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The stability of self-control across childhood

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ABSTRACT

While the link between low self-control and several behavioral and social problems is widely supported, debate remains regarding the stability of and the genetic and environmental sources of variation in self-control. Using data from the Early Childhood Longitudinal Study, Kindergarten Class 1998–1999 restricted data set, a sample of 360 twins was compared to a sample of 423 non-twins in order to examine the stability in self-control. The twin sample was also used to examine the genetic and environmental sources of stability in self-control. Findings indicated two stable classes for both the twin and singleton samples, and substantial stability in average self-control from kindergarten through fifth grade in both samples. The ACE decomposition model indicated strong genetic contributions to self-control (76%) with the remaining variation attributed to non-shared environment. Overall, the data suggest that self-control is identifiable early in life, stable across childhood, increasingly influenced by genes, and thus, is a critical focus for early intervention.

1. Introduction

Self-control refers to the ability of individuals to appropriately modulate emotional responses to internal and external stimuli, and to conform to proximate social expectations. Low self-control is typically characterized by problems with impulsivity, inappropriate risk-taking, the inability to delay gratification, and limited emotional sensitivity toward others (Gottfredson & Hirschi, 1990; Vazsonyi & Huang, 2010). A host of empirical studies across disciplines has established an association between low self-control and anti-social/problem behaviors, specifically noting that low self-control is a strong predictor of concurrent and future problem behavior and deviance (Baron, 2003; Lamont & Van Horn, 2013; Pratt & Cullen, 2000). This link is supported in psychological research as well, which consistently shows that a diminished capacity to exert self-control is associated with disturbances in emotional regulation, with substance abuse, and with externalizing problem behaviors (Barkley, 2005; Moffitt, Poulton, & Caspi, 2013; Vaughan, DeLisi, Beaver, Wright, & Howard, 2007; Wills, Ainette, Mendoza, Gibbons, & Brody, 2007; Zhou et al., 2007). Although there is agreement about the importance of self-control in a variety of life outcomes, debate remains regarding the magnitude of stability in self-control over time, and the source of stability in self-control (DeLisi, 2005; Moffitt,1993; Na & Paternoster, 2012).

Using the Early Childhood Longitudinal Study of the Kindergarten Class, 1998–1999 (ECLS-K), the same data as the current study, Beaver and Wright (2007) analyzed the stability of self-control from kindergarten through first grade using parent and teacher-reported measures from the Social Skills Rating System (SSRS). Structural equation modeling revealed substantial relative stability in their sample of nearly 17,000 children, with stability coefficients ranging from 0.84 to 0.96. Other studies have analyzed self-control over longer periods of time. Using a national sample of youth and semi-parametric group modeling techniques, Hay and Forrest (2006) examined the stability of self-control over 8 years of age (ages 7–15 years) across five waves of data. The year-to-year correlations revealed moderate stability in self-control, however, the semi-parametric trajectory analysis revealed high levels of relative stability in 84% of the sample with only a small group of respondents experiencing significant change in self-control across time. Similar recent studies (Hopwood et al., 2011; Vazsonyi & Huang, 2010) have reported parallel findings, indicating that self-control exhibits relative stability across childhood and adolescence.

While most studies find that self-control is time-stable, some studies have found evidence of change. Burt, Simons, and Simons (2006) examined the stability of self-control in a sample of 750 African American children. The authors administered a 39-item scale measuring low self-control when children were 10 years of age and then 2 years later. Self-control was coded into quartiles for both

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waves, and stability was measured by determining whether the participants had shifted quartiles over time. Results indicated that less than 50% of the entire sample remained in the same quartile as they began. Those in the highest and lowest quartiles of self-control shifted the least, however only 33% of those in the middle quartiles remained in the same quartile over the 2 years time period. A handful of other studies also report that self-control changes across different periods of time, and generally point to the possibility that self-control is relatively dynamic (Na & Paternoster, 2012; Turner & Piquero, 2002; Winfree, Taylor, He, & Esbensen, 2006).

Debate also remains regarding the source of variation in self-control. Although environmental factors such as parenting and peer networks may be salient in the development of self-control, various studies have found that self-control is under substantial genetic influence (Moffitt, 2005; Wright & Beaver, 2005; Wright et al., 2012). Genetic influences may help to explain not only why individuals vary in their levels of self-control but also why stability and change in self-control occurs (Bakermans-Kranenburg & Van Ijzendoorn, 2011; Dunn & Plomin, 1990). A number of studies have examined the genetic contributions of antisocial and aggressive behaviors (Hopwood et al., 2011; Tuvblad, Narusyte, Grann, Sarnecki, & Lichenstein, 2011), indicating that traits such as aggression and antisocial behavior are dominated by genetic influences, with estimates typically ranging from 50% to 95% (Rhee & Waldman, 2002).

In one of the few tests specifically focusing on self-control, Beaver, Wright, DeLisi, and Vaughan (2008) examined the genetic and environmental contributions to variation in self-control. In addition to finding strong stability in self-control across a two-year time period, their Cholesky decomposition model indicated that 82% of the variation in self-control was attributable to genetic factors, with the remaining variation due to non-shared environmental factors. Similar studies have reported parallel results—namely that the self-control is relatively stable over time and is genetically influenced (Haberstick, Schmitz, Young, & Hewitt, 2005; Hopwood et al., 2011). Overall, there is ample support that genetic factors are a source of variation in self-control.

Previous studies on the stability of self-control exhibit several limitations, including the use of non-representative samples (Arneklev, Cochran, & Gainey, 1998; Burt et al., 2006) and relatively short periods of analysis (Beaver & Wright, 2007; Beaver et al., 2008; Benes, 1995). Another limitation is the inconsistency in reporting sources (Cairns & Cairns, 1994; Verhust & Van e Ende, 1992; Youngstrom, Loeber, & Stouthamer-Loeber, 2000). Most studies, for example, have used parent or self-reports (Tuvblad et al., 2011; Van Hulle, Lemery-Chalfant, & Goldsmith, 2007; Winfree et al., 2006). While self-reports are important, they often lack reliability over time (Youngstrom et al., 2000). Moreover, parent reports have been shown to produce downwardly biased estimates of youth problem behavior (Harris, 1998; Verhust et al., 1992). Given the limitations and mixed findings regarding the studies of stability and the source of variation in self-control, further investigation is warranted.

As Wright and Beaver (2005) and Beaver and Wright (2007) have examined stability in self-control and genetic underpinnings with the same sample, the current study represents an extension to these previous studies, following individuals from kindergarten up through the fifth grade. With these data, we were able to examine the stability of self-control across 5 years of time as well as assess the source of variation in self-control with measures from reliable teacher-reports.

2. Methods

2.1. Participants

Data for this study came from the ECLS-K, the largest nationally representative sample of kindergartners, parents, teachers, and schools in the United States. The ECLS-K is sponsored by the U.S. Department of Education and the National Center for Education Statistics with the goal of providing reliable data that can help researchers describe and understand children's development and early experiences. The data provide detailed information about the subjects' cognitive, social, emotional, and physical development as well as information about their school and home environments. Information was collected through teacher and school administrator questionnaires, parent and child interviews, and trained evaluators in the schools.

The initial data were collected in the fall of 1998 when the children first entered kindergarten. Data were collected later in the spring of 1999 and then in the fall (1999) and spring (2000) of first grade. Follow-up data were collected in the springs of third grade (2002), fifth grade (2004), and eighth grade (2007). Because the eighth grade wave used different measures of self-control, it was excluded from this study. The current study used the following 4 waves of data: fall of kindergarten (1998), spring of first grade (2000), spring of third grade (2002), and the spring of fifth grade (2004).

In order to examine the influence of genetics on the variation in self-control, all twins were parceled out from the larger sample in order to run an ACE decomposition model. The twin sample included 360 twin individuals in the initial kindergarten wave. All twin individuals in the sample were matched resulting in 180 twin pairs. Of the 360 individual twins, 118 were monozygotic twins (59 twin pairs) and 242 were dizygotic twins (121 twin pairs). In order to create an equivalent analytical sample, we took a randomly generated 2% of the larger sample of 21,194 children that had no missing responses on any outcome variables ($n = 423$). No statistically significant differences were found between the twin sample and singleton sample on measures of race, age, and gender. Thus, the twin sample and the singleton sample closely resemble one another on key demographic variables as shown in Table 1.

2.2. Measures

The ECLS-K contains several measures of self-control and problem behaviors and has been used by other researchers (Beaver & Wright, 2007; Lamont & Van Horn, 2013; Wright & Beaver, 2005) to assess stability in self-control and related behaviors. The ECLS-K uses an adapted version of Gresham & Elliot, 1990) widely used Social Skills Rating Scale (SSRS). This scale is a multi-rater, standardized assessment which measures how often children exhibit certain behaviors and has been regarded as comprehensive, valid, and reliable (Demaray, Ruffalo, Carlson, & Busse, 1995; Mask, Albertus, BffiKinbine, & Naibi, 1996). The SSRS uses a Likert scale

Table 1
Twin and singleton sample descriptives: gender, race, age, self-control.

	Twins ($N = 360$)		Singletons ($N = 423$)	
	Mean	Standard deviation	Mean	Standard deviation
Gender (0 = male)	0.58	0.50	0.46	0.50
Race (0 = white)	0.37	0.48	0.47	0.50
Age (Years)				
Kindergarten	5.72	0.35	5.70	0.37
1st grade	7.26	0.34	7.26	0.37
3rd grade	9.27	0.34	9.28	0.38
5th grade	11.26	0.34	11.25	0.36
Self-control (4–16)				
Kindergarten	12.51	2.23	12.25	2.26
1st grade	13.03	1.97	12.58	2.37
3rd grade	12.92	2.14	12.67	2.08
5th grade	13.04	2.02	12.66	2.18

ranging from 1 to 4 (1 = never exhibits this behavior; 4 = very often exhibits behavior). Respondents provided a score for each item on each scale. The mean of these items was then used for the total score on each of the scales.

Parent and teacher reports from the SSRS were available in the first two waves of data. Unfortunately the parent reports were not available after the first grade. As such, only teacher-reported measures were used in the analyses. While parent reports capture behavior in the home and other social settings, teacher reports have been found to be comparatively more reliable and valid (Cairns & Cairns, 1994; Harris, 1998). Additionally, different teachers assessed child subjects at each wave, reducing the chance that systematic error influenced the stability estimates.

We used an expanded measure of self-control which included four SSRS scales: self-control, interpersonal skills, externalizing problem behaviors, and approaches to learning. Factor analyses confirm that these four scales reflect one underlying construct. Furthermore, the four scale measure is highly reliable (alpha = 0.85) across waves. The self-control measure ranges from 4 to 16, where higher values reflect higher levels of self-control. Statistical controls included zygosity, race, and gender. Zygosity was coded as 0 = monozygotic twins and 1 = dizygotic twins. Race was coded as 0 = white and 1 = non-white. Gender was coded as 0 = male and 1 = female.

2.3. Analytical approach

The study has two main analyses: an analysis of the stability in self-control from kindergarten through the fifth grade and an analysis of the genetic and environmental contributions to the variation in self-control. The stability of self-control was analyzed using latent growth class analyses. Latent growth class analyses are mixture models which involve estimation of latent classes of individuals based on observed patterns of changes in self-control which are defined by unique growth curves. The selection of the appropriate number of classes is based on fit statistics and classification benchmarks such as the Bayesian Information Criterion (BIC), the entropy value, latent class probabilities, and the Lo–Mendell–Rubin (LMR). These statistics have been used in several other studies involving latent class analyses (Muthén, 2004; Vermunt & Magidson, 2003). Latent class growth curve analyses also involve estimating the mean level of change for each class over time. This allowed us to examine how much change in the mean level of self-control occurred from wave to wave in both samples.

Sources of variation in self-control were assessed with ACE models calculated at each wave and for a combined score of self-control from kindergarten through the fifth grade. The ACE decomposition model is a structural equation estimation method which allows for the estimation of genetic (A), shared (C), and non-shared environmental (E) sources of variance in an outcome (Barnes & Boutwell, 2012). Following the suggestion of Kohler and Rodgers (2001) and Plomin, DeFries, Knopik, and Neiderhiser (2013), twin data were double entered and standard errors corrected by the use of robust standard error estimation. All analyses were conducted using the M-plus statistical package, and all models were estimated with full-information maximum likelihood for randomly missing data to accommodate the loss of data across waves.

3. Results

3.1. Stability in self-control

Table 2 presents the fit statistics for the latent class analysis. For both of the twin and singleton samples, the entropy, LMR, and mean probability values indicate that the data best fit a model with two classes. Figure 1 represents the two class trajectories for the twin sample. The first class makes up approximately 37% of the sample. This group demonstrates relatively low levels of self-control from kindergarten through the fifth grade with only slight variation in self-control across time. The second class made up 63% of the sample and is characterized by individuals with relatively high levels of self-control. This group exhibited virtually no change in self-control over time.

Figure 2 represents the class trajectories for the singleton sample. The first class makes up about 29% of the sample and is comprised of individuals with lower levels of self-control that remain stable across all four waves. The second class makes up 71% of the sample and is characterized by individuals with high levels of self-control that also remain stable over time. In sum, regardless of class membership and sample, the latent class analyses revealed a two class solution with very little change in self-control from kindergarten through fifth grade.

The latent growth curve analysis estimated the magnitude and direction of change in self-control for each class across the four waves. Table 3 presents the intercept and slope estimates for the sample means for both classes from the twin and singleton samples.

We detected significant differences in the mean intercepts across all classes and samples, indicating significant differences in self-control in kindergarten. Thus, children entered the school with pre-existing differences in self-control. However, the average rate of growth (slope) was not statistically significant for either class in either the singleton or twin sample. Overall, mean levels of self-control exhibited both relative and absolute stability across classes and samples. The high levels of stability were noteworthy considering the length of time under study—from kindergarten to fifth grade—and the fact that different teachers reported on each child across waves.

3.2. Source of variation in self-control

The parameter estimates from the ACE decomposition model for each wave are presented in Table 4. Results indicate that genetic contributions are dominant at each wave, with the excep-

Table 2
Fit statistics for the latent class analyses.

Model	Log likelihood	*Bayesian information criterion	Entropy	LMR adjusted value (*p* value)	Mean LC probabilities			
Twins: *N* = 360								
2 class	−1886.92	3757.97	**0.67**	**.00**	**0.88**	**0.91**		
3 class	−1851.97	3736.10	0.66	.54	0.75	0.89	0.78	
4 class	−1842.18	3742.55	0.70	.02	0.82	0.80	0.89	0.74
Singletons: *N* = 423								
2 class	−2151.77	4328.72	**0.75**	**.00**	**0.89**	**0.94**		
3 class	−2133.59	4300.76	0.59	.14	0.70	0.84	0.85	
4 class	−2128.97	4299.92	0.53	.04	0.65	0.73	0.77	0.70

* Sample size adjusted.

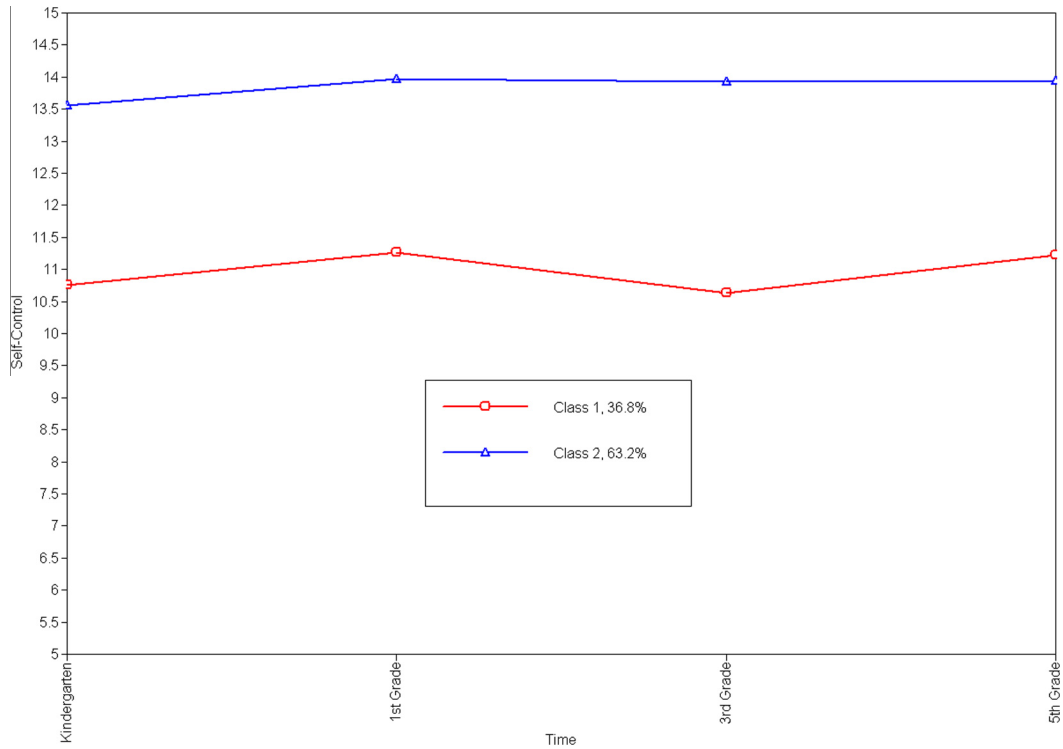

Fig. 1. Twins latent class trajectories for mean self-control scores from kindergarten through fifth grade.

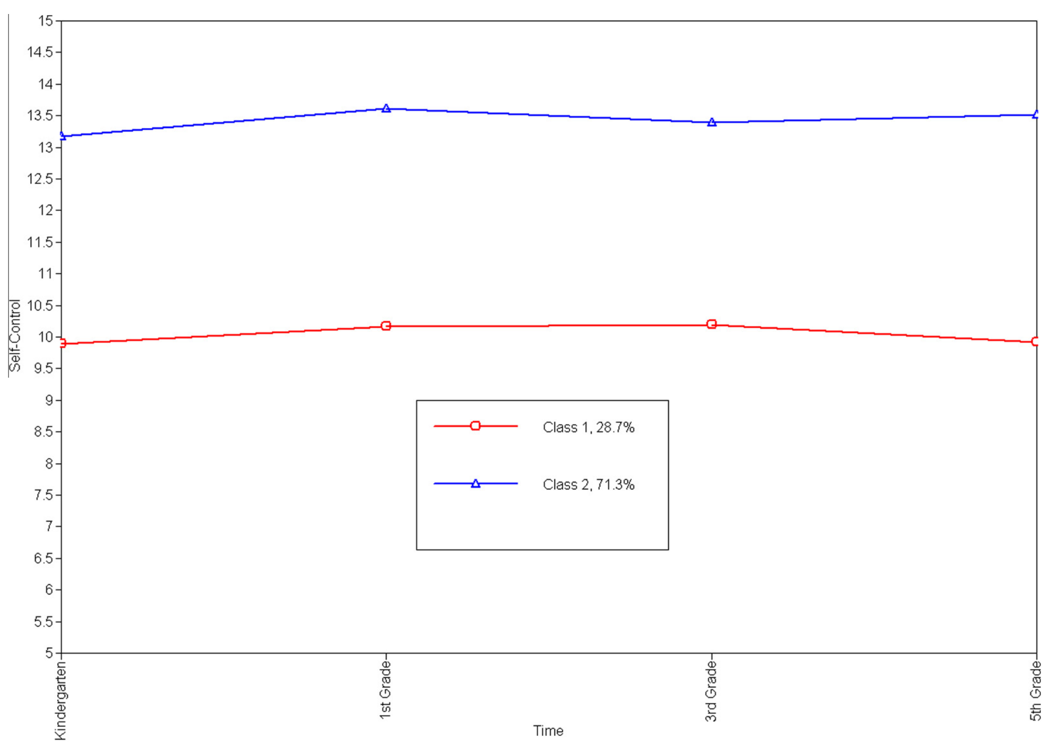

Fig. 2. Singletons latent class trajectories for mean self-control scores from kindergarten through fifth grade.

tion of kindergarten. Common environmental effects were present and dominant at the kindergarten wave (38%), but were not statistically significant at any other wave. Non-shared environmental influences increased from kindergarten (27%) through third grade (44%), and dropped slightly in the fifth grade (33%) when genetic influences grew stronger, reaching 66% in the fifth grade. However, genetic influences were strongest with the composite measure of self-control across all four waves. In the composite measure, 76% of the variation in self-control was due to genetic factors, with the remaining variation attributed to non-shared environment.

Table 3
Twin and singleton latent growth class estimates.

	Twins (*N* = 360)				Singletons (*N* = 423)		
	Estimate	Standard error	*p*-Value		Estimate	Standard error	*p*-Value
Class 1				*Class 1*			
Means				Means			
I	10.86	0.23	0.00	I	10.02	0.22	0.00
S	0.09	0.14	0.53	S	0.01	0.11	0.92
Class 2				*Class 2*			
Means				Means			
I	13.71	0.17	0.00	I	13.23	0.12	0.00
S	0.10	0.07	0.16	S	0.10	0.05	0.06

Table 4
ACE parameter estimates and confidence intervals for variance in self-control (*N* = 360 twins: MZ = 118 DZ = 242).

	A	C	E
Kindergarten	0.35* (.08–.62)	0.38* (.14–.61)	0.27* (.18–.36)
1st grade	0.44* (.01–.87)	0.20 (−.16–.56)	0.36* (.23–.49)
3rd grade	0.49* (.01–.97)	0.07 (−.31–.45)	0.44* (.24–.63)
5th grade	0.67* (.53–.81)	0.00	0.33* (.19–.48)
Combined K-5th	0.76* (.65–.87)	0.00	0.24* (.13–.35)

* 95% confidence intervals.

4. Discussion

Scholars across fields such as criminology and psychology have recently reaffirmed the importance of self-control. Although conceptualized in slightly different ways, self-control refers to the ability of an individual to regulate one's emotions and behavior. Low self-control is associated with antisocial behaviors, substance abuse, and a range of imprudent behaviors (Lamont & Van Horn, 2013; Pratt & Cullen, 2000; Vaughan et al., 2007; Wills et al., 2007). Collectively, a large body of research affirms the importance of self-control in a wide variety of life domains (Moffitt et al., 2013). Even so, less research has been conducted on self-control early in the life-course and even less is known about the source of variation in self-control in young children.

The present study contributes to this body of research in three ways. First, self-control was examined from kindergarten through the fifth grade, a period of rapid developmental change. Second, self-control was measured with teacher reports, a highly reliable and valid reporting source (Cairns and Cairns,1994; Harris, 1998). Finally, the study employed a sample of twins to estimate the proportion of variation in self-control explained by genetic factors. The present study thus contributes to both questions regarding stability of self-control and the source of variation in self-control. Overall, our findings revealed substantial cross-time stability in mean levels of self-control, regardless of class membership or the use of twin or singleton samples. Over a five-year span of childhood where behavior is expected to be most dynamic, very little change was observed across classes in either the twin or the singleton sample. Children who scored relatively low (or high) on self-control at time of entrance into school were likely to score relatively low (or high) on self-control in the fifth grade. Additionally, ACE models provided evidence that genetic influences contributed substantially to variation in self-control, especially as children aged. Common environmental influences contributed 38% of the variation in self-control in kindergarten, pointing to the importance of common environmental influences early in life. However, consistent with previous research, (Beaver et al., 2008; Bergen, Gardner, & Kendler, 2007; Hopwood et al., 2011) common environmental influences evaporate quickly in the life-course as genetic and non-shared environmental influences, such as peer groups, tend to have stronger effects as children age. Genetic influences exerted the strongest contributions in the fifth grade (66%) and in the composite measure from kindergarten through fifth grade (76%). Furthermore, the estimate for the composite measure is very similar to those found in previous research with children (Beaver et al., 2008; Haberstick et al., 2005; Hopwood et al., 2011) as well as with adolescents and adults (Barnes, Beaver, & Boutwell, 2011; Barnes & Boutwell, 2012).

Our findings must be interpreted with caution. We used Gresham and Elliot's (1990) SSRS scales as a global measure of self-control. While the SSRS contains valid and reliable measures and has been used in similar studies measuring self-control, we readily admit that the measurement is broader than Gottfredson and Hirschi's original conception of self-control. Nonetheless, the measurement of self-control does not appear to be consequential in the estimation of empirical associations (Pratt & Cullen, 2000).

We also point out that while teacher reports are indeed regarded as highly reliable and valid (Cairns & Cairns, 1994; Harris, 1998; Verhust et al., 1992), we acknowledge two possible problems. First, whenever possible it is best to employ multiple reporting sources to fully capture observed behaviors across settings. As no other reporting source was available across all waves, we were limited to one reporting source. While teacher reports capture child behavior in the classroom, we recognize that children may indeed behave differently outside of the classroom setting and that our measures cannot capture that variation.

Second, our use of teacher reports may have some effect on our stability estimates. Although different teachers reported on each child across waves, teachers may evaluate the self-control of children in a systematic way, overlooking important details and differences. If so, this may constrain variation in self-control and will thus inflate stability estimates. However, this may not be true of all teachers (Cairns & Cairns, 1994).

While limitations exist, our analyses indicate three important findings. First, deficits in self-control are measurable early in life. Second, deficits in self-control remain highly stable across childhood. Third, much of the variation in self-control is attributable to genetic influences, followed by non-shared environmental influences. There are pre-existing differences in self-control which children import into the classroom at an early age. Our findings indicate that deficits in self-control can be identified and measured. Furthermore, without intervention, these deficits in self-control are unlikely to change across childhood. Given the host of literature that indicates issues with self-control are related to a myriad of social problems, and given that our data indicate that problems in self-control emerge early in life and remain stable, these findings point to the importance of early identification of deficits in self-control as a relevant and vital target for intervention.

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Appendix

Correlations of self-control measures from kindergarten through fifth grade.

	Kindergarten	1st grade	3rd grade	5th grade
Twins				
Kindergarten	–	–	–	–
1st Grade	0.43	–	–	–
3rd Grade	0.45	0.57	–	–
5th Grade	0.40	0.40	0.59	–
Singletons				
Kindergarten	–	–	–	–
1st Grade	0.48	–	–	–
3rd Grade	0.36	0.63	–	–
5th Grade	0.52	0.55	0.60	–

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