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On the Development of Self-Control and Deviance from Preschool to Middle Adolescence

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On the development of self-control and deviance from preschool to middle adolescence☆

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A B S T R A C T

Purpose: The study tested whether developmental changes in self-control stabilize by late childhood (age 10) or continue into early and middle adolescence. Second, it tested the bidirectional, longitudinal relationship between self-control and deviance over an 11-year period.

Methods: Children (N = 1159) from the longitudinal NICHD Study of Early Child Care and Youth Development (SECCYD) were assessed six times, ages 4.5 to 15 years. Latent growth models tested self-control and deviance trajectories, using competing growth functions to capture change over time. The longitudinal, bidirectional self-control-deviance links were examined in a cross-lagged latent model.

Results: Findings showed that children's self-control significantly increased during childhood, but stabilized sometime between 8.5 and 10.5 years. Deviance also changed in parallel, but in the opposite direction; some evidence was found of continued change in deviance during early adolescence. Finally, self-control and deviance were bidirectionally and longitudinally linked across all assessments through childhood only.

Conclusions: Findings support theoretical predictions that self-control principally develops during childhood (by age 10) and subsequently remains stable. They also support longitudinal, bidirectional self-control-deviance links, largely identical in size prior to the age of 10; study findings are contextualized vis-à-vis self-control theory as well as recent behavior genetic evidence.

Gottfredson and Hirschi's (1990) *Self-control theory* or *General theory of crime* has been one of the most researched and influential theories of deviance, delinquency, and crime (Cohen & Farrington, 1999; de Kemp et al., 2009; Finkenauer, Engels, & Baumeister, 2005; Pratt & Cullen, 2000; Rebellon, Straus, & Medeiros, 2008; Vazsonyi & Huang, 2010; Vazsonyi, Mikuska, & Kelley, 2017; Wright, Bryant, & Miller, 2001), not only in the field of criminology, but also in social-behavioral and developmental sciences more generally. The central tenet of the theory is that *low self-control* characterized by tendency towards impulsivity, shortsightedness, and risk-taking behaviors, plays a crucial role in the ability to refrain from deviant and criminal behaviors when an opportunity to engage in such behaviors arises. Moffitt, Poulton, and Caspi (2013, p. 359) recently concluded that "improving individual self-control will prove essential for humanity's long-term health, wealth, safety, and happiness." A key theoretical tenet is that self-control develops during the first decade of life, primarily as a result of socialization pressures; following this period, few changes should be observed in self-control, which is expected to be largely stable, not necessarily in absolute terms, something frequently misunderstood, but in rank ordering across individuals.

The current study examined the developmental trajectories of self-control and deviance over a period of 11 years as well as the relationship between self-control and deviance during this period. The study builds on previous work by Vazsonyi and Huang (2010) who examined developmental trajectories of self-control and deviance from kindergarten to age 10, by extending the age range to middle adolescence, or age 15. Specifically, the study tested whether (a) both self-control and deviance trajectories continued their previous developmental course, and (b) the extent to which developmental changes in self-control influenced the development of deviance over time. Extending the timeframe by five additional years allowed for a more rigorous test of whether self-control changes stabilize by ages 8 to 10 or not. A number of studies have found evidence to the contrary, namely that it continued to change past childhood (e.g., Na & Paternoster, 2012;

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Turner & Piquero, 2002; Winfree, Taylor, He, & Esbensen, 2006).

1. Self-control and deviance

Previous scholarship has consistently shown that low self-control is key in understanding deviance and that it is its stable predictor across the lifespan (Eisenberg et al., 2005; Moffitt, 2005; Pratt & Cullen, 2000; Vazsonyi et al., 2017). The importance of self-control and related constructs such as self-regulation and impulse control in predicting adjustment has also been recognized in a number of social and behavioral science disciplines, including psychology (Baumeister, Heatherton, & Tice, 1994; Tangney, Baumeister, & Boone, 2004), education (Duckworth & Seligman, 2005), health (Griffin, Scheier, Acevedo, Grenard, & Botvin, 2011; Miller, Barnes, & Beaver, 2011), and developmental sciences (Eisenberg et al., 2005; Moffitt et al., 2011, 2013; Zhou et al., 2007).

Departing from traditional explanations of crime and deviance, Gottfredson and Hirschi (1990) do not define crime and deviance in strictly legal terms, but focus on the criminal acts themselves (Goode, 2008). They argue that all criminal acts share characteristics such as being immediately gratifying, simple, exciting, and distressing to victims. These features of criminal acts are, according to Gottfredson and Hirschi, "analogous" to the characteristics of individuals likely to commit them (Evans, Cullen, Burton, Dunaway, & Benson, 1997). Thus, individuals with a high propensity to commit crimes are impulsive, have difficulties delaying gratification, prefer short-term goals as opposed to the long-term ones, and are insensitive to the discomfort of others. This propensity has been termed *low self-control*, which not only increases the likelihood of criminal acts, but also a variety of other health and safety-compromising behaviors, including excessive drinking, substance use, and gambling – all manifestations of low self-control. Although criminal or health-compromising behaviors and the propensity to commit them (i.e. low self-control) are operationalized as similar concepts, they are not identical. Low self-control serves as a dispositional prerequisite for engaging in norm-violating or criminal behavior, but such behavior may not occur if the individual is not presented with an opportunity to do so (Gottfredson & Hirschi, 1990; Hirschi & Gottfredson, 2008).

2. The developmental course of self-control

One of the most important tenets of Gottfredson and Hirschi's theory is that self-control develops mainly during the first decade of life. Once the self-control stabilizes by ages 8 to 10, its relative level (or rank ordering) is expected to remain unchanged. This prediction was supported by several studies. Higgins, Jennings, Tewksbury, and Gibson (2009) found that although individuals differed in their mean levels of self-control, this level remained largely stable between ages 12 and 16. Similarly, based on Hay and Forrest's (2006) investigation, the majority of children between the ages of 7 and 15, showed considerable stability in self-control both in absolute and relative (rank-order) terms. In addition, Coyne and Wright (2014) found that rank-ordering of individuals with regard to their level of self-control remained stable in a sample of children between kindergarten and fifth grade.

On the other hand, some other studies have also found evidence that self-control continues to change during the second decade of life. Winfree et al. (2006) found declines in self-control between ages 12 to 17; similarly, Na and Paternoster (2012) found changes in self-control that might occur at least for some individuals even during adolescence as a result of social bonding and social control. Lastly, Burt, Sweeten, and Simons (2014) found neither absolute nor relative stability of self-control in a study spanning from childhood to the mid-20s. They also separately tested two facets of self-control, impulsivity and sensation seeking, and found that each dimension followed different developmental trajectories over time. A number of similar studies using data-driven, group-based trajectory modeling strategies found different degrees of stability or change in self-control, depending on the self-control group membership, suggesting that levels of self-control might in fact change for some, but remain stable for others (Burt, Simons, & Simons, 2006; Meldrum, Young, & Weerman, 2012; Ray, Jones, Loughran, & Jennings, 2013).

3. The current study

Previous studies have examined the developmental course of self-control and its stability over time (e.g., Arneklev, Cochran, & Gainey, 1998; Beaver, Wright, DeLisi, & Vaughn, 2008; Burt et al., 2006, 2014; Hay & Forrest, 2006; Perrone, Sullivan, Pratt, & Margaryan, 2004; Vazsonyi & Huang, 2010). However, they have also had several limitations, such as the use of non-representative samples (e.g., Burt et al., 2006) or a relatively short timeframe during which samples were followed (e.g., Beaver et al., 2008); in addition, very few previous efforts have focused on the critical transitional period from late childhood to adolescence, to fully test key theoretical predictions about the development of self-control. Additionally, few studies have examined whether the developmental course of self-control was associated with analogous changes in deviance over time. A number of authors (e.g. Burt et al., 2006; Meldrum et al., 2012) opted for testing data-driven, person-centered developmental trajectories to identify groups based on their developmental course of self-control. Although these studies provided important insights, they did not test mean developmental changes in self-control from childhood to adolescence, something we consider more consistent with Gottfredson and Hirschi's (1990) original thinking.

The current study uses the NICHD SECCYD (2001) longitudinal data set to answer questions about the developmental course, timing, and stability of self-control and deviance, as well as their developmental links over time. These are particularly suitable data for testing these questions because of the number of years over which individuals were followed (from early childhood to adolescence), the sample representativeness, as well as the consistency of key study constructs used across time points. The study represents an important extension of Vazsonyi and Huang's (2010) work by testing whether self-control and deviance trajectories change past childhood and into adolescence, until age 15. More specifically, the study sought to test for changes in the developmental cadence or pace of self-control after the ages of 8 to 10 years, and whether the developmental course of self-control predicted changes in deviance over time. Extending the timeframe of the study for an additional 5 years permitted a more thorough test of the fundamental assertion (and points of contention) by Gottfredson and Hirschi (1990) that self-control development stabilizes by late childhood; in addition, it addressed optimal timing of intervention efforts targeting self-control.

To test Gottfredson and Hirschi's (1990) premise that self-control stabilizes by age 10, developmental change was modeled in the full sample of children part of the study as opposed to examining empirically derived, group-based trajectories. The assertion that self-control develops principally during childhood followed by stability implies that a growth trajectory of self-control is steeper during childhood followed by small or no change in the construct subsequently. Additionally, as self-control has been found to be closely related to deviance (e.g. Vazsonyi et al., 2017), we expected changes in deviance over time parallel to those of self-control. Thus, consistent with theory, it was hypothesized that (a) self-control would increase during childhood only, followed by no additional changes during early adolescence, (b) levels of deviance would decrease inversely, parallel to the observed changes and increases in self-control, and (c) self-control scores would predict developmental changes in deviance over time.

Table 1
Descriptive statistics of the main study constructs.

Variable (age in years)	# of items	*N*	*Mean*	*SD*	Skewness	*SE*	Kurtosis	*SE*	α
Self-control 4.5	10	1065	1.30	0.30	0.09	0.08	− 0.32	0.15	0.78
Self-control 6.5	10	1029	1.30	0.33	0.05	0.08	− 0.33	0.15	0.82
Self-control 8.5	10	1027	1.37	0.34	− 0.15	0.08	− 0.27	0.15	0.82
Self-control 10.5	10	1020	1.39	0.33	− 0.12	0.08	− 0.63	0.15	0.81
Self-control 11.5	10	1021	1.39	0.34	− 0.20	0.08	− 0.39	0.15	0.83
Self-control 15	10	968	1.40	0.35	− 0.49	0.08	0.05	0.16	0.83
Deviance 4.5	8	1074	0.50	0.35	0.68	0.08	0.27	0.15	0.79
Deviance 6.5	8	1028	0.40	0.34	1.02	0.08	1.18	0.15	0.79
Deviance 8.5	8	1026	0.38	0.33	0.93	0.08	0.30	0.15	0.80
Deviance 10.5	8	1020	0.32	0.33	1.13	0.08	0.91	0.15	0.81
Deviance 11.5	8	1023	0.31	0.33	1.16	0.08	1.19	0.15	0.80
Deviance 15	8	975	0.28	0.33	1.56	0.08	2.69	0.16	0.83

4. Method

4.1. Participants and procedures

The data for this study were based on the National Institute of Child Health and Human Development (NICHD) Early Child Care Research Network Study of Early Child Care. The NICHD Study is a longitudinal project initiated to examine how differences in child care experiences relate to children's developmental outcomes, including their physical, social, emotional, intellectual, and language development. Data collection commenced in 1991 and enrolled a diverse sample of children and families at ten locations across the United States (NICHD, 2006). The data collection protocol was reviewed and supervised by a NICHD committee, and was reviewed annually by institutional review boards of the ten participating institutions responsible for data collection. For a detailed description of recruitment procedures and sample characteristics see NICHD ECCRN (2001).

Of the 1526 families who agreed to participate, 89% ($N = 1364$) completed the initial data collection. Additionally, $N = 1159$ caregivers provided data on the assessed construct on at least one time point from the six selected. Participant's primary caregivers (96.5% mothers) who completed the initial assessment were slightly older on average (28.6 years versus 26.38 years), better educated (14.4 years versus 13.7 years of schooling) and less likely to be of minority status (17% versus 27%) in comparison to participants lost due to attrition. The recruited families included 24% ethnic-minority children (including 13% African American, 6% Hispanic, and 5% others). The majority of children (90.2%) came from "traditional" families (two parents, two-parent extended or extended & augmented family and two-parent augmented family), while 9.8% of participants reported "non-traditional" family arrangements at the initial time point (step-father family, single parent nuclear family, single parent extended or extended and augmented family, single parent augmented family, nontraditional nuclear family, nontraditional step-father family, nontraditional extended or extended & augmented family, nontraditional augmented family, two-parent alternate caregiver family, single-parent alternate caregiver family). Sex of child was coded as either male (0) or female (1; the study sample was 51.7% female). Lastly, mothers reported whether their family received food stamp support from the government; thus, based on this information, 68.8% children's family socioeconomic status (SES) was low while 31.2% of the sample had average SES.

The current analysis used six assessments collected at ages 4.5, 6.5, 8.5, 10.5, 11.5, and 15 years. The assessments were selected to capitalize on being able to test the critical developmental transitions from childhood to adolescence, and based on the availability of the focal constructs of interest (i.e. self-control and deviance measures). The same measures of key study constructs were used across all six time points, which permitted the application of latent growth modeling to test the developmental trajectories of self-control and deviance.

4.2. Measures

4.2.1. Self-control

Mothers completed the Social Skills Rating System (SSRS-Parent Form, Gresham & Elliot, 1990), a measure consisting of three parts, namely social skills, problem behaviors, and academic competence scales; the social skills component consisted of three subscales: cooperation, assertion, and self-control. For the purposes of the current study, we selected the self-control scale, a 10-item measure answered on a 3-point Likert-type scale ranging from *never* (0) to *very often* (2). The items assess children's ability to exercise self-control in social situations, resulting in either socially appropriate or inappropriate behaviors; for example: "The child avoids situations that result in trouble" or "The child receives criticism well." The measure is copyrighted, and thus not included in an appendix. Reliability analyses provided evidence of good internal consistency over the entire study period (alpha ranged from $\alpha = 0.78$ to $\alpha = 0.83$; Table 1).

4.2.2. Deviance

To assess child and adolescent deviant behaviors, we used maternal reports of the Child Behavior Checklist (CBCL; Achenbach, 1991). The measure included 33 items that describe a variety of deviant behaviors, including lying or cheating, stealing at home, physically attacking people and fighting. Eight developmentally appropriate items were selected across all assessed ages (from 4.5 to 15 years), based on exploratory factor analyses completed in each age group. Mothers rated whether children exhibit each of the behaviors on a 3-point scale ranging from *not true* (0) to *very true or often true* (2). The scale showed good reliability over the six time points (alpha ranged from $\alpha = 0.79$ to $\alpha = 0.83$; Table 1). See Appendix for the selected items.

5. Analytic procedure and results

All items part of each measure were mean averaged; descriptive statistics of the study construct are summarized in Table 1. Bivariate correlations between the study constructs at all six time points are summarized in Table 2. To handle missing data, the full information maximum likelihood (FIML) feature in AMOS was implemented. All model tests were completed in Amos 21 (Arbuckle, 2012).

As self-control and deviance constructs are closely related (Piquero, 2008) and a number of critics have repeatedly argued that they are one and the same thing (Akers, 1991; Geis, 2000) – and unfortunately further adding to this, some researchers have also used items as either self-control or deviance in secondary data sets, such as the Add Health – we completed a series of exploratory (EFA) and confirmatory (CFA) factor analyses to test whether self-control and deviance as assessed were distinct constructs. Both EFA and CFA tests provided support that self-control and deviance are distinguishable constructs. As previously found in research, they were highly associated and shared between 30% and 50% of the variance.[1]

Table 2
Bivariate correlations between the study variables.

Variable (age in years)	1	2	3	4	5	6	7	8	9	10	11
1. Self-control 4.5											
2. Self-control 6.5	0.587										
3. Self-control 8.5	0.526	0.690									
4. Self-control 10.5	0.471	0.630	0.696								
5. Self-control 11.5	0.497	0.620	0.693	0.737							
6. Self-control 15	0.419	0.489	0.581	0.592	0.634						
7. Deviance 4.5	− 0.466	− 0.422	− 0.387	− 0.380	− 0.368	− 0.282					
8. Deviance 6.5	− 0.390	− 0.565	− 0.473	− 0.454	− 0.470	− 0.372	0.630				
9. Deviance 8.5	− 0.339	− 0.443	− 0.558	− 0.499	− 0.446	− 0.409	0.552	0.660			
10. Deviance 10.5	− 0.319	− 0.408	− 0.465	− 0.590	− 0.517	− 0.430	0.521	0.615	0.697		
11. Deviance 11.5	− 0.326	− 0.408	− 0.448	− 0.518	− 0.577	− 0.471	0.519	0.625	0.645	0.753	
12. Deviance 15	− 0.302	− 0.324	− 0.370	− 0.380	− 0.408	− 0.562	0.413	0.511	0.540	0.577	0.615

Note. All coefficients were significant at $p < 0.001$.

5.1. Missing data treatment

To further test whether the item-level missing data (11.6% of cases) were a source of concern, despite the implementation of FIML at the scalar level in AMOS, we employed a procedure proposed by Mazza, Enders, and Ruehlman (2015). They recommend comparing findings using two different scale scores, namely cases with no missing item-level values and all cases including cases with any missing item-level values (e.g., 7 items rated, of 8 total), thus, all available items and scale averages. Results between the two approaches were practically identical; findings from the cross-lagged model differed slightly, in some cases only at the third decimal. Findings from growth models yielded similar results, where the intercept was slightly different in some cases, while the slope terms were identical or different at the third decimal (second one with rounding). Therefore, missing data at the item level were a negligible issue in how they impacted study findings, and scale scores were simply computed from all available rated items for each respondent.

5.2. Developmental change in self-control and deviance over time

To test whether (a) self-control increases during childhood only, followed by no additional changes during early adolescence as specified by self-control theory, and whether (b) the levels of deviance decrease inversely, parallel to the observed changes and increases in self-control, latent growth modeling (LGM) was used. This analytic approach permits a test of the average shape of the developmental trajectory or the average rate of change in a sample. To more thoroughly test and compare possible shapes and courses of developmental trajectories, we a priori specified four models of the hypothesized developmental changes in self-control and deviance: (a) a linear, (b) a quadratic, (c) a piecewise model I with two different linear slopes before and after the age of 8.5, and (d) a piecewise model II with two different linear slopes before and after the age of 10.5.

Additionally, as sex differences in developmental trajectories of self-control and deviance have been previously found, we also tested for differences between boys and girls in the LGM models to assess whether sex had a substantial impact on the results (e.g. Chapple, Vaske, & Hope, 2010; Jo & Bouffard, 2014). We did not find support for sex differences in developmental trajectories of self-control and deviance.[2]

5.2.1. Unconditional linear models of self-control and deviance

To test whether self-control and deviance increased over time linearly, paths were fixed to 1 from the intercept term to the observed self-control or deviance scores at each time point; second, paths from the slope term to the observed scores were fixed to 0, 2, 4, 6, 7, and 10.5 to reflect the time intervals between each assessment. Based on the results, unconditional linear models of self-control[3] and deviance[4] indicated an unacceptable fit. Thus, the results are reported and interpreted in detail only for the subsequent models – quadratic and both piecewise models.

5.2.2. Unconditional quadratic models of self-control and deviance

To examine whether self-control and deviance followed a quadratic growth trajectory, paths were fixed to 1 from the intercept factor to the observed self-control or deviance scores at each time point; second, paths from the slope factor to the observed scores were fixed to 0, 2, 4, 6, 7, and 10.5 to reflect time intervals between each assessment. Lastly, paths from the quadratic factor to observed scores were fixed to 0, 4, 16, 36, 49, and 110.25.

Regarding self-control trajectory, the results indicated a close model fit: χ^2 (12) = 58.91, $p < 0.001$, CFI = 0.986, RMSEA = 0.058 [90%

[1] First, we completed an EFA to evaluate factor loadings of individual items part of both measures. Second, we specified and tested two competing CFA models: (a) a single factor model where all SSRS and CBCL items loaded onto one latent variable, and (b) a two latent factor model, where SSRS items loaded onto one latent factor and the CBCL items loaded onto a second latent construct. The latent constructs were specified to correlate. To be very thorough, all these analyses were repeated at each time point.
Based on the EFA, a 2-factor solution was found, where items loaded more strongly on their respective constructs. One item loaded well on both constructs, namely "Controls temper in conflict situations with you" from the SSRS, only at 3rd grade (λ = 0.476 vs. λ = − 0.406) and at 5th grade (λ = 0.438 vs. λ = − 0.441). Thus, overall, EFAs provided little evidence of construct overlap.
Next, six pairs of CFA models, two at each time point, were compared using the Akaike information criterion (AIC), most suitable for comparing non-nested models (Kline, 2010). Across all six time points, the two-factor model had substantially better fit than the one-factor model (at 54 months, AIC one-factor = 1510.21, AIC two-factor = 899.134; in 1st grade, AIC one-factor = 1194.05, AIC two-factor = 771.298; in 3rd grade, AIC one-factor = 1384.32, AIC two-factor = 921.66; in 5th grade, AIC one-factor = 1321.15, AIC two-factor = 930.62; in 6th grade, AIC one-factor = 1436.59, AIC two-factor = 952.26; and at 15 years, AIC one-factor = 1568.41, AIC two-factor = 985.33). As expected, self-control and deviance were highly correlated in the two-factor models (r range from − 0.58 to − 0.73).

[2] Multigroup tests with LGM model parameters (intercept, slope, quadratic factor or additional slope, and correlations between these three parameters) set to equality between boys and girls did not yield significantly worse fit than the freely estimated model when the trajectory was modeled as quadratic ($\Delta\chi^2$ = 7.070, Δdf = 6, p = 0.314, ΔCFI = 0.000, ΔRMSEA = 0.004), piecewise I ($\Delta\chi^2$ = 6.596, Δdf = 6, p = 0.360, ΔCFI = 0.000, ΔRMSEA = 0.005), and piecewise II ($\Delta\chi^2$ = 8.422, Δdf = 6, p = 0.209, ΔCFI = 0.001, ΔRMSEA = 0.005) function.
The same results were found also for deviance – the model with the intercept, slope, quadratic factor or additional slope, and correlations between these three parameters set to equality between boys and girls did not yield significantly poorer fit than the freely estimated model when the trajectory was modeled as quadratic ($\Delta\chi^2$ = 3.045, Δdf = 6, p = 0.803, ΔCFI = 0.001, ΔRMSEA = 0.007), piecewise I ($\Delta\chi^2$ = 5.278, Δdf = 6, p = 0.509, ΔCFI = 0.000, ΔRMSEA = 0.007), or piecewise II ($\Delta\chi^2$ = 2.567, Δdf = 6, p = 0.861, ΔCFI = 0.001, ΔRMSEA = 0.006) function.

[3] χ^2 (16) = 200.07, $p < 0.001$, CFI = 0.946, RMSEA = 0.100 [90% CI = 0.088, 0.112], p close < 0.001

[4] χ^2 (16) = 196.60, $p < 0.001$, CFI = 0.946, RMSEA = 0.099 [90% CI = 0.087, 0.111], p close < 0.001

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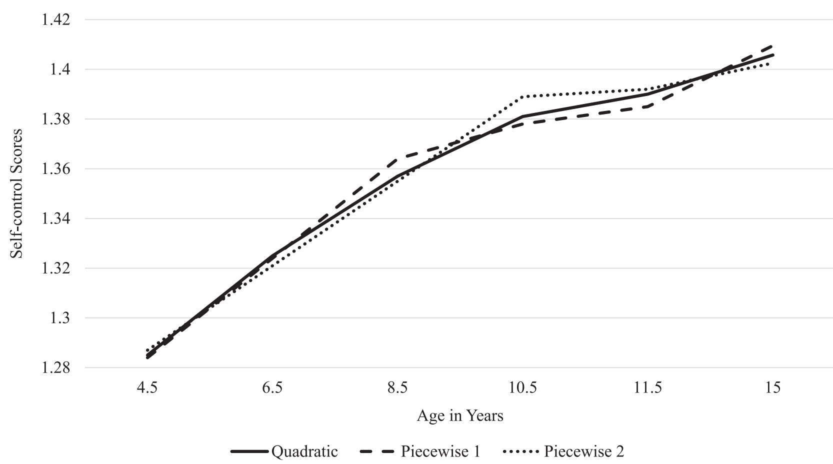

Fig. 1. Prototypic developmental trajectories of self-control (quadratic and two piecewise functions).

CI = 0.044, 0.073], *p* close = 0.167. Findings also provided evidence of a significant mean intercept factor (μ_i = 1.29, $p < 0.001$), slope factor (μ_s = 0.022, $p < 0.001$), and quadratic factor ($\mu_q = -0.001$, $p < 0.001$). Thus, the average level of self-control was 1.29 on a scale ranging from 0 to 2 at the initial time point at 4.5 years. The trajectory increased linearly by 0.022 unit per year; in addition, the developmental change over time slowed down slightly, as indicated by the negative quadratic component (Fig. 1). Additionally, evidence of statistically significant variances ($p < 0.001$) in the intercept (D_i = 0.082), slope (D_s = 0.003), and quadratic ($D_q < 0.001$) factor was found.

Regarding deviance trajectory, the results indicated a close model fit: χ^2 (12) = 58.424, $p < 0.001$, CFI = 0.986, RMSEA = 0.058 [90% CI = 0.043, 0.073], *p* close = 0.176. Findings also provided evidence of a significant mean intercept factor (μ_i = 0.493, $p < 0.001$), slope factor ($\mu_s = -0.039$, $p < 0.001$) and quadratic factor (μ_q = 0.002, $p < 0.001$). Thus, the average level of deviance was 0.493 on a scale ranging from 0 to 2 at the initial time point at 4.5 years. The trajectory decreased linearly by 0.039 units per year; in addition, the developmental change over time slowed down slightly, as indicated by the positive quadratic component (Fig. 2). Additionally, statistically significant variances ($p < 0.001$) in the intercept (D_i = 0.082), slope (D_s = 0.003), and quadratic ($D_q < 0.001$) factors were found.

5.2.3. Unconditional piecewise models of self-control and deviance

Finally, to assess the time when the growth of self-control and deviance slowed down or stabilized, we hypothesized and specified two different piecewise models, each with two separate linear slopes before and after age 8.5 (piecewise I) and before and after age 10.5 (piecewise II). In the piecewise I model, paths from the intercept factor to observed scores at each time point were fixed to 1; paths from the slope 1 factor to observed scores were fixed to 0, 2, 4, 4, 4, and 4. Lastly, paths from the slope 2 factor to observed scores were fixed to 0, 0, 0, 2, 3, and 6.5. In the piecewise II model, paths from the intercept factor to observed scores at each time point were fixed to 1; paths from the slope 1 factor to observed scores were fixed to 0, 2, 4, 6, 6, and 6. Lastly, paths from the slope 2 factor to observed scores were fixed to 0, 0, 0, 0, 1, and 4.5.

5.2.4. Unconditional piecewise I models of self-control and deviance

The results of piecewise I model for self-control indicated acceptable model fit: χ^2 (12) = 70.18, $p < 0.001$, CFI = 0.983, RMSEA = 0.065 [90% CI = 0.051, 0.080], *p* close = 0.044. Findings also provided evidence of a significant mean intercept factor (μ_i = 1.28, $p < 0.001$), slope 1 factor (μ_{s1} = 0.020, $p < 0.001$) and slope 2 factor (μ_{s2} = 0.007, $p < 0.001$). Thus, the average level of self-control was 1.28 on a scale ranging from 0 to 2 at the initial time point at 4.5 years. The trajectory increased linearly by 0.020 unit per year up until the age of 8.5, and by 0.007 units after the age of 8.5 (Fig. 1). Additionally, we found evidence of statistically significant variances ($p < 0.001$) in the intercept (D_i = 0.058), slope 1 (D_{s1} = 0.002), and slope 2 (D_{s2} = 0.001) factors.

The results from the piecewise I model for deviance indicated acceptable model fit: χ^2 (12) = 101.790, $p < 0.001$, CFI = 0.973, RMSEA = 0.080 [90% CI = 0.066, 0.095], *p* close < 0.001. Findings also provided evidence of a significant mean intercept factor (μ_i = 0.490, $p < 0.001$), slope 1 factor ($\mu_{s1} = -0.033$, $p < 0.001$) and slope 2 factor ($\mu_{s2} = -0.013$, $p < 0.001$). Thus, the average level of deviance was 0.490 on a scale ranging from 0 to 2 at the initial time

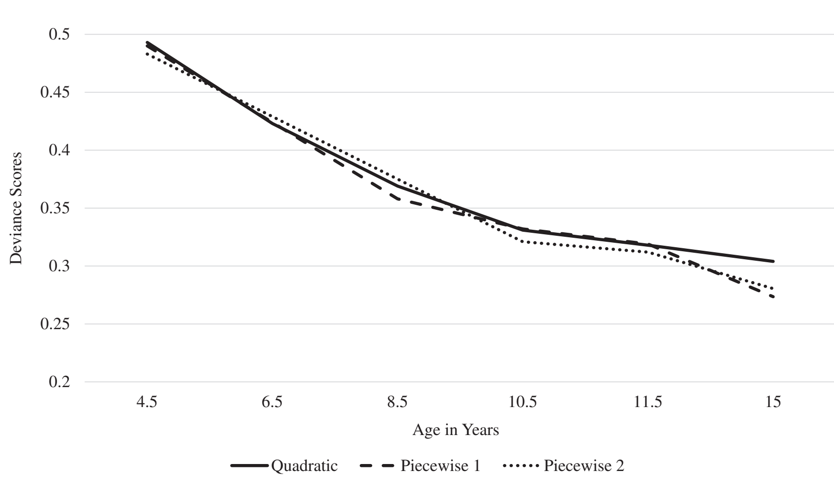

Fig. 2. Prototypic developmental trajectories of deviance (quadratic and two piecewise functions).

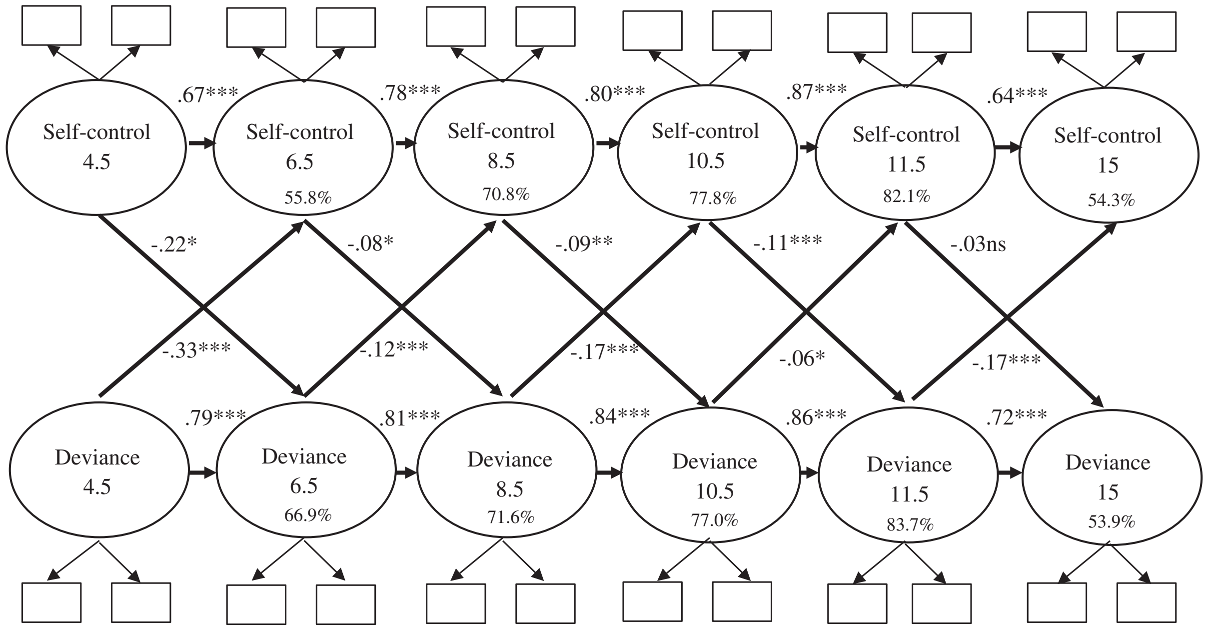

Fig. 3. Autoregressive and cross-lagged effects between self-control and deviance. Notes. Numbers in construct are age in years as well as the amount of variance explained; standardized coefficients are shown on paths. Item parcels are unlabeled for simplicity. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

point at 4.5 years. The trajectory decreased linearly by 0.033 unit per year up until the age of 8.5, followed by a much more modest rate of change (0.013 units; Fig. 2). Additionally, statistically significant variances were found ($p < 0.001$) in the intercept ($D_i = 0.082$), slope 1 ($D_{s1} = 0.002$), and slope 2 ($D_{s2} = 0.001$) factors.

5.2.5. Unconditional piecewise II models of self-control and deviance

The piecewise II model for self-control yielded an acceptable model fit: χ^2 (12) = 77.05, $p < 0.001$, CFI = 0.981, RMSEA = 0.068 [90% CI = 0.054, 0.083], p close = 0.017. Findings also provided evidence of a significant mean intercept factor ($\mu_i = 1.29$, $p < 0.001$), slope 1 factor ($\mu_{s1} = 0.017$, $p < 0.001$), but non-significant slope 2 factor ($\mu_{s2} = 0.003$, $p = 0.130$). Thus, the average level of self-control was 1.29 on a scale ranging from 0 to 2 at the initial time point at 4.5 years. The trajectory increased linearly by 0.017 units per year up until age 10.5 years, after which no further changes were found (Fig. 1). Additionally, we found evidence of statistically significant variances ($p < 0.001$) in the intercept ($D_i = 0.061$), slope 1 ($D_{s1} = 0.001$), and slope 2 ($D_{s2} = 0.002$; $p = 0.002$) factors.

The piecewise II model for deviance provided acceptable fit: χ^2 (12) = 54.206, $p < 0.001$, CFI = 0.987, RMSEA = 0.055 [90% CI = 0.041, 0.070], p close = 0.263. Findings also provided evidence of a significant mean intercept factor ($\mu_i = 0.483$, $p < 0.001$), slope 1 factor ($\mu_{s1} = -0.027$, $p < 0.001$), and slope 2 factor ($\mu_{s2} = -0.009$, $p < 0.001$). Thus, the average level of deviance was 0.483 on a scale ranging from 0 to 2 at the initial time point at 4.5 years. The trajectory decreased linearly by 0.027 unit per year up until the age of 10.5 and after this time point changed to a much smaller extent (by 0.009; Fig. 2). Additionally, evidence was found of statistically significant variances ($p < 0.001$) in the intercept ($D_i = 0.079$), slope 1 ($D_{s1} = 0.001$), and slope 2 ($D_{s2} = 0.002$) factors.

6. Directionality of the relationship between self-control and deviance

To test the third hypothesis, namely that self-control would predict developmental changes in deviance over time, the direction of the relationship between self-control and deviance was examined by estimating a cross-lagged latent model, where latent constructs were measured by two parcels each (Little, Cunningham, Shahar, & Widaman, 2002). Five autoregressive paths between the latent constructs of the same variable were specified, along with ten cross-lagged paths between the six time points of self-control and deviance. Then, using multigroup tests, the relative strengths of the cross-lagged effects were compared to test for directionality of the relationships between self-control and deviance; this included comparing a model with freed parameters to one with constrained ones, where the cross-lagged effects were set to equality. Model fit between the two models were compared; additionally, to be thorough, we tested for potential significant differences in the bidirectional paths at each time point separately, one by one.

The change in fit between the two models, one with freed parameters and one with constrained ones, was evaluated based on changes in χ^2, CFI, and RMSEA. The χ^2 difference test is the most common index for evaluating change in model fit; a statistically significant $\Delta\chi^2$ between a freely estimated and a constrained model is interpreted as a difference between models (e.g., Kline, 2010). However, there is an evidence that χ^2 difference may yield statistically significant results in large samples even though difference between models is trivial (Cheung & Rensvold, 2002). Thus, Cheung and Rensvold (2002) suggest evaluating differences in alternative fit indices, including the CFI (ΔCFI larger than 0.01 for evidence of difference). Additionally, Chen (2007) suggests that a change in RMSEA larger than 0.010 should be considered as evidence of a difference.

The cross-lagged path model revealed support for bidirectional effects between self-control and deviance over time (cross-lagged, longitudinal paths, see Fig. 3); as expected, constructs were also stable over the 11-year period, with variance estimates ranging from 54 to 84% in each construct. Bidirectional paths between self-control and deviance were constrained pairwise to equality between times 1/2, times 2/3, times 3/4, times 4/5, and times 5/6. Comparisons of the bidirectional cross-lagged latent model with freed parameters to the one with constrained paths set to equality revealed significantly poorer fit ($\Delta\chi^2 = 14.78$, $\Delta df = 5$, $p = 0.011$, ΔCFI = 0.000, ΔRMSEA = 0.001). To further investigate this difference, path by path comparisons were completed. Only one pair of cross-lagged paths revealed a significant difference, namely between times 5 and 6, where time 5 deviance predicted time 6 self-control, while time 5 self-control did not significantly predict time 6 deviance ($\Delta\chi^2 = 6.45$, $\Delta df = 1$, $p = 0.011$, ΔCFI = 0.000, ΔRMSEA = 0.001).

7. Discussion

The aim of the current investigation was to model developmental trajectories of self-control and deviance from kindergarten until age 15. The study extended Vazsonyi and Huang's (2010) work by adding five more years to the studied period as well as the critical transitional period during which self-control development should end, based on theory. Thus, the study tested whether self-control stabilized between ages 8 and 10 or whether it continued to change and develop, and whether self-control scores predicted deviance over time. It was hypothesized that (a) self-control increased during childhood followed by a stabilization of growth during early adolescence, (b) deviance decreased parallel with the observed increases in self-control, and (c) self-control scores predicted developmental changes in deviance over time. Developmental change in self-control and deviance were modeled as linear, quadratic, and as two piecewise functions (I and II). Consistent with some previous research (Vazsonyi & Huang, 2010), self-control increased and deviance decreased over the time period investigated. Findings provide evidence that developmental trajectories are non-linear in both constructs. They also confirm based on extensive psychometric work that the two constructs are in fact distinct, conceptually as well as empirically.

Unlike Vazsonyi and Huang (2010) who found a linear function to represent developmental change in self-control and deviance, the model representing increases and decreases in the constructs as linear did not fit the data well when the study time period was extended until age 15. Instead, a quadratic model better represented the data, suggesting that self-control increased during childhood followed by deceleration of developmental changes. The deviance trajectory paralleled the changes observed in self-control; deviance decreased at a faster pace initially, followed by a slower rate of change in late childhood and early adolescence.

We further investigated the change in the developmental trajectory of self-control and deviance by estimating two piecewise models; piecewise I was specified as two linear trajectories – the first one from 4.5 years to 8.5 years, the second one from 8.5 years to 15 years. Piecewise II was specified as two linear trajectories before and after 10.5 years. This procedure provided a more nuanced look at how and whether developmental changes continued or not. Based on these analyses, self-control increased more rapidly before age 8.5 than after this age, and importantly, although self-control increased at a slower rate of change until 10.5 years, there was no further change following this age. These findings strongly support one of the central tenets by Gottfredson and Hirschi's (1990) self-control theory, namely that self-control develops rapidly and principally during childhood, followed largely by stability. The developmental course of deviance was largely parallel, in the opposite direction; however, findings provided some evidence that deviance continued to change past age 10.5, although at a lower rate of change as compared to childhood. Thus, findings supported study hypotheses that self-control increased over time while deviance decreased, that is, in a non-linear manner.

The results revealed statistically significant variance in both intercept and slope factors; however, it is important to note that the variances of slope or growth factors were modest in size, close to zero. Hence, there was some variability in the rate of change in both self-control and deviance, but this magnitude was very modest, indicating that self-control and deviance largely developed at a similar pace across individuals over time. This finding further suggests relative stability of self-control and deviance over time, meaning that individuals differ in mean levels of these constructs but not in the rate of their change over time.

At the same time, results are not inconsistent with findings which show that self-control might change in some adolescents, beyond childhood. For example, Ray et al. (2013) provided evidence that developmental trajectories of self-control differed in groups of adolescents, Burt et al. (2014) found different developmental trajectories of two dimensions of self-control, namely impulsivity and sensation seeking, and lastly, Na and Paternoster (2012) argued that changes in self-control during adolescence might occur at least for some individuals as a result of social bonding. However, we found and concluded that when testing average developmental changes in self-control over time, from childhood to adolescence, results followed one key prediction made by Gottfredson and Hirschi, namely that self-control generally stabilizes by late childhood, by the age of 10.

Second, the results revealed that self-control and deviance do not only concurrently develop but that they are also significantly associated. We found that self-control significantly predicted deviance across time points, with the exception of time 5 self-control to time 6 deviance. Deviance predicted self-control across all time points. Thus, the association between the two constructs is best described as bidirectional. The effects were not significantly different in size when tested, with the exception of the last time point, where Time 5 deviance predicted time 6 self-control, but time 5 self-control did not predict time 6 deviance. Thus, we found support for our last hypothesis in that self-control predicted deviance; however, deviance also reciprocally predicted self-control equally well, with one exception past the age of 10, where self-control no longer predicted deviance at age 15.

The bidirectional effects are a bit unexpected conceptually as self-control has been treated as a predictor of deviance and understood as an antecedent of deviance (Perrone et al., 2004; Pratt & Cullen, 2000; Vazsonyi & Huang, 2010). On the other hand, these findings are not surprising given how self-control and deviance were originally operationalized. Gottfredson and Hirschi (1990) argued that criminal or deviant acts share a similar set of characteristics as the individuals likely to commit them (Evans et al., 1997). Individuals with a high propensity to commit crimes, i.e. having *low self-control* are impulsive, have difficulty to delay gratification, prefer for short-term goals as opposed to the long-term ones, and are insensitive to others' discomfort. Individuals low in self-control do not necessarily seek out to commit crimes or engage into health-compromising behaviors; but, they are unable to exercise an appropriate amount of self-restraint when confronted with immediately gratifying temptations (Gottfredson & Hirschi, 1990).

As deviant acts and the propensity to commit them (i.e., low self-control) are operationalized as analogous concepts, it is understandable that some authors criticized the theory as being tautological (Akers, 1991; Geis, 2000; Goode, 2008). Akers (1991) argued that it may be problematic to explain the propensity to commit crime by low self-control, because this propensity and self-control represent in essence the same set of characteristics. The propensity to commit crime was originally referred to as a *criminality* by Gottfredson and Hirschi (1990), but in essence, it represents low self-control. Additionally, low self-control manifests as a propensity towards norm-violations, deviance, and criminal behaviors, and as such, is partially defined by simply committing criminal or deviant acts. Piquero (2008) added to this that the issue is often encountered in measurement of both self-control and deviant behavior as some items used to measure self-control actually tap into illegal behaviors, particularly when relying on secondary data sets. However, this issue can be avoided by employing in effect "unconfounded," strong, and validated measure of self-control, such as Social Skills Rating System employed in the current study.

In a reaction to this critique, Hirschi and Gottfredson (2008) emphasized that part of the critique is simply based on a confusion of terms used. The argument presented by Akers (1991) that propensity to commit crimes cannot be explained by self-control because they represent the same set of characteristics was misguided according to Hirschi and Gottfredson (2008). This was so because in their theory, the propensity to commit crimes is the same construct as low self-control. This seeming ambiguity might also be related to the fact that

Gottfredson and Hirschi used these terms interchangeably before settling on low self-control. Thus, they argue that their theory is solely about the relationship between low self-control and crime or deviance (Hirschi & Gottfredson, 2008).

Regarding the relationship between low self-control and crime, these two concepts are not the same one although they share similar set of features. Criminal or deviant acts are only an imperfect measure of self-control, and low self-control itself does not guarantee that criminal acts will be committed. In order to commit crime, the individual low in self-control needs to be faced with opportunities to do so in the environment, thus low self-control does not simply "equal" crime (Gottfredson & Hirschi, 1990); it is simply a probabilistic construct. Low self-control and crime are correlated as underlying individual differences in self-control manifest themselves as a different likelihood of being involved in illegal, externalizing, or health-compromising behaviors. Yet, the overlap is not complete and the fact that similar items are sometimes used to measure theoretically distinct concepts does not suggest that the theoretical concepts or the theory in general are invalid (Hirschi & Gottfredson, 2000). Sharing similar characteristics does not imply that the constructs in question are non-distinguishable as our results after all clearly show.

Fairly strong, and more importantly, bidirectional relationships between both constructs in the study certainly document a close relationship between low self-control and deviance. Despite this significant overlap, results show that self-control and deviance are in fact distinct. First, based on both EFA and CFA analyses, a cross-lagged model, as well as the main LGMs, a substantial amount of variance remains unexplained in both constructs. Second, although self-control changes stabilized by age 10.5 years, deviance continued to change, suggesting that it does not perfectly parallel changes observed in self-control, and that there remains uniqueness in deviance, above and beyond self-control. Thus, as critics of the *self-control theory* suggest, self-control and deviance seem to share important part of their variance, yet they maintain uniqueness as Hirschi and Gottfredson (2008) have argued.

Recent behavior genetic evidence shows in fact that a high proportion of heritability observed might in fact underlie the shared variance between self-control and deviance (Beaver, Boutwell, Barnes, Schwartz, & Connolly, 2014; Connolly & Beaver, 2014). Beaver, Connolly, Schwartz, Al-Ghamdi, and Kobeisy (2013) make the case that the heritability of self-control is important, in addition to environmental factors, in understanding the development and stability of self-control. They also found that variability in externalizing behaviors may be the result of heritable factors (Beaver et al., 2014). In fact, the factors including shortsightedness, difficulty delaying gratification, and impulsivity that characterize low self-control also constitute a propensity towards criminal behaviors, and since these characteristics are heritable, both self-control and deviance may simply share some common, underlying genetic factors, in effect "imperfectly" so. Supporting this, Connolly and Beaver (2014) found that genetic factors accounted for between 51% and 92% of the variance in self-control and between 30% and 41% of the variance in delinquency. Again, this does not imply that low self-control and deviant or criminal behavior can be explained by genetic factors only; socialization, identified by Gottfredson and Hirschi (1990) as key in self-control development, has been shown to predict and explain self-control (Bindman, Hindman, Bowles, & Morrison, 2013; Burt et al., 2006; Hay & Forrest, 2006; Mittal, Russell, Britner, & Peake, 2013; Perrone et al., 2004; Vazsonyi & Huang, 2010). However, individual differences in self-control seem to precede socialization efforts (see Vazsonyi & Huang, 2010), something Gottfredson and Hirschi (1990) originally acknowledged and addressed, but something often overlooked; as they argued, in thinking and writing about crime and deviance, they chose to focus on what appears to be malleable. Thus, it is possible that self-control and deviance develop in tandem, in parallel, and that factors predicting their developmental course predate preschool age (age 4 or younger).

8. Limitations and future directions

The current investigation was focused on modeling developmental changes of self-control and deviance, and association between the two constructs. We were not primarily interested in predictors of the growth in self-control and deviance; however, socialization practices such as parenting or peer influences are important to consider in understanding the factors that affect developmental course of self-control and deviance. As evidenced by the significant variances of latent factors, both initial status and shape of the developmental trajectory varied significantly in children, thus, understanding sources of the variability, both biological and environmental, would be important for targeting the groups at-risk for both self-control difficulties and related deviance.

Second, as recent behavior genetic evidence has shown, some shared variance of self-control and deviance might be explained by common genetic factors that underlie both constructs (Connolly & Beaver, 2014). Thus, to fully understand the relationship between self-control and deviance, heritability should be considered which was unfortunately not possible to do in the current NICHD dataset.

Lastly, it is important to note that the significant overlap as well as strong and bidirectional effects between self-control and deviance may be partially related to the measurement of the both constructs. First, the items selected to assess deviance reflected general, childhood problem behaviors rather than criminal behavior, and thus might be associated with self-control more closely than delinquency would be. Second, all items part of the two examined variables were mother-reported, thus, the significant overlap as well as fairly strong and bidirectional effects between self-control and deviance may be partially related to the shared method of assessment.

9. Conclusions

Results from the current study support Gottfredson and Hirschi's (1990) hypothesis that self-control principally develops during childhood, followed by stabilization in late childhood, around the age of 10, at the point of transition into early adolescence. No evidence was found supporting that self-control continues to develop past the age of 10, based both on latent growth models as well as latent cross-lagged models over a 11 year period, from age 4 to age 15; however, the developmental course of deviance, to a large part until age 10, parallels the one of self-control. Thus, the relationship between self-control and deviance over time was bidirectional until the age 10, suggesting that the two processes develop in tandem, perhaps at least in part due to shared genetic factors that underlie both the propensity towards low self-control and deviance, but also related to shared environmental influences during infancy.

Appendix A

Child behavior checklist — deviance at all time points (8 selected items)

0	1	2
Not true	Somewhat or sometimes true	Very true or often true

1. Argues a lot.
2. Cruelty, bullying, meanness others.
3. Demands a lot of attention.
4. Does not seem to feel guilty after misbehaving.
5. Lying or cheating.
6. Stubborn, sullen, or irritable.
7. Sudden changes in mood or feelings.
8. Temper tantrums or hot temper.

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