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Research report

Self-controlled children stay leaner in the transition to adolescence

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ABSTRACT

In a prospective longitudinal study, we examined whether the personality trait of self-control protects against weight gain during the transition from childhood to adolescence. We obtained multi-method, multi-source measures of self-control from a socioeconomically and ethnically diverse sample of 105 fifth-grade students. Height and weight were recorded by the school nurse and used to calculate age- and gender-specific standardized body mass index (BMI) *z*-scores. Self-controlled fifth graders had lower BMI *z*-scores in eighth grade compared to their more impulsive peers, and this relationship remained significant when controlling for potential confounds, including gender, age, socioeconomic status, ethnicity, IQ, and happiness. Moreover, when controlling for the same covariates, self-control measured in fifth grade predicted decreases in BMI *z*-scores from fifth to eighth grade. These results suggest that more self-controlled children are protected from weight gain in the transition to adolescence.

Adolescence is a critical period for the development and persistence of obesity (Dietz, 1994, 2004). Weight gain in the transition from childhood to adolescence is normative (Kuczmarski et al., 2002). However, increases in body mass index (BMI) relative to one's gender and age cohort during this developmental period predict negative health outcomes in adulthood, including subcutaneous and visceral adipose tissue, obesity, impaired glucose tolerance, diabetes, and coronary events (Baker, Olsen, & Sorensen, 2007; Barker, Osmond, Forsen, Kajantie, & Eriksson, 2005; Bhargava et al., 2004; Kindblom et al., 2009). Well-documented correlates of BMI in adolescence include age, stage of pubertal development, gender, ethnicity, socioeconomic status, and depression (e.g., Bini et al., 2000; Sjöberg, Nilsson, & Leppert, 2005; Wardle, Brodersen, Cole, Jarvis, & Boniface, 2006). Less is known about personality traits that may influence BMI.

Personality might be expected to play an increasingly important role in determining weight gain as children enter their teenage years. As children develop independence from their parents, they have more latitude in deciding what to eat and how to spend leisure time. Today's youth make these lifestyle choices in an environment where high-calorie foods are tasty, inexpensive, and convenient, and physical exertion is no longer a daily requirement for survival. Not surprisingly, the prevalence of overweight and obese children in the United States continues to increase (Ogden, Flegal, Carroll, & Johnson, 2002). In this obesogenic context, self-control, the capacity to regulate behavior, attention, and emotion in the service of personal standards and goals, is required to forego immediate gratification and choose instead options that protect against weight gain. Even if adolescents do not worry about their long-term health, they might be concerned about their weight and its impact on their overall physical attractiveness. For instance, a recent large population-based survey found that 94% of adolescent girls and 86% of adolescent boys care about controlling their weight (Neumark-Sztainer, Story, Hannan, Perry, & Irving, 2002). More self-controlled children should, therefore, be protected against unhealthy weight gain, relative to their more impulsive peers.

Consistent with this hypothesis, children diagnosed with attention-deficit hyperactivity disorder (ADHD) are more likely to be overweight (Agranat-Meged et al., 2005; Holtkamp et al., 2004). In delay of gratification experiments, obese children are less able or willing to wait for food rewards than normal-weight children (Bonato & Boland, 1983; Johnson, Parry, & Drabman, 1978). Finally, cross-sectional studies show that obese children are more impulsive than normal-weight children (Braet, Claus, Verbeken, & Van Vlierberghe, 2007; Nederkoorn, Braet, Van Eijs, Tanghe, & Jansen, 2006).

Prospective, longitudinal studies are needed to make a stronger case for the causal role of self-control. In the current investigation, we test the hypothesis that self-control protects against weight gain in the transition from childhood to adolescence. An important feature of our study design is the use of multi-method, multi-

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source measurements of self-control, an approach which increases measurement precision and accuracy (Eid & Diener, 2006). Our study also measures and controls for variables previously associated with both BMI and self-control, including demographics (Duckworth & Seligman, 2006; Freire, Gorman, & Wessman, 1980; Wardle et al., 2006), intelligence (Chandola, Deary, Blane, & Batty, 2006; Halkjær, Holst, & Sørensen, 2003; Shamosh & Gray, 2008) and happiness (Sjöberg et al., 2005; Stice, Presnell, & Spangler, 2002; Tangney, Baumeister, & Boone, 2004).

Methods

Participants

The participants were $N = 105$ children from a socioeconomically and ethnically diverse public school in a city in the Northeast. About 54.3% of participants were Caucasian, 22.9% were Black, 17.1% were Asian, 3.8% were Latino, and 1.9% were of other ethnic backgrounds; 52% were female. Median household income in this sample was $38,191; 21% of participants were from low-income families, as indicated by participation in the federal free and reduced-price lunch program. The mean age of participants during data collection in fifth grade was 10.56 years ($SD = 0.36$).

Procedure

This study was approved by the Institutional Review Board of the University of Pennsylvania. Signed child assent and parent consent forms, which assured participants of the confidentiality of their data, were received for all participants. In Fall 2003, we collected questionnaires from students, teachers, and parents and administered delay of gratification tasks and an intelligence test during non-academic school periods. Three years later, we obtained fifth- and eighth-grade height and weight data from the school nurse.

Measures

Self-control. Our battery of self-control measures included both hypothetical and behavioral measures of self-control, as well as questionnaires completed by students, teachers, and parents. None of these measures included items that specifically pertained to food or eating.

We administered two widely used self-report measures of self-control. The Impulsivity subscale of the Eysenck I_6 Junior Questionnaire (Eysenck, Easting, & Pearson, 1984) was designed exclusively for children and includes 23 *yes–no* questions about doing and saying things impulsively (e.g., "Do you save regularly?" and "Do you mostly speak before thinking things out?"). The Brief Self-Control Scale (Tangney et al., 2004) is a 13-item questionnaire designed for adults, but it is face valid for adolescents. Items are endorsed on a 5-point scale, where 1 = *not like me at all* and 5 = *very much like me* (e.g., "I have a hard time breaking bad habits" and "I do certain things that are bad for me, if they are fun").

Homeroom teachers and parents completed a version of the Brief Self-Control Scale written in the third person, with the student as target (e.g., "This student/child has a hard time breaking bad habits"). We standardized each teacher's scores about his or her own mean prior to all statistical analyses.

Delay of gratification was assessed using two measures. First, children completed the Kirby Delay-Discounting Rate Monetary Choice Questionnaire (Kirby, Petry, & Bickel, 1999). This questionnaire contains 27 questions posing hypothetical choices between smaller, immediate rewards and larger, delayed rewards (e.g., "Would you prefer $55 today or $75 in 61 days?"). From these responses, we calculated a discounting rate (k), a parameter that reflects the degree to which future rewards are diminished in value as a function of the delay that must be endured to receive them. Because the distribution of k-values was right-skewed, we used a natural log transformation of k for all statistical analyses.

Second, as a reward for participating in the study, we gave each participant a $1 bill. We then posed the following choice: participants could either take the dollar immediately and keep it or return it to us immediately in order to receive $2 dollars exactly 1 week later. We coded the choice to take the dollar immediately as 0 and the choice to wait as 1. We made clear that the delayed choice, if selected, would be delivered in school by homeroom teachers, thus eliminating any disincentive of going out of their way to receive the delayed reward.

By standardizing and averaging self-control scores from each measure (and reverse-scoring when appropriate), we created composite self-control scores for each subject. The internal reliability of this composite was $r = .88$, according to a formula specific to linear combinations of standardized scores (Nunnally, 1978).

Happiness. We used two self-report questionnaires to capture the three major components of subjective well-being: positive emotion, lack of negative emotion, and life satisfaction (Diener, Suh, Lucas, & Smith, 1999). The Positive and Negative Affect Schedule for Children (PANAS-C: Laurent et al., 1999) lists 15 positive and 15 negative emotions which are rated according to the extent they have been experienced during the last month. The Student's Life Satisfaction Scale (SSLS: Huebner, 1991) is a 7-item questionnaire specifically designed for children. We standardized and averaged positive affect, negative affect (reverse scored), and life satisfaction scores to create composite happiness scores for each subject. The internal reliability of this linear combination was $r = .92$.

Intelligence. As a measure of intelligence, we used the Otis-Lennon School Ability Test—Seventh Edition Level F (Otis & Lennon, 1997). This 40-min group-administered, paper-and-pencil test measures verbal, quantitative, and figural reasoning skills. The school ability index for this test is a standard score normalized according to the student's age in months, with a mean of 100 and a standard deviation of 16. Normal curve equivalent scores were derived from percentile ranks for use in statistical analyses.

Standardized body mass index. We obtained students' height and weight information from school records. Each school year, shortly after the fall commencement of classes, the school nurse measured and recorded the height and weight of students using a precision scale for weight and a precision stadiometer for height. Following current recommendations to standardize scores for gender and age (Must & Anderson, 2006), we used EPI Info, a computer program provided by the Centers for Disease Control and Prevention (CDC) to compute gender- and age-specific standardized BMI z-scores for statistical analyses.

Demographic variables. We obtained from school records data on gender, ethnicity, birthday, and participation in the federal lunch program. We used home addresses in conjunction with U.S. Census Bureau data (Census, 2000) to estimate median household income by census block. After log transforming income to normalize the distribution, we created a composite measure of socioeconomic status by averaging the standardized income and federal lunch program participation variables.

Results

Summary statistics and bivariate correlations for all variables are included in Table 1. On average, participants were about half a

Table 1
Summary statistics and intercorrelations for body mass index, demographic variables, self-control, happiness, and IQ.

	M	*SD*	1	2	3	4	5	6	7	8	9	10	11	12
1. BMI *z*-score at eighth grade	0.46	0.99	–											
2. BMI *z*-score at fifth grade	0.56	1.05	.83***	–										
3. Female[a]	0.52	0.50	−.10	−.26**	–									
4. Age	10.56	0.36	.04	−.09	.18	–								
5. SES	0.00	0.82	−.04	−.04	.06	.14	–							
6. Caucasian[a]	0.54	0.50	−.04	−.07	−.11	.07	.53***	–						
7. Black[a]	0.23	0.42	.14	.20*	.11	−.17	−.36***	−.59***	–					
8. Hispanic[a]	0.04	0.19	.19	.18	−.11	.00	−.21*	−.22*	−.11	–				
9. Asian[a]	0.17	0.38	−.16	−.17	.08	.10	−.18*	−.50***	−.25*	−.09	–			
10. Other ethnicity[a]	0.02	0.14	−.13	−.12	−.01	.01	−.07	−.15	−.08	−.03	−.06	–		
11. Self-control	0.00	0.58	−.22*	−.22*	.35***	.21*	−.03	−.02	.02	−.06	.03	.02	–	
12. Happiness	0.00	0.83	−.01	−.07	.06	.16	.07	.07	−.03	−.17	−.03	.16	.42***	–
13. IQ NCE	67.84	12.00	−.11	−.04	−.02	−.31**	.10	.01	.02	−.05	−.03	.09	.18	.15

Note. BMI *z*-scores: body mass index scores standardized by sex and age; SES: socioeconomic status; IQ NCE scores are normal curve equivalent IQ scores.
[a] Binary variable: the mean of this variable multiplied by 100 represents the percentage.
* $p < .05$.
** $p < .01$.
*** $p < .001$.

standard deviation higher in BMI than age and gender-matched references from the 2000 CDC growth charts, which reflect norm samples collected from the 1960s to 1990s (Kuczmarski et al., 2002). As predicted, self-control in fifth grade was inversely correlated with BMI in both fifth ($r = -.22$, $p < .05$) and eighth grade ($r = -.22$, $p < .05$). In addition, self-control was associated with being a girl ($r = .34$, $p < .01$), older ($r = .21$, $p < .05$) and happier ($r = .43$, $p < .01$). There were non-significant trends toward more intelligent children being leaner.

To test the incremental predictive validity of self-control over and beyond potential covariates, we fit a hierarchical multiple regression model predicting BMI in eighth grade (see Table 2). Because previous research has shown our control variables to be potential confounds, we included them in our models even if they were not significant predictors. In Step 1, we found that demographic variables including age, SES, and ethnicity accounted for 11% of the variance in eighth-grade BMI. In Step 2, self-control in fifth grade was a significant predictor ($\beta = -.22$, $p < .05$) and explained an additional 4% of the variance over and beyond the variance explained by demographic variables. We added IQ and happiness in Step 3 and found that neither of these potential confounds was a significant predictor and, collectively, their inclusion did not significantly increase the variance explained ($\Delta R^2 = .02$, $F(2, 94) = 1.14$, *ns*). In Step 4, we added BMI in fifth grade as a covariate to determine whether self-control predicted 3-year changes in BMI.[1] Not surprisingly, BMI in fifth grade increased the variance explained by 57%. The effect of self-control was somewhat diminished ($\beta = -.15$, $p < .05$) but remained significant. The semi-partial correlation for self-control of −.12 ($p < .05$), indicated that self-control explained an additional 1% of the variance explained above and beyond the other predictors in the final model. Neither gender ($p = .78$) nor BMI in fifth grade ($p = .47$) moderated the effect of self-control on BMI in eighth grade.

Table 2
Summary of beta coefficients from hierarchical multiple regression model predicting eighth-grade BMI *z*-scores from variables at fifth grade.

Variable	Step 1	Step 2	Step 3	Step 4
1. Female	−.11	−.04	−.02	.17**
Age	.10	.13	.10	.10
SES	.02	−.01	−.01	−.07
Ethnicity				
Black	.16	.15	.16	−.06
Hispanic	.18	.17	.19	.04
Asian	−.11	−.12	−.11	−.06
Other	−.12	−.12	−.14	−.06
Self-control		−.22*	−.28*	−.15*
3. Happiness			.16	.11
IQ			−.04	−.02
4. Fifth-grade BMI *z*-score				.84***
R^2	.11	.15	.17	.74

Note. $N = 105$. Caucasian is the reference group for ethnicity.
* $p < .05$.
** $p < .01$.
*** $p < .001$.

Discussion

In an ethnically and socioeconomically diverse sample of youth, self-control in late childhood predicted weight gain in the transition to adolescence. These results remained significant when controlling for a range of potential third-variable confounds including demographic factors, intelligence, and happiness. Our findings suggest that self-control protects children from weight gain in the transition to adolescence and, more generally, suggest that personality traits may be important protective/risk factors for weight changes over the course of development.

This study had three notable strengths. First, we measured self-control using a multi-method, multi-source approach, a resource-intensive methodology widely acknowledged as optimal for increasing the reliability and validity of psychological assessment but, unfortunately, rarely used. Second, the longitudinal, prospective design of our investigation allowed us to examine the predictive validity of self-control for both BMI in adolescence and changes in BMI from childhood to adolescence. Unlike cross-sectional studies or prospective studies in which BMI is not measured repeatedly over time, our investigation was able to rule out the possibility of reverse causality (i.e., BMI determining personality ratings). Finally, our analyses controlled for a range of theoretically relevant third-variable confounds.

The implications of these findings must be discussed in the context of the study's limitations. Study participants came from a single urban school which, although diverse in demographic terms, was not a representative sample of the U.S. population. Further studies with larger and more representative samples are needed.

[1] Controlling for prior levels of a variable changes the interpretation of the outcome into a measure of change and is the recommend method of examining change in personality research (Fleeson, 2007).

We are aware that the multi-method, multi-source approach to measuring self-control in the current study is resource-intensive. Nevertheless, the increased reliability and validity of such a measurement approach merits its consideration for large, national studies.

A second limitation of this study is that weight changes were observed only during a 3-year period. Whether self-control also protects against weight gain during later periods of development is unknown. Third, our investigation did not explore potential mediators of the relationship between self-control and BMI change. Future studies should explore the relative contributions of food choices, physical activity, television watching, and other lifestyle choices through which self-control exerts its influence. Fourth, children's knowledge of healthy eating choices and motivation to eat healthfully were not measured. We would expect such variables to moderate the observed relationship between self-control and weight change: self-control probably does not protect children from weight gain if they fail to recognize that some foods are more fattening and less healthy than others or if they are not motivated to eat in a healthy manner. Fifth, as with any non-experimental design, we cannot rule out all third-variable confounds and firmly establish a causal role for self-control in reducing BMI. Finally, the BMI measure used (based on height, weight, age, and gender) in this study is not as accurate as more sophisticated measures of body fat (e.g., waist-to-hip ratio, skin-fold measurements, bioelectrical impedence). It is possible that more precise measures of body fat would have revealed even stronger associations with self-control.

Interventions that increase self-control in children are now an active area of research (Diamond, Barnett, Thomas, & Munro, 2007; Strayhorn, 2002). Self-regulatory strategies that specifically target changing exercise and eating habits, so far shown to be teachable to adults (Stadler, Oettingen, & Gollwitzer, 2009; Verplanken & Faes, 1999), are particularly promising and warrant further study with younger populations.

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Appendix A

Summary statistics for the individual self-control measures.

	M	*SD*	Correlations		
			Composite self-control	BMI *z*-score at fifth grade	BMI *z*-score at eighth grade
Eysenck Junior Impulsivity Subscale[a]	8.37	4.37	.62***	−.07	−.07
Self-report Brief Self-Control Scale	3.98	0.64	.63***	−.13	−.09
Teacher Brief Self-Control Scale	4.34	0.75	.54***	−.19	−.17
Parent Brief Self-Control Scale	4.04	0.51	.65***	−.21*	−.17
Log Kirby Delay-Discounting[a]	−4.86	1.92	.55***	−.16	−.16
Delay Task[b]	0.88	0.32	.49***	.02	−.04

[a] Reverse scored for correlations.
[b] Binary variable: the mean of this variable multiplied by 100 represents the percentage.
* $p < .05$.
*** $p < .001$.