charge that our manipulations affect both factors, and that assuming only one factor to be crucial amounts to scientific

negligence. Furthermore, it may turn out that these "independent" factors mutually influence each other, as well as independently affecting the outcome of the resistance effort.

We have come a long way in understanding self-regulation in the past few decades, although one cannot help thinking that some ancient Greek philosophers must have known all of this, but we clearly have a long way to go in terms of establishing the relative merits of the competing theories (or even the extent to which the competing theories are not just saying the same thing in different words). Eating provides a nice crucible for testing models of self-regulation and self-regulatory failure. As our survey indicates, several intriguing models have been developed specifically in the context of eating, whereas others have been developed elsewhere and imported into the domain of eating. The next step, we believe, will be to identify and articulate more clearly the empirically testable differences among these models and begin to do the sort of research that will help us to decide which models best account for the data.

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