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Abstract

Surprisingly few studies have explored the intuitive connection between self-control and weight loss. We tracked participants' diet, exercise and weight loss during a 12-week weight loss program. Participants higher in self-control weighed less and reported exercising more than their lower self-control counterparts at baseline. Independent of baseline differences, individuals high in dispositional self-control ate fewer calories overall and fewer calories from fat, burned marginally more calories through exercise, and lost more weight during the program than did those lower in self-control. These data suggest that trait self-control is, indeed, an important predictor of health behaviors.

Keywords

Body Mass Index, control, diet, eating, eating behavior, exercise, health behavior, health psychology, obesity, overweight

The Centers for Disease Control and Prevention report that 34 percent of Americans were obese as of 2007 (Ogden et al., 2007). Obesity has physical, social, and psychological consequences including increased risk of chronic disease (e.g. Kenchaiah et al., 2002; Mokdad et al., 2003), social stigma (Puhl et al., 2008), and reduced attractiveness to others (Swami et al., 2007). While many overweight and obese individuals attempt to lose weight (Carrol, 2005), people often have only limited success in achieving and maintaining weight loss (Mann et al., 2007).

One salient barrier to weight loss is poor self-control in the face of tempting, high calorie foods. It is important at the outset to note that obesity cannot be reduced to a simple lack of will power. The success of weight loss efforts is affected by multiple factors over which people have little control including individual differences in genetic predispositions (Yang et al., 2007), physiological factors (Knudsen et al.,

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2005; Turnbaugh et al., 2006), and socioeconomic status (Wang and Beydoun, 2007). That said, those who lack the self-control necessary to consistently choose healthy alternatives over high-calorie foods are likely to have greater difficulty losing weight than those who can more easily bring their eating behavior in line with their weight loss goals.

A person's level of self-control can be defined as his or her ability to control or change responses to meet a given standard (Carver, 2004). Individuals who consistently display self-control are thought to be high in dispositional or trait self-control while those who less frequently control their responses are considered lower in dispositional self-control (Tangney et al., 2004). Self-control is particularly relevant to motivational conflicts in which one must resist a pleasurable temptation in order to satisfy a long-term goal. In that sense, self-control is relevant for maintaining both a healthy diet (as in resisting the temptation to eat fattening foods) and regular exercise (as in resisting the temptation to engage in easier, more sedentary pursuits). To the degree that weight loss depends upon diet and exercise, self-control should be an important predictor of success in pursuing a weight loss goal. Consistent with this argument, Junger and Van Kampen (2010) have recently found that people with high self-control report engaging in exercise more often than those with less self-control. For many people, dispositional self-control seems to also be an important tool for regulating eating. Individuals scoring high in dispositional self-control are more likely than those lower in self-control to report healthy dietary practices such as eating a regular breakfast and avoiding unhealthy sweets (Junger and Van Kampen, 2010). They also score lower than people low in self-control on measures of disordered eating including the drive for thinness, bulimia (Tangney et al., 2004), and emotional eating (Konttinen et al., 2009). Self-control is not always associated with healthy eating practices. Indeed, self-control is associated with unhealthy forms of restrained eating in some samples (Williams and Ricciardelli, 2000) and people with anorexia nervosa report having high self-control (Butler and Montgomery, 2005). However, self-control does seem to be an important tool for resisting tasty but fattening temptations. Perhaps because of the relationships between self-control and diet and exercise, individuals high in trait self-control have lower body mass indices than do those lower in self-control (Junger and Van Kampen, 2010; Konttinen et al., 2009).

It seems straightforward and theoretically compelling that possessing high trait self-control might help people maintain healthy diet and exercise behaviors and, as a consequence, have more success in losing weight than those low in self-control. There is, however, surprisingly little research that directly tests these predictions. Our review of the literature revealed only two studies in which self-control was measured and participants' diet and exercise behaviors were tracked over time, rather than relying upon retrospective self-report. Both articles suggested some support for a relationship between self-control and engagement in health behaviors. Schroder and Schwarzer (2005) found that heart surgery patients high in self-control reported eating fewer calories and exercising more than those with low self-control. Wills et al. (2007) conceptually replicated the effect of self-control on diet and exercise behavior in a large, multiethnic sample of high school students. However, neither article focused on a population hoping to lose weight and, perhaps for that reason, neither article demonstrated a relationship between dispositional self-control and weight loss. The only evidence we could find suggesting that self-control related specifically to changes in weight involved weight gain rather than loss. Two longitudinal studies demonstrated that children low in self-control were more likely than their peers to become obese as they grew older (Duckworth et al., 2010; Francis and Susman, 2009).

Therefore, the first goal of the present investigation was to demonstrate that dispositional self-control is an important predictor of weight loss. We hypothesized that, in the context of a weight loss program, persons high in self-control would lose more weight than others. We tracked participants in a longitudinal weight loss program that included weekly meetings and online diet and exercise diaries. We predicted that participants high in trait self-control would comply better with the diet and exercise advice offered in the program than would those lower in self-control. Specifically, we expected participants high in self-control to attend more weekly meetings, eat fewer calories, exercise more, and ultimately to lose more weight than participants lower in self-control. Further, we predicted that trait self-control would be a significant predictor of these important outcomes when controlling for baseline effects of self-control, suggesting that self-control exerts a unique and important influence on health behaviors during active goal pursuit.

Method

Participants

For six weeks prior to the start of the program, participants were recruited through a series of paper-based advertisements located around the Florida State University campus and the greater Tallahassee, FL community. An identical ad was placed on craigslist. The advertisement offered information about the opportunity to participate in a free 12-week weight loss research study that encouraged healthy eating and regular exercise. Interested individuals were directed to a website for additional information and to apply to participate.

Two hundred and five prospective participants completed the web-based application, which asked about their height and weight and included the EAT-26 eating attitudes measure (Garner et al., 1982). One hundred thirty-eight applicants met our inclusion criteria of being overweight (as defined by BMI of 25 kg/m^2 or more) with a low risk of an eating disorder (as indicated by responses to the EAT-26). Fifty prospective participants were lost through attrition during the six weeks between the start of recruitment and the first measurement of self-control (one week after the start of the program). Two additional participants attended the first two meetings but arrived late and did not complete the self-control scale. Because they also did not attend subsequent meetings, they were not able to be included in the analyses.

The final sample included 86 participants who were 70.9 percent female. Participants were 52.3 percent non-Hispanic Caucasian, 18.6 percent Black, 16.3 percent Hispanic, and of 4.7 percent mixed or other race. An additional 8.1 percent of participants did not provide race or ethnicity information. Participants ranged in age between 18 and 60 (Median = 21.00, Mean = 26.56, SD = 10.77), ranged in weight between 59.87 and 190.51 kg (Median = 86.18, Mean = 89.41, SD = 22.84), and ranged in BMI between 25.01 and 53.92 (Median = 29.13, Mean = 31.30, SD = 6.33). Students made up 66.3 percent of the sample. The student sample was 68.75 percent employed while 82.75 percent of non-student participants were employed.

Baseline measures of diet and exercise

Participants were asked to complete online measures of baseline diet and exercise two weeks before the start of the program. Dietary habits were assessed using the National Cancer Institute Percent Energy from Fat Screener (Thompson et al., 2007). Participants were asked, in this measure, to report the frequency with which they consumed a number of high fat foods (e.g. eggs, butter, bacon) over the past year. Published scoring guidelines were used to translate these values into an estimated percentage of each participant's caloric intake that came from fat.

Participants were also asked to estimate the number of days in a typical week during which they engaged in moderate exercise, defined as any activity that produced some increase in breathing and heart rates (e.g. brisk walking or bicycling) (Physical Activity Guidelines Advisory Committee 2008). They were also asked to estimate the number of hours or minutes typically spent on this activity. Participants were next asked to estimate 'in a usual week in the past month', the number of days per week in which they engaged in vigorous exercise, defined as any activity that produced a large increase in breathing and heart rates (e.g. running or aerobics). The wording of the final question was confusing and several participants offered estimates of having engaged in vigorous exercise, on average, more than seven days per week. Because these data could not be clearly interpreted, the baseline measure of exercise used in data analyses represents only participants' minutes spent in moderate exercise per week.

Weight loss program procedure and dependent measures

Participants took part in a 12-week weight loss program, adapted from the Diabetes Prevention Program, that emphasizes gradual and healthy modifications to dietary habits (e.g. reduced calorie and fat intake) and increased physical activity (DPP, 2002). The program also addresses psychological and social factors (e.g. problem-solving, cognitive restructuring) that influence lifestyle modifications. Each week, participants attended a group meeting led by a program coach during which they were weighed using calibrated electronic scales. Every other meeting, participants completed the 13-item measure of dispositional self-control (Tangney et al., 2004). This scale asked participants to rate their agreement with statements such as 'People would say I have iron self-discipline', and 'I do certain things that are bad for me, if they are fun.'

This investigation was conducted in concert with an independent study for which participants' focus was focused on either what they had already achieved or what they had left to achieve in order to reach their weight loss goal. This manipulation was achieved through a weekly questionnaire in which participants were asked to discuss the changes they had already made in the service of their weight loss goal or the changes they still needed to make. A third set of control participants completed no questionnaire. This manipulation is not germane to the current investigation but is described in detail elsewhere (Conlon et al., 2010). In this article, we report the effects of trait self-control on health behaviors without controlling for participants' focusing condition. However, including focusing condition as a covariate in these analyses does not affect the observed pattern of results.

Participants were also encouraged to log in daily to a companion website and record all of their meals and exercise activities. Participants logged their meals by entering each food item consumed into a search box linked to nutritional database. Upon finding the correct food item in the search results, participants entered the amount consumed and whether it was a part of breakfast, lunch, dinner, or a snack. To log exercise, participants entered each activity into a search box linked to an exercise database. After selecting the right activity from the search results, participants indicated the duration of the exercise activity. Participants were able to review the number of calories consumed or burned for each food item and exercise activity in their food and exercise diaries, organized by date and meal.

We created composite food and exercise variables from participants' diary data by first summing the reported number of calories consumed and burned for each participant each week. We also calculated, separately, the number of weekly calories from fat. Participants logged in, on average, 4.77 days of each week. Because participants presumably did not log every meal, we divided weekly sums by the reported number of meals for each participant to create measures of the average number of calories per meal for each week. We computed the average number of calories from fat per meal and the average number of calories from sources other than fat per meal in the same way. All analyses of website data also controlled for the number of days on which participants logged in to minimize the potential impact of individual differences in food diary compliance.

Results

The present study explored the predictive power of trait self-control over the course of a 12-week weight loss program. While the trait self-control scale has demonstrated high test–retest reliability, this reliability was demonstrated over a shorter period of time than the current investigation (three weeks) and in the absence of the sort of salient

Table 1. The effect of self-control on diet and health behaviors and weight loss at baseline

	High self-control	Low self-control	Difference
Average percent of calories that came from fat	33.38%	35.37%	–1.99%[NS]
Average number of minutes per week spent in moderate exercise	44.16	25.89	18.27*
Average Body Mass Index	29.25	31.77	–2.52*

Note: The values in this table are estimates, derived from reported regression equations, for individuals one standard deviation above the mean on trait self-control (high self-control) and one standard deviation below the mean (low self-control)
[NS] – not significant; *$p < .05$

temptations to self-control present when pursuing a weight loss goal. To ensure that trait self-control scores remained stable for the full length of this investigation, we measured self-control once every other week and conducted an unconditional growth model analysis to test for linear change in self-control scores over time. This analysis revealed no significant change in self-control scores over the six administrations of the measure, $F(1, 44.06) = .33$, NS. After confirming that the scores remained stable, we averaged across the six administrations to create a single self-control score for each participant.

A recent meta-analysis suggests that trait self-control differs by age and gender (De Ridder et al., 2010). Consistent with this research, women in our sample scored marginally higher in self-control than did men, $\beta = -.22$, $t(84)$[1] $= -1.68$, $p < .10$, and older participants scored marginally higher than did younger participants, $\beta = .20$, $t(84) = 1.84$, $p < .10$. To explore the effect of trait self-control on health behaviors independent the effects of age and gender, all analyses included these demographic variables as covariates.

The effect of self-control on baseline health behaviors

Before exploring the effect of self-control on baseline health behaviors, we log-transformed participants' baseline weight values in order to satisfy the assumptions of normality in regression. We also corrected for a positive skew in participants' baseline engagement in moderate exercise with log-transformation.

We next conducted a series of regression analyses to test whether participants high in self-control had healthier diet and exercise practices at baseline and lower BMI than those low in self-control. As predicted, participants higher in self-control engaged in more moderate exercise at baseline ($\beta = .31$, $t(72) = 2.30$, $p < .05$) and had lower BMI ($\beta = -.23$, $t(82) = -2.14$, $p < .05$) than did those lower in self-control (see Table 1 for estimated mean values for all baseline dependent measures, derived from reported analyses). However, self-control did not predict participants' baseline caloric intake from fat ($\beta = -.15$, $t(75) = -1.26$, NS). Further, participants' exercise behavior did not significantly relate to their weight in an analysis controlling for trait self-control ($\beta = -.15$, $t(75) = 1.28$, NS). Therefore, the relationship between self-control and baseline weight was not mediated by self-control differences in diet or exercise.

The effect of self-control on health behaviors during goal pursuit

We predicted that participants high in trait self-control would have greater ability to resist temptation when pursuing a weight loss goal than would those lower in self-control and, as a result, they would engage in positive health behaviors more often and, consequently, lose more weight. Because of the longitudinal nature

Table 2. Self-control and health behaviors during the weight loss program, controlling for baseline behaviors

	High self-control	Low self-control	Difference
Meetings attended	7.66	5.68	−1.99*
Average calories consumed per meal	411.03	473.30	−62.27*
Average fat calories consumed per meal	104.10	132.35	28.26*
Average calories burned through exercise each week	900.34	553.30	347.04*
Percentage weight lost at the end of 12 weeks	2.45%	−.26%	2.70%*

Note: The values in this table are estimates, derived from reported regression and HLM equations, for individuals one standard deviation above the mean on trait self-control (high self-control) and one standard deviation below the mean (low self-control)
*$p < .05$

of our data, we utilized two statistical approaches to test these predictions. First, we explored the overall effect of self-control on health behaviors through regressions predicting caloric intake and exercise behavior averaged across the 12-week program. To explore changes in diet, exercise, and weight longitudinally, we used a series of multilevel models to explore within-person behavioral change across the 12 weeks (level 1) and the effect of self-control on behavioral change across the weeks (level 2) as advised by Singer and Willett (2003). Multilevel modeling was selected over other repeated measures methods because it uses all the data provided by each participant to model change over time, including those who remained in the program for only a short time. In this way, each person's data are weighted in a way commensurate with participation in the program.

We first tested our hypothesis that participants' level of self-control would predict their meeting attendance. A regression predicting the number of meetings attended from participants' self-control, controlling for baseline BMI, revealed that participants higher in self-control attended more meetings than did those lower in self-control, $\beta = .25$, $t(81) = 2.24$, $p < .05$ (see Table 2 for estimated mean values for all program dependent measures, derived from reported analyses).

Next, we explored whether, as predicted, participants high in self-control consumed fewer calories than those lower in self-control. A regression predicting participants' caloric consumption, averaged across all weeks, revealed that participants high in self-control consumed fewer calories per meal, on average, than did those lower in self-control, $\beta = -.25$, $t(65) = -2.15$, $p < .05$. The effect of trait self-control on caloric consumption remained significant when controlling for baseline differences in caloric fat intake, $\beta = -.25$, $t(57) = -2.07$, $p < .05$. Next we examined whether caloric consumption changed over the course of the program with a series of multilevel models with program week centered at the first week. An unconditional linear growth model revealed a tendency for participants to eat fewer calories per meal as the program went on, B = −.03, SE = .01, $t(17.59) = -2.88$, $p = .01$, $\tau = .06$, z < .001. Level two models controlling for baseline consumption of fat calories confirmed the regression result that those high in self-control ate fewer calories, on average, than those lower in self-control, B = −.11, SE = .05, $t(88.47) = -2.29$, $p < .05$. However, changes in the number of calories consumed over time were unrelated to participants' self-control, B = .01, SE = .01, $t(17.87) = .35$, NS.

In addition to our interest in the *number* of calories consumed by participants, we also explored whether self-control predicted the *type* of calories consumed. We conducted a regression predicting participants' calories from fat from self-control, controlling for the number of calories consumed from sources other than fat. This analysis revealed that participants higher in self-control consumed fewer fat calories than did those lower in self-control, $\beta = -.31$, $t(65) = -2.68$, $p < .01$. This finding remained significant after controlling for baseline caloric intake from fat ($\beta = -.28$, $t(56) = -2.30$, $p < .05$). As with overall calorie consumption, an unconditional linear growth model revealed that participants consumed fewer fat calories as the program progressed (B = –.05, SE = .02, $t(31.60) = -3.19$, $p < .01$, $\tau = .24$, $z < .001$) and an analysis adding self-control to the model confirmed that those high in self-control ate fewer calories from fat during the program (B = –.20, SE = .09, $t(57.25) = -2.30$, $p < .05$). Again, self-control was unrelated to the observed decrease in caloric consumption from fat over the course of the 12 program weeks, B = .02, SE = .03, $t(29.93) = .89$, NS.

We next explored whether high self-control participants would engage in more exercise than those low in self-control. A regression predicting exercise calories, averaged across all weeks, from self-control revealed that participants high in self-control burned more calories through exercise, on average, than did those lower in self-control, $\beta = .28$, $t(62) = 2.17$, $p < .05$. This effect remained marginally significant when controlling for baseline levels of moderate exercise, $\beta = .24$, $t(53) = 1.65$, $p = .10$. As with caloric intake, we used multilevel model analyses to explore change in exercise over the course of the program. An unconditional growth analysis revealed that participants burned an increasing number of calories through exercise over the course of the program, B = .06, SE = .02, $t(24.44) = 2.60$, $p < .05$, $\tau = 1.06$, $z < .001$. Adding self-control and baseline exercise to the model revealed a marginally significant effect of dispositional self-control on exercise, averaged across the program weeks (B = .34, SE = .17, $t(64.43) = 1.96$, $p < .001$) as well as an interaction between self-control and program week suggesting that individuals higher in self-control increased their exercise more over the course of the program than did those lower in self-control, B = –.11, SE = .05, $t(12.52) = -2.51$, $p < .05$.

Effect of self-control on weight loss

To explore whether dispositional self-control facilitated weight loss during the program, we calculated the cumulative amount of weight lost each week for each participant, expressed as a percentage of their baseline weight. An unconditional linear growth model with program week centered on the final week (week 12) revealed a tendency for participants to lose weight over time, B = .12, SE = .001, $t(52.04) = 1.98$, $p = .05$, $\tau = 5.52$, $z < .001$. Adding self-control to the model revealed that, at the end of the 12 weeks, participants higher in self-control lost more weight than did those lower in self-control, B = 2.32, SE = 1.10, $t(45.23) = 2.11$, $p < .05$.

Finally, we conducted a series of multilevel models to determine whether the effect of self-control on weight loss was mediated by diet or exercise. Although participants' level of self-control predicted diet and exercise, the effect of self-control on weight loss was not mediated by engagement in these health behaviors. Neither participants' caloric intake (B = –.68, $t(190.24) = -1.31$, NS) nor their engagement in exercise (B = .17, $t(161.09) = .92$, NS) predicted their percent of weight lost during the program when controlling for the effect of self-control.

Discussion

The present findings provide the first solid evidence that trait self-control predicts success at weight loss. In the context of a coordinated weight loss program, individuals high in dispositional self-control lost a greater proportion of body weight than did those with lower levels of the trait. Our findings went beyond merely linking self-control to successful weight loss. During the weight loss program, participants with high self-control attended more meetings and burned marginally more calories through exercise than did those lower in self-control. Both patterns suggest that dispositional self-control is an important tool for maintaining compliance with behavioral guidelines that are conducive to goal pursuit but that may be at times difficult or unappealing.

Participants' level of self-control did not predict their baseline percentage of fat consumed but did predict eating behavior during the program. Participants high in self-control ate fewer calories and fewer calories from fat during the program than those lower in self-control. In our view, these results underscore the nature of self-control. It is effective for changing behavior in specifically desired, intended ways. Thus, people with high self-control do not necessarily eat healthier fare than other people generally–but these differences do emerge when people are specifically trying to lose weight.

Success in weight loss stems, in part, from the balance between calories consumed and calories burned (e.g. Sacks et al., 2009). It seems logical then that participants with high self-control, who consumed fewer calories and burned more calories through exercise, also lost more weight than participants low in self-control. To be sure, our mediation analyses failed to provide significant evidence that the effect of trait self-control on weight loss was mediated by diet and exercise. It is possible that some relationships were concealed by the many factors that affect weight loss outside of diet and exercise and by the many factors that can dilute statistical power in field experiment data such as these, including measurement error, small sample size, and attrition. Hence we think the most appropriate conclusion is to note that trait self-control contributed significantly to exercise, eating, and weight loss, without making a strong claim that these three effects are entirely independent of each other.

The present findings go beyond the reliance on all-questionnaire measures that have come to dominate personality and social psychology (see Baumeister et al., 2007), thus adding a valuable behavioral and health outcome dimension. This study also includes longitudinal measures of eating and exercise behavior, providing information about participants' behavioral habits during the program. In this respect, the present study goes beyond most research on self-control, which has focused largely on measuring single occasion expressions or failures of self-control. A recent meta-analysis by De Ridder et al. (2010) suggests that the focus on habits characterizing the present research might be the best way to understand the effects of self-control on behavior. Their analysis of 50 studies revealed that the effects of self-control on behavior were most reliable and strongest when operating on stable patterns of behavior over time, such as by forming and breaking habits. The present findings provide a powerful example of self-control predicting not simply individual acts, but positive habits including attending program meetings, exercising regularly, and eating low-fat foods in a restrained, disciplined manner. The present findings suggest that trait self-control may be an important factor contributing to people's ability to adopt healthy diet and exercise habits, to maintain these changes over time, and to lose weight.

Our findings suggest practical implications. First, those wishing to lose weight may benefit from attempting to improve their level of self-control. Preliminary research suggests that regular self-control practice can lead to improvements on a variety of self-control tasks (Baumeister et al., 2006). Second, recent research suggests that exercise depletes self-control resources when completed as a means to a goal but not when completed as a goal in itself (Fishbach and Choi, 2010). Therefore, one might overcome poor self-control by identifying forms of exercise that are truly enjoyable and, as a result, do not require self-control. More broadly, the present findings provide further evidence that self-control is an important trait for changing behavior and may predict success in behavioral therapy.

Competing Interests

None declared.

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Note

1. Degrees of freedom for regression analyses vary slightly across tests due to incomplete responses in some cases.

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