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Research report

DiETING as a case of behavioural decision making. Does self-control matter?

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ABSTRACT

To be a successful dieter, one has to be able to consistently resist immediate temptations in order to achieve the bigger, but delayed rewards of weight loss, increased attractiveness and better health. These long-term benefits are by no means guaranteed as the delayed rewards are more uncertain than the immediate rewards. Several researchers have suggested that the population of restrained eaters consists of two populations: unsuccessful dieters who score high on restraint and high on disinhibition, and successful dieters who score high on restraint but low on disinhibition. The present study examines to what extent restrained eating in combination with individual differences in self-control (akin to low disinhibition) is related to successful decision making on a task that mimics the uncertainty of dieting (measured with the Iowa Gambling Task). As expected, self-control moderated the association between restraint and decision making: restrained eating was related to worse decision making when self-control was low, but to better decision making when self-control was high. This suggests that those high in restraint and high in self-control may be more successful in their dieting attempts because they are generally better at inhibiting short-term rewards in order to gain better long-term outcomes.

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Introduction

DiETING is common practice, especially among young females. But is dieting good or bad: does it ultimately result in weight loss or does dieting actually promote disordered eating patterns such as binge eating and eventually result in weight gain? The empirical evidence is contradictory (cf. Stice, Pressnell, Groesz, & Shaw, 2005b; Van Strien, Engels, Van Staveren, & Herman, 2006). Several authors have suggested that dieting may only promote problematic eating patterns and result in adverse outcomes in a subset of individuals, that is, those with a high tendency toward disinhibited eating (Ouwens, VanStrien, & VanderStaaak, 2003; Ricciardelli & Williams, 1997; Stunkard & Mesnick, 1985; Van Strien, 1997). To be a successful dieter, one has to be able to consistently resist immediate temptations such as indulging in eating chocolate or ice cream in order to achieve the bigger, but delayed rewards of weight loss, increased attractiveness and better health (the two principal reasons given by dieters for wanting to lose weight, Polivy & Herman, 2006). However, these long-term benefits are by no means guaranteed as the delayed rewards are much more uncertain than the immediate

rewards (Van den Bos & De Ridder, 2006). As such dieting behaviour can be viewed as making constant trade-offs between immediate and delayed benefits under uncertain conditions. The present study examines to what extent restrained eating in combination with individual differences in self-control (akin to low levels of disinhibition) is related to successful decision making on a task that mimics the uncertainty of dieting. In doing so we aim to further understanding of why some dieters are successful and others are not.

Decision making under uncertainty

A task that has been widely used to assess decision making under uncertainty is the Iowa Gambling Task (IGT) developed by Damasio and colleagues (Bechara, Damasio, Damasio, & Anderson, 1994). This task requires participants to choose from four decks of cards and simulates real-life decision making under uncertain conditions. The cards in two decks are associated with high immediate rewards, but with even higher losses. The cards in the other two decks are associated with small immediate rewards and small losses. In the long run, the high reward – high loss decks are disadvantageous, whereas the low reward – low loss decks are advantageous. Participants receive minimal instructions regarding the rules of the task, that is, they are only told that each card can result in a net gain or a net loss and that the goal is to win as much money as possible.

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The Iowa Gambling Task was originally developed to examine decision making in patients with circumscribed damage to the ventromedial region of the frontal lobes (Bechara et al., 1994). These patients have severe impairments in personal and social decision-making, that is, they consistently choose for immediate benefits even when they are aware of the long-term negative consequences. Over the course of the task (approximately after the first 40 trials) control participants learn to choose from the low paying (advantageous) decks, which results in long-term gain. In contrast, patients with ventromedial damage keep selecting from the high paying (disadvantageous) decks, resulting in long-term loss. Impaired performance has also been found among people with a variety of disinhibited behaviours such as (poly)substance abusers, violent offenders, and pathological gamblers (see for a review Overman et al., 2004). Recently, a study by Davis, Levitan, Muglia, Bewell, and Kennedy (2004) has shown that overweight and obesity may also be related to poor performance on the IGT. In their study, women with normal weight performed better on the IGT than did overweight and obese women.

Restrained eating, self-control, and decision making

Decision making as assessed with the IGT has important elements in common with dieting. First, in order to attain the long-term goal of weight loss, dieters must be able to consistently resist the immediate temptation of foods. In the IGT this would amount to consistently choosing the low reward – low loss decks over the high reward – high loss decks. Second, dieters need to come to terms with the fact that investments in long-term wins are uncertain by definition, which makes it more difficult to deny the immediate rewards presented to them.

At first glance, we might expect high levels of restrained eating to be related to successful decision making according to the IGT, after all dietary restraint means inhibiting ones immediate responses with respect to eating in order to achieve a weight loss goal. However, studies on the effects of restrained eating suggest that this relationship might be less straight forward. In fact, some studies measuring self-reported dieting tendencies suggest that dieting is actually associated with problematic eating patterns such as binge eating and even weight gain (e.g. Klesges, Isbell, & Klesges, 1992; Polivy & Herman, 1985; Stice, Cameron, Killen, Hayward, & Taylor, 1999; Stice, Presnell, Shaw, & Rhode, 2005a). Moreover, several studies have shown that restrained eating is associated with lower levels of dispositional self-control (Williams & Ricciardelli, 2000), higher levels of impulsivity (Nederkoorn, VanEijs, & Jansen, 2004), and higher levels of self-reported binge drinking and alcohol use (Krahn, Kurth, Gomberg, & Drenowski, 2005; Stewart, Angelopoulos, Baker, & Boland, 2000), suggesting a more generalized lack of self-control and poor decision making among restrained eaters.

In contrast, however, other studies have found no relation between restrained eating and overeating in an experimental setting (Ouwens et al., 2003), prospective weight gain (Van Strien et al., 2007), or impulsivity (Lyke & Spinella, 2004). Moreover, experimental studies randomly assigning people to a diet intervention have found decreases in bulimic symptoms and weight gain (e.g. Pressnell & Stice, 2003; Stice et al., 2005a, 2005b). It is important to note that most studies showing negative effects of restrained eating have used the Restraint Scale (RS; Herman & Polivy, 1980) to discriminate between restrained and unrestrained eaters. In addition to items measuring dietary restraint, the Restraint scale also contains items that measure disinhibited eating.

The contradictory findings have led a number of researchers to suggest that the assumed homogenous population of dieters or restrained eaters actually may consist of two populations: successful dieters who are characterised by high restraint and a low tendency toward disinhibited eating, and unsuccessful dieters who are characterised by a combination of high restraint and a high tendency toward disinhibited eating (Ouwens et al., 2003; Ricciardelli & Williams, 1997; Stunkard & Mesnick, 1985; Van Strien, 1997; Van Strien et al., 2007).

The present study

Disinhibited eating refers to a lack of self-control, that is, the inability to override or control ones inner responses or impulses (Tangney, Baumeister, & Boone, 2004). The present study examines the role of dispositional self-control in the association between restrained eating and successful decision making as assessed by the IGT. A number of studies have shown that disinhibited eating tendencies are associated with lower levels of self-control or higher levels of impulsivity among eating disordered populations (Kane, Loxton, Staiger, & Dawe, 2004) as well as normal samples (Lyke & Spinella, 2004; Tangney et al., 2004). The reasoning by Van Strien and others (e.g. Van Strien, 1997) implies that some dieters (high restraint/high self-control) are better at inhibiting short-term rewards when long-term consequences are negative than other dieters (high restraint/low self-control). The first goal of the study was to test the hypothesis that the relation between restrained eating and decision making would be moderated by self-control in such a way that women scoring high on restraint and high on self-control would score better on the IGT (i.e., consistently choose for advantageous low reward/low loss decks) than would women scoring high on restraint and low on self-control. It was further expected that the moderator effect would not manifest itself until later on in the game (i.e. after the first 40 trials). Individuals need time to learn to distinguish between the “good” decks and the “bad” decks, and it is not until after about 40 trials that those who perform poorly on the IGT start to differ from those who perform well on the task (e.g. Bechara & Martin, 2004; Davis et al., 2004; cf. Van den Bos, Houx, & Spruijt, 2006).

A second goal of the present study was to examine whether individual differences in self-control influence performance on the IGT. Theoretically, one would expect dispositional self-control to be related to better performance on the IGT. A handful of studies have examined the relations between personality traits akin to self-control and behavioural decision making with the IGT and the results are inconsistent. Self-reported disinhibition (Crone, Vendel, & VanderMolen, 2003), lack of premeditation (Zermatten, VanderLinden, d'Acromont, Jermann, & Bechara, 2005), and impulsivity (Davis, Patte, Tweed, & Curtis, 2007) were found to be related to poorer decision making in these three studies. However, two other studies found no support for a relation between measures of impulsivity and IGT performance (Franken & Muris, 2005; Overman et al., 2004). Moreover, Davis et al. (2007) found that high reward responsiveness was related to poorer performance, whereas Franken and Muris (2005) found the opposite.

Method

Participants and procedure

Fifty female psychology undergraduates participated in the present study for extra course credit (age $M = 21.6$ years; $S.D. = 1.7$). Participants were invited to the laboratory and were seated behind a computer. A maximum of six students were run at

the same time. The Iowa Gambling Task was programmed in Excel. All the other variables were programmed in E-prime software.

Measures

Iowa Gambling Task

A computerized version of Bechara's Iowa Gambling Task (Bechara et al., 1994) was used to measure decision making (Van den Bos et al., 2006). Participants were presented with four decks of cards (A–D) and were told that the game requires a series of card selections, one card at the time, from any of the four decks, until they were told to stop. Card selections were made by a mouse click on the chosen card. They were told that each card could result in a net gain or a net loss and that the goal was to win as much money as possible. At the right side of the computer screen, a bar showed the cumulative gain (or loss). They were not told how many choices had to be made, but the game stopped after 100 trials.

The instructions and the win and loss schedule were similar to those used by Bechara et al. (1994). After choice A or B, the participant always received €100, after choice C and D they always received €50. However, some cards from decks A–D required the participant to pay a penalty, often higher than the amount of money received on that card. In deck A the penalties varied between €150 and €350. In deck B there was one penalty of €1250. In deck C the penalties varied between €25 and €75. In deck D there was one penalty of €250. Thus, in the high-paying decks (A–B) the penalties were higher as well, resulting in a negative balance of €250 per 10 trials for both decks. In the low-paying decks (C–D), the modest penalties resulted in a net gain of €250 per 10 trials for both decks. This means that decks A and B were disadvantageous in the long run, whereas decks C and D were advantageous in the long run.

The percentage of advantageous choices over the entire game (the number of cards selected from the “good” decks, i.e. decks C and D, divided by 100) was used as the dependent variable. To reflect improvements in performance over the course of the game, the percentage of advantageous choices over the first 40 trials and percentage of advantageous choices over the last 60 trials (trials 41–100) were compared.

Self-control

Participants completed a Dutch translation of the Tangney et al. (2004) dispositional Self-Control Scale. The scale shows good internal consistency and retest reliability. Higher scores on the scale correlate with a range of positive outcomes, such as better grades, better psychological adjustment, less binge eating and alcohol use (Tangney et al., 2004). The scale consists of 36 items. Answers are given on a five-point scale ranging from 1 “not at all like me” to 5 “very much like me”. Sample items are: “I am good at resisting temptation”, “I am lazy”, and “I wish I had more self-discipline”. Negatively formulated items are reverse scored. Cronbach's alpha was .90 in the present study.¹

¹ The mean score for self-control in the present study ($M = 3.32$ or 120 in a summed scale, $S.D. = 0.44$ or 16 in a summed scale) was higher than the means reported by Tangney et al. (2004; $M = 114$, $S.D. = 19$ in Study 1, and $M = 103$, $S.D. = 18$ in Study 2). The range of observed scores and standard deviation was lower in the present study. Like in our study, participants in Tangney's studies were young undergraduate students receiving course credit for a psychology course. To examine whether our sample scored exceptionally high on self-control we compared the data in the present study with data from 218 female psychology undergraduates who participated in other studies at our department. Their mean score and standard deviation were virtually identical ($M = 3.32$ or 119 in a summed scale, $S.D. = 0.43$ or 15 in a summed scale) to those reported in the present study, $t(267) = 0.05$, ns. Thus, although participants in the present study scored on average higher on self-control compared to Tangney's participants, they did not score higher when compared to another sample of Dutch participants.

Table 1

Correlations, means and standard deviations for the variables under study

		1	2	3	4	5
1	IGT 1–40					
2	IGT 41–100	–0.06				
3	IGT total	0.34*	0.92***			
4	Self-control	–0.05	0.11	0.08		
5	Restraint	–0.07	–0.05	–0.07	–0.23	
	<i>M</i>	47.7	58.4	54.2	3.32	2.90
	<i>S.D.</i>	10.8	17.9	11.0	0.44	0.88

Note: $p < .05$, ** $p < .01$, *** $p < .001$. IGT = Iowa Gambling Task.

Restrained eating

Individual differences in restrained eating were assessed using the Restraint subscale of the Dutch Eating Behaviour Questionnaire (DEBQ; Van Strien, Frijters, Bergers, & Defares, 1986). Sample items are “Do you watch exactly what you eat?” and “Do you deliberately eat foods that are slimming”. Cronbach's alpha is .94. Scores ranged from 1.0 to 4.5 (possible range is from 1.0 to 5.0) and were normally distributed around a mean of 2.90. The DEBQ-restraint scale was used rather than the Restraint Scale (Herman & Polivy, 1980), because the latter is confounded with disinhibited eating tendencies.

Analyses

First, correlations and *t*-tests were conducted to examine whether individual differences in self-control and restrained eating influenced performance on the IGT. Although examining the relation between self-control and IGT performance was the second goal of this paper, it will be discussed first because it involves looking at the simple main effects.

Next, hierarchical regression analyses were employed to examine the moderating role of self-control in the association between restrained eating and IGT performance. Separate analyses were done with IGT performance over the entire game, IGT performance over the first 40 trials and IGT performance over the last 60 trials, respectively, as the dependent variable. Restraint and Self-control were entered in step 1 of the analyses. The interaction term between Restraint and Self-control was entered in step 2. Predictors involved in the interaction terms were centered in order to avoid high inter-correlations between predictors and interaction terms (West, Aiken, & Krull, 1996). Interactions were further examined by calculating regression slopes one standard deviation above and below the mean of the moderator and conducting simple slope analyses (West et al., 1996).

Results

Main effects

Consistent with the idea that participants need some time to understand how the game works, participants made more advantageous choices in the second part of the game (trials 41–100; $M = 58\%$) than they did in the first part of the game (trials 1–40; $M = 48\%$), $t(49) = 3.60$, $p < .001$ (Table 1).

No significant correlations were found between IGT performance and dispositional self-control (Table 1). To examine the possibility that only those with more extreme scores on dispositional self-control differed with respect to their IGT performance, we selected participants scoring in the top or bottom 20% of the distribution. This amounted to 11 participants scoring low on self-control (2.97 or lower) and 11 participants scoring high on self-control (3.63 or higher). Although the results were in the expected direction for IGT performance over the entire game, and IGT

Table 2

Iowa Gambling Task (IGT) scores for individuals scoring high (top 20%) or low (bottom 20%) on Self-control

	Bottom 20%	Top 20%	t-test ^a		Effect size ^b
	M (S.D.)	M (S.D.)	t(20)	p	
IGT total	50.6 (9.0)	54.6 (7.3)	1.09	0.29	0.49
IGT 1–40	47.7 (4.1)	46.4 (11.3)	0.38	0.71	0.18
IGT 41–100	52.4 (13.8)	59.9 (17.9)	1.15	0.27	0.47

^a Levene's test for equality of variances showed no significant differences, all $F_s < 1.43$, ns.

^b Cohen's *d*.

Table 3

Iowa Gambling Task (IGT) performance over the entire game, the first 40 trials, and the last 60 trials regressed on Restraint and Self-control

		R ² change	β	<i>b</i>
IGT total percentage				
Step 1	Restraint	0.01	−0.03	−0.42
	Self-control		0.10	2.44
Step 2	Restraint × Self-control	0.11*	0.34*	10.53*
IGT trials 1–40				
Step 1	Restraint	0.01	−0.09	−1.06
	Self-control		−0.06	−1.55
Step 2	Restraint × Self-control	0.01	0.06	1.88
IGT trials 41–100				
Step 1	Restraint	0.01	0.01	0.01
	Self-control		0.13	5.10
Step 2	Restraint × Self-control	0.11*	0.33*	16.29*

Note: * $p < .05$, ** $p < .01$, *** $p < .001$.

performance over the last 60 trials, they were not significant (Table 2). As this may be due to the small sample size (i.e. 11 in each group) we calculated effect sizes (Cohen's *d*). The effect sizes for IGT total percentage and percentage over the last 60 trials approached a medium effect size (Cohen, 1988, defines an effect size of 0.50 as medium).

No significant correlations between restraint and IGT performance, or restraint and dispositional self-control were found (Table 1).

Moderating role of self-control

First, it was examined whether self-control moderated the association between restrained eating and IGT performance over

the entire game. As expected, the interaction term in step 2 of the analysis explained a significant amount of variance after controlling for the main effects (Table 3). Regression slopes for self-control were calculated one standard deviation above and below the mean. Simple slope analyses showed that, as expected, there was a positive relation between restraint and IGT performance for women who scored high on self-control ($\beta = 0.34$), whereas there was a negative relation between restraint and self-control for women who scored low on self-control ($\beta = -0.41$).

Regression analyses with IGT scores over the first 40 trials and over the last 60 trials were subsequently conducted. In line with the expectations, the interaction term was significant with the percentage of advantageous choices over the last 60 trials as the dependent variable, but not with the percentage over the first 40 trials as the dependent variable, indicating that the effect of individual differences in self-control and restraint only manifested itself later on in the game (Table 3). This is illustrated in Fig. 1: the relation between restraint and IGT performance was close to zero in the first 40 trials, both for women high ($\beta = -0.02$) and low in self-control ($\beta = -0.15$). In the last 60 trials, the relation between restraint and IGT performance was positive for women high in self-control ($\beta = 0.37$) and negative for women low in self-control ($\beta = -0.37$). When scores on the last 60 trials are compared to average scores on the first 40 trials, it appears that all women improved over time, but that women who scored high on restraint and high on self-control improved most and that women who scored high on restraint and low on self-control improved least (Fig. 1).

Discussion

The present study examined the relation between restrained eating and behavioural decision making under conditions that mimic the uncertainty of dieting. On the whole women scoring high on restrained eating did not score better or worse on the decision making task than did women scoring low on restrained eating. As expected, it was found that whether or not restrained eaters were successful decision makers depended on their self-reported dispositional self-control. That is, restrained eating only related to worse decision making when self-control was low, but restrained eating was actually related to better decision making when self-control was high. Furthermore, when scores on the last 60 trials were compared to the first 40 trials it was found that women high on restraint and low on self-control showed almost no

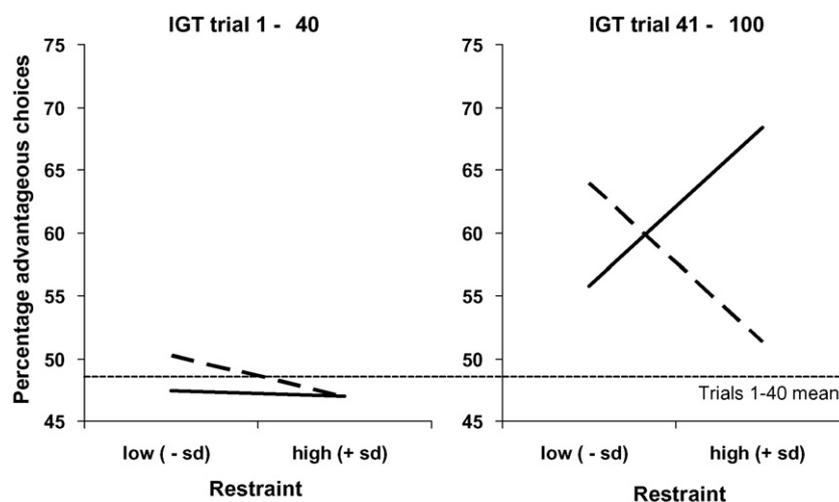


Fig. 1. Interactive effect of restraint and self-control on Iowa Gambling Task performance over the first 40 trials (trials 1–40) and over the last 60 trials (trials 41–100) of the game. Continuous line = high self-control (+1S.D.); broken line = low self-control (−1S.D.).

improvement in decision making, whereas those who scored high on both restraint and self-control showed most improvement. According to a number of researchers, the population of restrained eaters consists of two subpopulations: the unsuccessful dieters who are characterised by high restraint and a high tendency toward disinhibition (akin to low self-control) and the successful dieters who are characterised by high restraint and a low tendency toward disinhibition (e.g. Stunkard & Mesnick, 1985; Van Strien, 1997). The present research suggests that those high in restraint and high in self-control may be more successful in their dieting attempts because they are generally better at inhibiting short-term rewards in order to gain better long-term outcomes.

In addition to a moderating role of self-control we expected to find a main effect of self-control on IGT performance. However, we found little support for an unqualified effect of dispositional self-control. Correlations close to zero were found when dispositional self-control was treated as a continuous variable. These findings are in line with two other studies that failed to find a relationship between measures of self-reported impulsivity and IGT performance (Franken & Muris, 2005; Overman et al., 2004). A study that did find a relationship between impulsivity, reward sensitivity and IGT performance only did so when they used a novel approach to define poor decision making (i.e., they compared “learners” versus “non-learners”), not when they used a more commonly reported method similar to ours looking at percentage of advantageous choices (Davis et al., 2007). Crone et al. (2003) found a relationship between disinhibition and IGT performance by selecting the top and bottom 20% of disinhibited individuals (Crone et al., 2003). Following this method in our study we found results in the expected direction approaching a medium effect size. However, the results were not statistically significant. Although it is possible that this is due to the small sample size in the current study, it is important to point out that the current findings are also in line with studies examining the relationship between self-report measures and behavioural measures of impulsivity other than the IGT (e.g. Mitchell, 1999; Reynolds, Ortengren, Richards, & De Wit, 2006).

A recent study by Zabelina, Robinson, and Anicha (2007) offers an interesting explanation for our finding that overall, self-control was virtually unrelated to decision making. They showed that, in addition to numerous benefits, there may be certain costs to high levels of self-control. Their results showed that individuals high in self-control (as measured with the Tangney et al., 2004, scale) made less frequent references to positive and negative affect, and physiological states (e.g. feeling hungry, tired) in their daily lives, and were rated as less spontaneous by informants compared to individuals low in self-control. According to the somatic marker hypothesis (Bechara, Damasio, Tranel, & Damasio, 1997) one has to rely to some extent on one's feelings and hunches in order to be successful on the IGT. That is, over the course of the task anticipatory emotional feelings (“somatic markers”) come to be connected to predicted outcomes and act as a warning signal. Individuals high in self-control may either be unaware of these emotions or ignore them and as a result perform not as well on the IGT as one would expect at first glance. In the present study the relation between self-control and decision making was qualified by restraint eating, suggesting that the possible costs of high levels of self-control were off-set by high levels of restraint eating. Women who diet pay a lot of attention to bodily processes and physical states and this may have helped them perform well on the IGT in combination with high levels of self-control.

Two other findings in the present study are noteworthy. First, the finding that restrained eating was not significantly related to dispositional self-control supports the claim that the restraint scale of the DEBQ is a measure of pure restraint, uncontaminated by tendencies toward disinhibition (Ouwens et al., 2003). Second,

in line with the expectations it was found that the individual differences in restraint and self-control did not have an effect on decision making until in the second part of the game (i.e. that last 60 trials).

A limitation of the present study was the relatively small sample size. The fact that differences in IGT performance were not statistically significant when participants with more extreme scores on self-control were compared might be due to power problems. In addition, the sample in the present study scored on average higher on self-control and was more restricted in range of observed scores than the samples reported by Tangney et al. (2004) (see footnote 1), suggesting that particularly those in bottom 20% did not score at very low levels of self-control.

Restraining ones eating behaviour has gained a bad reputation through the many studies that showed that restrained eating is related to weight gain, uncontrolled eating behaviour, and impulsivity (e.g. Klesges et al., 1992; Nederkoorn et al., 2004; Polivy & Herman, 1985). However, in these studies restrained eating is typically measured with the Restraint Scale (Herman & Polivy, 1980) measuring dietary restraint and disinhibited eating at the same time. The present study suggests that the intention to restrict food intake and actually doing so (as measured by the restraint scale of the DEBQ) may not be problematic in itself, as long as this intention and the behaviour is regulated well. For many people, restricting food intake is the only way to lose weight and interventions aimed at increasing peoples' general self-control may be beneficial.

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