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Journal
Journal of Personality and Social Psychology, 119(2)

ISSN
0022-3514

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Publication Date
2020-08-01

DOI
10.1037/pspp0000283

Peer reviewed

Published in final edited form as:
J Pers Soc Psychol. 2020 August ; 119(2): 417–456. doi:10.1037/pspp0000283.

The Development of Effortful Control from Late Childhood to Young Adulthood

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Abstract

The present study investigated the developmental precursors of effortful control, a temperament trait that involves the propensity to regulate one's impulses and behaviors, to motivate the self towards a goal when there are conflicting desires, and to focus and shift attention easily. Data came from the California Families Project, a multi-method longitudinal study of 674 Mexican-origin youth (and their parents), who were assessed at ages 10, 12, 14, 16, and 19. Effortful control (measured via self- and parent-reports) was moderately stable over time (r=.47 from age 10 to 19), and its developmental trajectory followed a u-shaped pattern (decreasing from age 10 to 14, before increasing from age 14 to 19). Findings from latent growth curve models showed that youth who experience more hostility from their parents, associate more with deviant peers, attend more violent schools, live in more violent neighborhoods, and experience more ethnic discrimination tend to exhibit an exacerbated dip in effortful control. In contrast, youth with parents who closely monitor their behavior and whereabouts exhibited a shallower dip in effortful control. Analyses of the facets of effortful control revealed important disparities in their trajectories; specifically inhibitory control showed linear increases, attention control showed linear decreases, and activation control showed the same u-shaped trajectory as overall effortful control. Moreover, most of the precursors of effortful control replicated for inhibitory control and attention control, but not for activation control. We discuss the broader implications of the findings for adolescent personality development and self-regulation.

Keywords

effortful control; self-regulation; personality development; etiology; longitudinal

Effortful control is one of many constructs that lie within a larger nomological network of self-regulatory traits including self-control, executive function, impulsivity, constraint, ego control, delay of gratification, and conscientiousness (Carver, 2005; Duckworth & Kern, 2011; Roberts, Lejuez, Krueger, Richards, & Hill, 2012). Effortful control is considered to be the *temperamental core* of self-regulation and is often defined as one's capacity to regulate dominant impulses (inhibitory control), to focus and shift attention when needed (attention control), and to activate the self to pursue goals when there are competing desires (activation control) (Rothbart & Bates, 2006). Therefore, effortful control encompasses not

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only top-down regulatory processes (i.e., inhibitory control, attention control) similar to cognitive processes like executive function, but also motivational processes (i.e., activation control, goal pursuit, perseverance) akin to broader self-regulatory traits measured in adulthood, like conscientiousness.

The consequences of effortful control (and related self-regulatory traits) span multiple domains of functioning including achievement and wealth, health and longevity, mental health problems, and relationship functioning (Atherton, Lawson, Ferrer, & Robins, in press; Atherton, Zheng, Bleidorn, & Robins, in press; Barrick & Mount, 1991; Claxton, O'Rourke, Smith, & DeLongis, 2011; Duckworth & Seligman, 2005; Halford, Lizzio, Wilson, & Occhipinti, 2007; Hill et al., 2011; Moffitt et al., 2011; Noftle & Robins, 2007; Strauman, 2017). Although a significant amount of research has documented the pervasive ramifications of effortful control, we know less about its development from childhood to young adulthood. The present study addressed this gap using multi-method data from a longitudinal study of youth followed from late childhood (age 10) to young adulthood (age 19). We examined stability and change in effortful control (and its facets), and investigated a wide array of antecedents to effortful control development. To better understand which youth become good or bad at self-regulating, we examined etiological factors from multiple levels of analysis – individual, family, social, community, and cultural –to predict the trajectory of effortful control (measured via self- and parent-reports) across three developmental periods (late childhood, adolescence, young adulthood).

Stability and Change in Self-Regulatory Traits

Researchers quantify stability and change in personality traits in two ways: rank-order stability and mean-level change. *Rank-order stability* reflects the degree to which the relative ordering of individuals on a given trait is maintained over time, whereas *mean-level change* refers to changes in the average trait level of a population. The rank-order stability of effortful control is moderate-to-high from early childhood to late childhood, with test-retest correlations ranging from .44 to .80 (Kochanska & Knaack, 2003; Kochanska, Murray, & Harlan, 2000; Li-Grining, 2007; Valiente et al., 2006; Vazsonyi & Huang, 2010). However, there is little research on the stability of effortful control beyond childhood, with two studies reporting moderate consistency (test-retest *r*s range = .50 to .68) from age 11 or 12 to 16 (Laceulle et al., 2012; Vijayakumar et al., 2014). We can gain some insight into the likely stability of effortful control in adolescence by examining the stability of conscientiousness, which shares many core features with effortful control, but is a broader construct that also includes orderliness, punctuality, and responsibility. Conscientiousness tends to be moderately-to-highly stable from age 12 to 22, with one-year test-retest correlations ranging from .45 to .90 (Borghuis et al., 2017; Klimstra et al., 2009). Taken together, these findings suggest that self-regulatory traits are moderately stable from childhood to young adulthood, but this issue merits further attention given the lack of fine-grained longitudinal studies that have assessed effortful control across multiple developmental periods.

In terms of mean-level change, previous research has shown that there are significant increases in inhibitory control during early childhood, as well as improvements in the ability to manage attention and regulate behavior (as measured by cognitive/behavioral tasks)

(Carlson, 2005; Kochanska, Murray, & Harlan, 2000; Eisenberg, Spinrad, & Eggum, 2010; Li-Grining, 2007; Murphy et al., 1999). Effortful control, and related traits such as self-control and conscientiousness, continue to increase from early childhood to late childhood (Eisenberg, Duckworth, Spinrad & Valiente, 2012; Kochanska, Murray & Harlan, 2000; Kochanska & Knaack, 2003; Kohnstamm et al., 1998; Van den Akker, Dekovic, Asscher, & Prinzie, 2014; Vazsonyi & Huang, 2010), and from late childhood to early adolescence (King, Lengua & Monahan, 2013; Murphy et al., 1999).

However, there is little consensus about mean-level change in effortful control across adolescence (i.e., age 13 to 18), or during the transition to young adulthood. It was initially thought that effortful control and other self-regulatory traits (i.e., conscientiousness, constraint, orderliness, diligence) followed the maturity principle and exhibit increases across adolescence and into young adulthood (Branje, van Lieshout, & Gerris, 2006; Donnellan, Conger, & Burzette, 2007; Roberts, Walton, & Viechtbauer, 2006). However, more recent research has found no statistically significant mean-level change in effortful control, or conscientiousness, across adolescence (Klimstra et al., 2009; Laceulle et al., 2012). Further complicating the situation, a growing body of research suggests that self-regulatory traits may even *decrease* during adolescence (De Fruyt et al., 2006; Borghuis et al., 2017; Leon-Carrion, Garcia-Orza, Perez-Santamaria, 2004; Soto et al., 2011; Van den Akker, Dekovic, Asscher, & Prinzie, 2014), leading some researchers to conclude that there is a temporary “self-regulatory dip” during adolescence (Soto & Tackett, 2015). Often referred to as the *disruption hypothesis*, it is thought that temporary decreases in socially desirable traits during adolescence are due to the profound biological, psychological, and social changes that most youth face during this time (Soto & Tackett, 2015). Subsequently, individuals resume the well-established, mean-level increases in self-regulatory traits during young adulthood and beyond, in accordance with the *maturity principle* (Bleidorn et al., 2009; Blonigen et al., 2008; Hopwood et al., 2011; Murphy et al., 1999; Roberts, Caspi, & Moffitt, 2001; Roberts, Walton, & Viechtbauer, 2006; Robins, Fraley, Roberts, & Trzesniewski, 2001; Shulman, Harden, Chein, & Steinberg, 2015 Van den akker, Dekovic, Asscher, & Prinzie, 2014).

Thus, the extant research suggests that we have much to learn about patterns of consistency and change in effortful control from late childhood to young adulthood. Additionally, because there is a wide nomological network of self-regulatory traits, it is possible that contradictory mean-level trends during this period are due to substantive and meaningful change over time in different aspects of self-regulation. For example, there are three components of effortful control: 1) *inhibitory control* – the propensity to regulate one’s impulses and behaviors, 2) *attention control* -- the ability to focus and shift attention when needed, and 3) *activation control* -- the capacity to motivate the self towards a goal when there are competing desires. It is possible that the basic capacity to control one’s impulses (i.e., inhibitory control, or self-control) and shift attention improves from childhood to young adulthood, as individuals develop more complex cognitive skills. This is supported by previous research on executive function, which shows linear increases in inhibition, attention, and working memory capacity across adolescence before plateauing in young adulthood (Best & Miller, 2010; Boelema et al., 2014; Casey & Caudle, 2013; Friedman et al., 2016; Zelazo & Carlson, 2012). Thus, the hypothesized decline, or “dip”, in self-regulatory traits during adolescence may be driven by a decrease in motivational processes related to persisting towards a goal (e.g., activation control, industriousness). By focusing on broad constructs like effortful control and conscientiousness, we may miss divergent developmental trends at the facet level that have important implications for other aspects of development. Moreover, given the mixed evidence of the direction of mean-level changes during adolescence, it is crucial to better understand whether there is support for the *disruption hypothesis*, and if so, identify factors that mitigate or exacerbate this dip in effortful control.

Ecological Systems Theory and Personality Development

Ecological systems theory posits that child development is impacted by multiple environmental systems at varying levels of proximity to the child, including the individual, familial, social, community, and cultural levels (Bronfenbrenner, 1979). This theory is useful for personality psychologists trying to understand trait development for a number of reasons. First, it takes a holistic view of development, in that there is not just one environmental system that impacts a trait, but rather, multiple environmental systems can simultaneously work to influence personality development. Second, by considering the influence of multiple systems in the same study, we are able to gain a better understanding of which etiological factors have stronger and weaker associations with the development of effortful control from late childhood to young adulthood. Third, ecological systems theory does not discount the role of time, as evidenced by the *chronosystem* put forth by Bronfenbrenner (1979). The *chronosystem* suggests that all environmental systems, as well as the child, are changing over time. Given that there is consistency and change in both personality development and etiological factors across the lifespan, it is critical to incorporate these dynamic systems into our investigations of the antecedents of personality development.

In the present study, we examine numerous factors across multiple systems, including the individual (i.e., gender, IQ), family (i.e., socioeconomic status, parenting practices), social influence (i.e., peer and sibling deviance), community (i.e., school and neighborhood socioeconomic status; school and neighborhood violence), and cultural (i.e., nativity status, discrimination, Mexican cultural values) systems. Below we review the research literature on these hypothesized influences on the development of effortful control, focusing on longitudinal studies conducted in preadolescence and adolescence.

Individual systems.

At the most proximal level are characteristics unique to the individual, such as gender and IQ. Girls are typically higher than boys on effortful control (and conscientiousness) (Else-Quest, 2012), but we know of only one study that has examined gender differences in the development of effortful control. This study failed to find gender differences in effortful control change from age 11 to 16 (Lacuelle et al., 2012), although the study had only two time points. In research on related self-regulatory traits, girls tend to have higher overall trajectories of conscientiousness and impulse control from childhood to young adulthood. However, no consistent gender differences in the slopes have emerged; some studies have found that girls increase and boys decrease over time, whereas other studies have found that both genders increase over time, but girls increase at a more rapid pace (Borghuis et al., 2017; Klimstra et al., 2009; Shulman Harden, Chein, & Steinberg, 2015; Van den Akker, Dekovic, Asscher, & Prinzie, 2014).

Much of the previous research on the association between IQ and effortful control has been limited to concurrent correlations. Researchers find that children who have higher IQs often have higher effortful control (and related self-regulatory traits) in toddlerhood (Chang & Olson, 2016; Olson, Kerr, & Lopez-Duran, 2005) and early childhood (Asendorpf & Van Aken, 2003; Choe, Lane, Grabell, & Olson, 2013). In adolescence, researchers have conceptually-replicated this association by showing that there are concurrent, positive associations between self-control (mother-, father-, and teacher-reported) and IQ among 10 to 13 year olds (Duckworth, Quinn, & Tsukayama, 2012), as well as between delay of gratification and IQ among 14 year olds (Funder & Block, 1989). Oddly, the correlation between self-regulatory traits, like conscientiousness, and intelligence appears to switch directions when examining adult populations, as evidenced by a meta-analysis that indicates conscientious individuals tend to have lower concurrent intelligence scores (Poropat, 2009). It is unclear whether the non-intuitive and discrepant findings are due to: methodological issues (e.g., non-representative adult samples, see Murray, Johnson, McGue, & Iacono, 2014), substantive explanations (i.e., highly conscientious people compensate for lower intellectual abilities, see Rammstedt, Danner & Martin, 2016), or developmental differences (i.e., the association is positive early in development, but negative later in development). Regardless, a concurrent association does not inform our understanding of the *prospective* influence of intelligence scores on *change over time* in effortful control. This research question has yet to be examined and is one of the goals of the present study.

Familial systems.

Within the family system, we examined several antecedents to effortful control development: family socioeconomic status (SES) and parenting practices. Family SES, which is often calculated using education level, income, and/or occupational prestige, signifies the amount of economic and social resources parents have to provide for their children. A recent meta-analysis of both cross-sectional and longitudinal studies showed that family SES is positively related to child effortful control and conscientiousness, in that more affluent families tend to have children who are higher in effortful control and conscientiousness (Ayoub, Gosling, Potter, Shanahan, & Roberts, 2018). However, these effects were very small, suggesting that family SES may be less important for personality development than traditionally believed. Moreover, the meta-analytic effects were not moderated by age, which implies that there may be few longitudinal influences of family SES on change in effortful control and conscientiousness. Another recent study, based on seven large samples totaling over 60,000 participants, failed to find any association between parent education level and child conscientiousness, or any moderation by age (Sutin et al., 2017).

In addition to SES, we examine three commonly studied dimensions of parenting: warmth, hostility, and monitoring (Schofield & Atherton, in press). The *concurrent* associations between parenting and self-regulation are well-documented (e.g., Karreman, van Tuijl, van Aken, & Dekovic, 2006); parental monitoring is related to better, and parental hostility to worse, self-regulatory skills, whereas parental warmth has no significant association. Additionally, a large body of research has used longitudinal data with two time points to investigate the prospective influence of parenting practices on effortful control in childhood and adolescence (e.g., Crosswhite & Kerpelman, 2012; Eisenberg et al., 2003; Graziano, Keane, & Calkins, 2010; Lengua, Honorado, & Bush, 2007; Meldrum, 2008). However, very little research has examined parenting practices as predictors of *changes* in effortful control over time. One study found that parental warmth predicts relative increases in effortful control from age 9 to 11, but not from age 11 to 13 (Eisenberg et al., 2005). In related research on conscientiousness, Schofield et al. (2012) found that higher parental warmth predicted relative increases in adolescent conscientiousness, and de Haan et al. (2013) found that parental warmth lessened the likelihood of youth being classified in "undercontrolling trajectories" (i.e., a combination of low conscientiousness and low agreeableness). Consistent with these findings, research suggests that the slopes of parental warmth and conscientiousness are correlated in adolescence, such that increases in warmth are associated with increases in conscientiousness time (Van den Akker et al., 2014). Finally, there is little evidence of reciprocal effects, that is, evocation effects of effortful control on changes in parental warmth (Eisenberg et al., 2005).

With regard to longitudinal research on parental hostility and effortful control, Lengua (2006) used bivariate latent growth curve models to show that there was no significant influence of the level of parental rejection on the effortful control trajectory across 3 years. However, there was an evocation effect, such that the adolescent's effortful control was associated with changes in parental rejection over time (Lengua, 2006). Paradoxically, some studies have found no influence of parental rejection and physical punishment on the trajectory of effortful control, but a significant influence on the trajectory of impulsivity from age 9 to 14 (King, Lengua, & Monahan, 2013). Last, research on related self-regulatory traits, like conscientiousness, has shown an association with parental hostility, in that greater *decreases* in parental hostility were associated with greater *increases* in childhood conscientiousness during adolescence (Van den Akker et al., 2014).

Surprisingly few studies have examined parental monitoring and effortful control, except in early childhood. A meta-analysis conducted among preschoolers found that limit-setting and guidance from parents (two aspects of parental monitoring) was associated with higher levels of self-regulation (Karreman, van Tuijl, van Aken, & Dekovic, 2006). However, to our knowledge, there has been no longitudinal research on parental monitoring and effortful control beyond childhood. Theoretically, given the nature of parental monitoring, which is itself a form of behavioral regulation, it seems plausible that parental monitoring and effortful control are longitudinally associated across adolescence. Specifically, parents who actively monitor their offspring will have adolescents who show greater increases in effortful control, whereas parents who do not monitor their offspring will have adolescents who show greater declines in effortful control. With this socialization process, parents' use of behavioral regulation engenders an equivalent level of self-regulatory skills in the child. Alternatively, it is possible that the more parents monitor their offspring, the less the child will learn to behaviorally control themselves because their parents do it for them. In this case, greater increases in parental monitoring will lead to no change (or decreases) in the adolescent's effortful control over time, and vice versa.

Social influence systems.

Given the influential nature of peers and siblings on those around them and the increased prevalence of deviant behavior during adolescence (Moffitt, 1993), we can ask whether having peers and siblings who engage in delinquent behaviors is associated with the development of effortful control across adolescence. Peers play a powerful role in adolescent development, particularly as children branch out from their families and spend more time with friends outside the home. A large body of work has demonstrated that adolescents with more deviant peers tend to have lower levels of concurrent effortful control (Garnder, Dishion, & Connell, 2008; McGloin, & Shermer, 2009; Pokhrel, Herzog, Sun, Rohrback, & Sussman, 2013; Dyson, Robertson, & Wong, 2015; Kuhn & Laird, 2013; Bao, Li, Zhang, & Wang, 2015; Chapple, 2005; Meldrum & Hay, 2012), which continues into early adulthood (Boman & Gibson, 2011). This relation holds across various measures of effortful control (i.e., self-report, parent-report, teacher-report; Garnder, Dishion, & Connell, 2008; Chapple, 2005) and peer deviance (i.e., direct and indirect measures; Boman & Gibson, 2011). However, we know of no work testing whether peer deviance is associated with *changes* in effortful control.

Although we would expect a similar direction of the association between sibling deviance and effortful control (i.e., children who have more deviant siblings will be lower on effortful control than children who have less deviant siblings), there is very little cross-sectional (or longitudinal) work on this topic. Past research suggests that having older siblings who engage in deviant behavior (i.e., getting in physical fights, selling drugs) is associated with increased younger sibling deviant behavior (Low, Shortt, & Snyder, 2012). Although deviant behavior is rooted, at least partially, in poor impulse control, it is unclear whether sibling deviance plays any role in influencing effortful control development specifically.

Community systems.

The neighborhoods children grow up in, and the schools they attend, reinforce societal standards, norms, expectations, and disparities. Moreover, the composition of the neighborhood and school contexts likely have cascading effects on more proximal systems, such as peer groups and family dynamics, which could subsequently lead to changes in effortful control as a result. Indeed, psychologists have long theorized about the role communities play in the development of criminality and other adolescent outcomes (e.g., Gottfredson & Hirschi, 1990; Leventhal, & Brooks-Gunn, 2000; Mayer & Jencks, 1989; Wikstrom & Sampson, 2003), yet there is virtually no research examining the influence of community factors on the development of effortful control.

Researchers have found a concurrent association between neighborhood resources (low parental education and employment, lack of neighborhood housing and play areas) and effortful control, in that having more neighborhood resources was related to higher child effortful control at age 7 (Wang et al., 2017). Additionally, a longitudinal study of low-income Black and Latino/a children showed that moving out of low poverty neighborhoods and into high poverty neighborhoods was associated with fewer gains in self-regulation by 5th grade, while moving out of high poverty neighborhoods and into low poverty neighborhoods was associated with more gains in self-regulation by 5th grade (Roy, McCoy,

& Raver, 2014). With respect to school SES, one longitudinal study of low-income prekindergarten students demonstrated that having a higher percentage of affluent families at school was associated with improvements in executive function by the transition to kindergarten (Weiland & Yoshikawa, 2014). Another study following children across four waves, from kindergarten through first grade, found that the proportion of students at the school eligible for free and/or reduced lunch was associated with mother- and teacher-reports of child self-control, such that students from lower SES schools tended to have lower levels of self-control (Beaver, Wright, & Maume, 2008). Together, these findings suggest that lower neighborhood and school SES are associated with lower levels of effortful control concurrently and longitudinally, though the evidence remains weak and essentially nonexistent in adolescence.

Exposure to neighborhood and school violence may also be important antecedents for personality development. The little extant work on this topic yields mixed results. In a large group of Italian adolescents, exposure to neighborhood violence was concurrently negatively associated with effortful control (Esposito, Bacchini, Eisenberg, & Affuso, 2017). Additionally, exposure to neighborhood violence was negatively associated with performance on executive function tasks in a sample of African American and non-White Hispanic 10-year-olds (McCoy, Raver, & Sharkey, 2015). However, one longitudinal study found that the association between neighborhood violence and effortful control goes away when parenting effects are controlled for (Gibson, Sullivan, Jones, & Piquero, 2010), whereas another found a robust effect of neighborhood violence even after controlling for parenting (Pratt, Turner, & Piquero, 2004).

To our knowledge, no studies have examined the influence of school violence on effortful control development. It seems likely that the effect of school violence would be similar to the effect of neighborhood violence, but this remains an open question given the lack of relevant research.

Cultural systems.

The final and most distal system that may influence adolescent personality development is culture. The vast majority of the literature reviewed above examined the development of effortful control and its antecedents in samples of predominantly White, non-Latino youth. Thus, the present study is unique compared to previous research because we focus on an ethnic minority sample, Mexican-origin youth, to examine *both* general and culture-specific risk and protective factors for the development of effortful control.

For Mexican-origin individuals living in the United States, there are myriad cultural factors that may influence the development of temperamental factors, including nativity status, perceived ethnic discrimination, and Mexican cultural values (e.g. *familismo*, *respeto*). However, little work has investigated the association between these cultural factors and effortful control in Mexican-origin youth. Previous research has shown that more acculturated youth experience *more* behavioral problems than less acculturated youth, a pattern referred to as the *Immigrant Paradox* (Garcia-Coll & Marks, 2011; Marsiglia, Kulis, FitzHarris, & Becerra, 2009; Teruya & Bazargan-Hejazi, 2013; but see Chiswick & DebBurman, 2004; Landale, Oropesa, & Llanes, 1998). Given that behavioral problems are often indicative of poor effortful control, it is possible that there may be acculturation differences in self-regulatory traits, such that first-generation youth, and those who endorse more Mexican cultural values, will develop better effortful control than later-generation youth and those who endorse fewer Mexican cultural values.

Ethnic and racial minority youth in the United States face a number of challenges that majority youth do not (García Coll et al., 1996), most notably frequent and pervasive racial/ ethnic discrimination (Fisher, Wallace, & Fenton, 2000; Romero, Carvajal, Valle, & Orduna, 2007). García Coll et al.'s (1996) integrative model proposes that ethnic minority youth are at greater risk for negative developmental outcomes because of social stratification mechanisms such as racism, prejudice, and discrimination, which are linked to both physical and social segregation (e.g., peer exclusion). In a large, longitudinal sample of African American adolescents, perceived ethnic discrimination and self-control were significantly negatively associated at age 12 and 18, but not 16 (Gibbons, O'Hara, Stock, Gerrard, Weng, & Wills, 2012). Additionally, maternal perceived ethnic discrimination was unrelated to child effortful control at age four in a sample of Mexican-origin families (Derlan, Umana-Taylor, Jahromi, & Updegraff, 2018). To the best of our knowledge, no studies have examined how the experience of discrimination relates to changes in effortful control across time. Overall, the dearth of research investigating the role of cultural factors in the development of effortful control highlights the importance of the present research.

The Present Study

In the present study, we used longitudinal data from age 10 to 19 (five waves of data) to examine developmental antecedents of stability and change in effortful control (measured via a composite of self- and parent-reports). Specifically, we addressed three main research questions:

1. What is the rank-order stability and mean-level change in effortful control (and each of its facets) from late childhood to young adulthood?
2. Which antecedent factors from multiple levels of analysis (i.e., individual, family, social influence, community, cultural) are associated with the development of effortful control?
3. Do the three facets of effortful control have different antecedent factors?

This research is largely exploratory, although we have noted above the direction of certain expected associations. Given the dearth of research on the development of effortful control after childhood, the present study is well suited to provide an important contribution to the literature. First, we used longitudinal data from age 10 to 19 (five assessments), which spans three developmental periods: late childhood, adolescence, and young adulthood. Thus, if the *disruption hypothesis* is a true developmental phenomenon that occurs during adolescence, we have closely spaced assessments across the periods in which this pattern of personality development should emerge. Second, we were also able to examine the facets of effortful control (activation control, inhibitory control, attention control) to determine whether these different aspects of self-regulation change in the same way across this period. Third, we were able to systematically investigate antecedent factors across multiple levels of analysis (i.e., individual, family, social, community, and cultural), which allows us to take a more holistic view of development and consider multiple etiological pathways to effortful control stability and change. Fourth, we utilized multi-method data for effortful control (self- and parent-reports), as well as multi-method data for many of our antecedent factors, including parent-reports, spouse-reports, behavioral coding, school records, and census data. Fifth, we had multi-wave assessments for many of the antecedent factors, which allowed us to account for change in the antecedents and examine co-development with effortful control. Last, we focused on an understudied and underrepresented ethnic minority group, Mexican-origin youth, which allowed us to extend previous research beyond the White, non-Latino samples prevalent in the literature.

Method

Participants and Procedures

Data for the study came from the California Families Project, a longitudinal study of Mexican-origin youth and their parents ($N = 674$) designed to examine risk and protective factors for drug use and other behavioral problems.[1] Children were drawn at random from rosters of students from the Sacramento and Woodland, CA, school districts. The focal child had to be in the 5th grade, of Mexican origin, and living with his or her biological mother, in order to be eligible to participate in the study. 72.6% of the eligible families agreed to participate in the study, which was granted approval by the University of California, Davis Institutional Review Board (Protocol # 217484–21). The children (50% female) were interviewed, by trained staff members, in their homes in Spanish or English, depending on their preference.

The present study uses data from when the children were 10.8, 12.8, 14.7, 16.8, and 19.8 years old (on average), the years when effortful control was assessed. Family-level retention rates (relative to the original sample of 674) were 86% at age 12, 91% at age 14, 90% at age 16, and 92% at age 19. To investigate the potential impact of attrition, we compared individuals who did and did not participate in the age 19 assessment on study variables assessed at age 10. No significant differences were found in effortful control, $p = .13$, or any of the other antecedent factors except that individuals who dropped out of the study at age 19 were more likely to be male ($p = .03$), had lower family socioeconomic status at age 10 ($p = .03$), had lower fluid and verbal IQ at age 10 ($p = .02$ and $p = .003$, respectively), and attended less violent schools at age 10 ($p=.04$). Below we provide details about all of the measures used in the current study. For all of the antecedent measures, when there was multi-wave assessments completed, we utilized the data available at the same ages as when effortful control was assessed (age 10, 12, 14, 16, 19). Further, for all measures, we used

[1]Seven papers from the California Families Project have examined effortful control (Atherton, Conger, Ferrer, & Robins, 2016; Atherton, Lawson, et al., in press; Atherton, Tackett, Ferrer, & Robins, 2017; Atherton, Zheng, et al., in press; Clark, Donnellan, Conger, & Robins, 2015; Robins, Donnellan, Widaman, & Conger, 2010; Taylor, Widaman, & Robins, in press). None examined the relation between any of the antecedent factors used in the present study and effortful control, with one exception. Atherton, Zheng, et al. (in press) examined concurrent correlations between school violence and effortful control at ages 10, 12, 14, and 16. However, in the present study, we examine the co-development of change over time in school violence with change over time in effortful control from age 10 to 19. For a full list of California Families Project publications, see: https://osf.io/rn34p/.

multi-method data when it was available. See Table 1 for a general overview of the methods and assessment years used for each construct.

Measures

Effortful control.—Children and their mothers completed the Effortful Control scale (16 items) from the short form of the *Early Adolescent Temperament Questionnaire—Revised* when the child was 10, 12, 14, and 16 years old (*EATQ-R*; Ellis & Rothbart, 2001). Six of the EATQ-R items were not appropriate for young adults. Thus, at the age 19 assessment, the child and the mother completed a modified version of the Effortful Control scale (18 items total), which included 10 of the original items from the EATQ-R and 8 new items from the *Adult Temperament Questionnaire* (*ATQ*; Evans & Rothbart, 2007).[2] See Appendix A for a list of items used at each assessment. The EATQ-R and ATQ Effortful Control scales assess various aspects of self-control including the capacity to anticipate and suppress inappropriate responses; the capacity to focus attention and shift attention when desired; and the capacity to perform an action when there is a strong tendency to avoid it. This scale includes items such as, *"When someone tells [you/your child] to stop doing something, it is easy for [you/your child] to stop."* and *"[You/your child] pay close attention when someone tells [you/your child] how to do something."* Ratings were made on a 4-point scale ranging from 1 (*not at all true of you/your child*) to 4 (*very true of you/your child*). Child- and mother-reports of effortful control correlated between .40 and .45 across ages. Therefore, we computed a multi-method latent factor of 'effortful control' using four indicators, which were computed by creating domain-representative parcels of randomly selected items and then averaging across child and mom reports of those items. The loadings of the indicators ranged from .71 to .83 across waves.

In addition to the broad 'effortful control' scale, we also computed three facet scales: 'inhibitory control' (the capacity to plan and to suppress inappropriate responses), 'attention control' (the capacity to focus attention as well as to shift attention when desired), and 'activation control' (the capacity to perform an action when there is a strong tendency to avoid it). Each facet scale had four indicators, based on parcels of randomly selected items within rater and then averaging the same-item parcels across raters. Omega reliabilities are shown in Table 1 for effortful control (and facets) and all subsequent latent variables.

Individual factors.

Gender.: The child reported on his/her gender (0 =male, 1=female).

IQ.: At age 10, the child took the Woodcock-Johnson III Test (Woodcock, Mather, & McGrew, 2001), a widely-used cognitive abilities measure that assesses one's general knowledge, language, and reasoning, as well as memory, spatial, sequencing, and problem-solving skills. From this test, each child receives a verbal and fluid IQ score. For the present sample, the average verbal IQ score was 90.85 (*SD*=13.22) and the average fluid IQ score was 94.81 (*SD*=14.36) at age 10.

[2]When selecting ATQ items for the age 19 assessment, we attempted to (a) maximize content overlap with the EATQ-R items that were removed and (b) maintain an equal number of items per facet.

Familial factors.

Family socioeconomic status.: At the age 10 assessment, mothers reported their own and their child's biological fathers' total years of education. A parent education variable was created by averaging the mother's and father's education level (for single-parent families, we used the mother's education level). The resulting variable ranged from 0 to 19 years (*M*=9.3, *SD*=3.3). 63% of mothers and 65% of fathers had less than a high school education.

Total annual household income was reported by the mothers at the age 10, 12, 14, and 16 assessments using a 20-point ordinal response scale, with response options increasing in $5,000 increments (1="Less than $5,000", 2="$5,000-$10,000, …, up to 20="95,000 or more"). We recoded this response scale into dollar values by taking the midpoint dollar range for each response option (1="$2,500", 2="$7,500", …, up to 20= "$100,000") (*M* = $35,000 at age 10). We divided total household income by household size at each assessment to compute per capita income. Socioeconomic status (SES) was computed as a standardized composite of parent education level and per capita income (*rs* = .34 to .39 across waves).

Parenting practices.: We assessed three different domains of mother and father parenting practices (warmth, hostility, and monitoring) using a multi-method composite of child-reports, parent-reports, and observational data.[3] The child and parents reported on parenting using the Behavioral Affective Rating Scale (BARS; Conger, 1989a), the Iowa Parenting Scale (IPS; Conger, 1989b), and the Parental Monitoring of Child Scale (PMC; Small & Kerns, 1993). Observational data come from videotaped interactions when the child was 10 and 12 years old. Dyads of mom-child and dad-child (if two-parent families) were instructed to discuss their life together with the aid of cue cards asking relevant questions. The 20-minute interactions were videotaped while the interviewer was in another room.

The videotapes were then rated by trained coders using the Iowa Family Interaction Rating Scales (IFIRS; Melby et al., 1998). The IFIRS is an observational coding system designed to measure behavioral and emotional characteristics of individuals, the nature of behavioral exchanges from one family member to another, and attributes regarding overall family processes such as parenting. Approximately 20–25% of the coding was completed by a second coder to test for reliability. One family member was coded at a time. Videos were randomly assigned to coders, with the only constraint that for each parent-child dyad the child was rated by a different coder than the parent. Coders rated the degree to which the focal parent: (a) expressed liking, appreciation, praise, care, concern, or support for the child during the interaction task (*parental warmth*); (b) displayed hostile, angry, critical, or disapproving behavior toward the child during the interaction task (*parental hostility*); and (c) displayed knowledge of and pursued information about the child's life and daily activities during the interaction task (*parental monitoring*).

Warmth.: To assess parental warmth, we created a multi-method latent composite using 9 items from the BARS (4-point Likert), 9 items from the IPS (4-point Likert), and

[3]We used a parenting measure combining assessments of mothers and fathers. In the father's absence, the latent parenting composites are comprised of mothers' parenting only.

observational data from the interaction tasks (9-point Likert). For the BARS and IPS, we used child reports of the mother's and father's warmth, as well as spousal reports of warmth (i.e., mother's reports of father's warmth, and vice versa). The intra-class correlation between coders of the observational data was .80 for maternal warmth and .66 for paternal warmth. These aforementioned measures assess various aspects of warm parenting including how often the parent displays affection, uses positive reinforcement and inductive reasoning, and praises or shows concern for the child. We created a multi-method latent factor of overall 'parental warmth' when the child was 10, 12, 14, and 16 years old. Each latent factor had three indicators, which were created by averaging across informants (i.e. child, and spouses) and across methods (i.e. BARS, IPS, and observational data) to remove the influence of shared method variance.

Hostility.: To assess parental hostility, we created a multi-method latent composite using 13 items from the BARS (4-point Likert) and observational data from the interaction tasks (9-point Likert). For the BARS we used child reports of the mother's and father's hostility, as well as spousal reports of hostility (i.e., mother's reports of father's hostility, and vice versa). The intra-class correlation between coders of the observational data was .86 for maternal hostility and .85 for paternal hostility. These measures assess various aspects of hostile parenting including the frequency of hostile behavior toward the child, for example by insulting or swearing at the child or by ignoring the child when the child tries to talk to the parent. We created a multi-method latent factor of overall 'parental hostility' when the child was 10, 12, 14, and 16 years old. Each latent factor had three indicators, which were created by averaging across informants (i.e. child and spouses) and across methods (i.e. BARS and observational data) to remove the influence of shared method variance.

Monitoring.: To assess parental monitoring, we created a multi-method latent composite using 14 items from the PMC (4-point Likert) and observational data from the interaction tasks (9-point Likert). For the PMC, we used child reports of the mother's and father's monitoring, as well as mother and father self-reports and spousal reports of monitoring (i.e., mother's reports of father's monitoring, and vice versa). The intra-class correlation between coders of the observational data was .68 for maternal monitoring and .67 for paternal monitoring. These measures assess the extent to which the parents monitor and have knowledge of their child's whereabouts. We created a multi-method latent factor of overall 'parental monitoring' when the child was 10, 12, 14, and 16 years old. Each latent factor had three parcel indicators, which were created by averaging across informants (child, parents, spouses) and across methods (PMC and observational data) to remove the influence of shared method variance.

Social influence factors.

Peer and sibling deviance.: The child reported on 23-items about their peers' and siblings' deviance at ages 10, 12, 14, and 16. The scale, which was adapted from the Delinquent Behavior Scale, the Self-Report Delinquency Scale, and the Gang Membership Inventory (Elliott, 1990; Rochester Youth Development Study, 1988; Pillen & Hoewing-Roberson, 1992), includes a wide range of antisocial behaviors. Although the item content was the same for the peer and sibling scales, the wording of the items and the response options were slightly different.

For the peer deviance scale, participants indicated the proportion of their peers that were engaged in antisocial activities, using a 5-point Likert scale ranging from 1 (*none of them*) to 5 (*all of them*). Example items include, "*How many of your friends, hit or threatened to hit someone?*" and "*How many of your friends have suggested that you should sell drugs?*". For the sibling deviance scale, participants reported whether their older sibling(s) did ("1") or did not ("0") perform each antisocial act (e.g., "*In the past 3 months, did your sibling(s) hit or threaten to hit someone?*" and "*In the past 3 months, did your sibling(s) sell drugs?*"). Of the 674 children, 213 had one older sibling and 193 had more than one older sibling. For both scales, we created latent factors to represent 'peer deviance' and 'sibling deviance' at ages 10, 12, 14, and 16. Each latent factor had four indicators, with each indicator comprised of five or six randomly selected items.

Community factors.

Neighborhood socioeconomic status.: Block-group level data from the 2000 U.S. Census were used to assess median family income (M=.23, SD=.09, range = .00 to 1.00) and the percentage of households on public assistance (M=12.1%, SD=9.7%), based on family addresses at the first assessment. Given the strong correlation between these variables (r = −.75), we computed a standardized composite (public assistance reverse scored) representing neighborhood socioeconomic status.

School socioeconomic status.: We utilized school records to estimate school-level socioeconomic status at age 10 based on the percentage of students at each school eligible for free or reduced price meals (M = 76%, SD = 20%). To facilitate interpretation, we reverse-coded the variable so that higher values indicate higher school socioeconomic status.

Neighborhood violence.: The child and mother reported on neighborhood-level violence behavior at ages 10, 12, 14 and 16 using the Neighborhood Criminal Events Scale, which consists of 10 items. Additionally, the child reported on neighborhood-level violence at age 19 using a subset of the original items (5 items total; see https://osf.io/tcdy7/). These items assess the extent to which there is violence and disorder in the neighborhood (Anashensel & Sucoff, 1996; Bowen & Chapman, 1996; Cutrona et al., 2000; Ross & Jang, 2000; Sampson, Raudenbush, & Earls, 1997). The scale includes items such as, "*How often did [violent crimes including stabbings, shootings, and violent assaults] happen in your neighborhood in the past year?*" and "*How often did [kids sell illegal drugs] in your neighborhood in the past year?*" Ratings were made on a 4-point scale ranging from 1 (*almost never or never*) to 4 (*almost always to always*). We computed parcels from a randomly selected set of items as parcels that were averaged across child- and mother-reports (child-reports only for the age 19 assessment). The resulting latent factor of 'neighborhood violence' had three indicators. The loadings of the indicators ranged from .74 to .93 across waves.

School violence.: The child reported on school-level violence at ages 10, 12, 14 and 16 using an adapted version of the Neighborhood Criminal Events Scale, which consists of 10 items (9 items only at age 10) that assess the extent to which there is violence and disorder in the school context (Anashensel & Sucoff, 1996; Bowen & Chapman, 1996; Cutrona et al., 2000; Ross & Jang, 2000; Sampson, Raudenbush, & Earls, 1997). The scale includes items such as, "*How often did [violent crimes including stabbings, shootings, and violent assaults] happen in your school in the past year?*" and "*How often did [kids sell illegal drugs] in your school in the past year?*" Ratings were made on a 4-point scale ranging from 1 (*almost never or never*) to 4 (*almost always to always*). We computed a latent factor of 'school violence' using three indicators, which were comprised of randomly selected items as parcels. The loadings of the indicators ranged from .68 to .95 across waves.

Cultural factors.

Nativity status.: Participants were categorized as 1st generation if their birth country was Mexico (29%); as 2nd generation if their birth country was the U.S., and only one of their parents was reported as being born in the U.S. (62%); and as 3rd generation if their birth country and both parents were born in the U.S. (9%). Because of the low percentage of 3rd generation youth, we created a dichotomous nativity status variable comparing 1st generation (born in Mexico) to 2nd+ generation (born in U.S.) youth in all analyses.

Perceived ethnic discrimination.: The child reported on his/her perceived personal experiences with ethnic discrimination at ages 10, 12, 14, and 16 using four items, which were adapted for use in the La Familia Project (Johnston & Delgado, 2004) from questions on the Racism in the Workplace Scale (Hughes & Dodge, 1997) and Schedule of Sexist Events (Klonoff & Landrine, 1995). At the age 19 assessment, many of the original items were not age-appropriate for young adults; and therefore, we administered an instrument to assess perceptions of ethnic discrimination for adults based on items adapted from Hughes and Dodge (1997), James, Lovato, and Cropanzano (1994), and the University of Michigan's National Study of American Lives. The age 19 discrimination measure had ten items total. A summary of the items assessed at each wave can be found here: https://osf.io/tcdy7/. Ratings were made on a 4-point Likert scale, ranging from 1 (*Almost never or never*) to 4 (*Almost always or always*). We computed a latent factor of 'ethnic discrimination' using each of the items as an indicator on the factor at ages 10 through 16. We used three parcels of 2–3 randomly selected items on the ethnic discrimination factor at the age 19 assessment. The loadings of the indicators ranged from .36 to .91 across waves.

Mexican cultural values.: At ages 10, 12, 14, 16, and 19, the child completed the Mexican American Cultural Values Scale (MACVS; Knight et al., 2010). The MACVS was developed through focus groups of immigrant and U.S. born Mexican-origin adolescents and adults who identified values that they ascribed to Mexican and American culture. In the present study, we focused on the MACVS scales related to traditional family values, given that they have been implicated as a key cultural domain in the literature (Stein et al., 2014; Knight et al., 2010). These scales are comprised of three domains of familism values (i.e., support, obligations, and family as a referent; 16 items) and respect for parents and elders (i.e., respeto, 8 items). The respeto items were not administered at the age 19 assessment (thus, there were only 16 items at the last wave instead of 24 items). Sample items include, "*Children should always do things to make their parents happy*" and "*Children should* *respect adult relatives as if they were parents*". Response options ranged from 1 (*Not at all*) to 4 (*Very much*) for all scales. We computed a latent factor of 'Mexican cultural values' using four indicators (three indicators at the age 19 assessment), which were computed by creating parcels of randomly selected items. We created an overall Mexican cultural values construct because the familism values and respeto subscales were highly correlated across waves (*r*s=.60-.70). The loadings of the indicators ranged from .65 to .95 across waves.

Statistical Analyses

All analyses were conducted using M*plus* Version 7 (Muthén & Muthén, 1998–2011). We used a robust maximum likelihood estimator (MLR) to account for non-normal distributions of observed variables and full information maximum likelihood procedure (FIML) to account for missing data (Allison, 2003; Schafer & Graham, 2002). We used item parcels as indicators for the latent variables because they typically produce more stable solutions, are less likely to share specific sources of variance, and reduce the likelihood of spurious correlations (Little, Cunningham, Shahar & Widaman, 2002; Little, Rhemtulla, Gibson, & Schoemann, 2013). For all latent variables, we randomly assigned items to parcels, given that random parceling has been shown to be appropriate when sampling error is low (Sterba & MacCallum, 2010). Additionally, for multidimensional constructs (i.e., effortful control), we used a domain-representative approach to parceling (including items from each facet of the broader domain on all parcels) because parameter estimates are more stable and acceptable when using this method to distribute items to the parcels, compared to parceling based on the homogeneous facets (Kishton & Widaman, 1994; Little, Cunningham, Shahar & Widaman, 2002). For all analyses, we assessed adequate model fit via change in chi-square and degrees of freedom, change in comparative fit index (ΔCFI) less than or equal to .01, change in McDonald's non-centrality index (ΔNCI) less than or equal to .02 (Cheung & Rensvold, 2002; Meade, Johnson, & Braddy, 2008).We also note the CFI values (for which adequate fit is indicted by values greater than .95), and the root-mean-square error of approximation (RMSEA) (for which adequate fit is indicated by values less than or equal to .06) (Hu & Bentler, 1998; Hu & Bentler, 1999).

Longitudinal Measurement Invariance

We conducted longitudinal measurement invariance tests of effortful control and the antecedent factors, in order to examine whether these constructs were the same over time.[4] To evaluate measurement invariance over time, we compared three measurement models: (1) freely estimating the factor loadings for the latent factors at each age of assessment (i.e., configural invariance); (2) constraining the respective factor loadings to be equal at each age of assessment (i.e., weak invariance); and (3) constraining the factor loadings and intercepts to be equal at each age of assessment (i.e., strong invariance). If the more constrained models do not fit worse than the lesser constrained models, then we can conclude that the structure of the latent constructs is the same over time. When the strong invariance model fit significantly worse than the weak invariance model, we compared a "partial" strong

[4]We used observed variables, instead of latent variables, for family SES and school SES.

invariance model with the weak invariance model, given that it is best to retain a strong invariant model whenever possible (Widaman, Ferrer, & Conger, 2010).

Stability and Change in Effortful Control

Rank-order stability.—In order to understand the degree to which individuals maintained their relative ordering over time, we estimated the rank-order stability of effortful control (and its facets) by specifying correlations between all time-points in the latent variable measurement models.

Mean-level change.—We used second-order, univariate latent growth curve (LGC) models to examine change over time in effortful control (and its facets). LGC models describe the average initial level (intercept) and growth over time (slope) of a construct, as well as how much variability there is in the intercept and slope. To find the best-fitting growth trajectory, we conducted a series of model comparisons and evaluated changes in model fit indices. Specifically, we compared three models: (1) no growth model, where the slope is fixed to be zero over time; (2) linear growth model, where the slope linearly increases by two (or three) units over time, with the first time point centered at ‘0’, the second time point fixed at ‘2’,…, and the last time point is fixed at ‘9’; and (3) a latent basis model, where the first and last time points of the slope are fixed (at ‘0’ and ‘9’, respectively) and the middle time points are freely estimated to the data. In all models, path coefficients from the intercept to the repeated assessments are fixed to 1, and the intercept and slope are allowed to covary.

Antecedents to Effortful Control Development

Multiple-group analyses.—To examine gender and nativity status differences in the change over time in effortful control, we conducted multiple group LGC analyses. For both gender and nativity status, we began with univariate growth models where all parameters were constrained to equality across groups (i.e., boys vs. girls; Mexico-born vs. U.S.-born). Then, we removed the constraints for two parameters and examined changes in the chi-square, degrees of freedom, and alternative fit indices. Specifically, we examined whether the groups differed in: (1) their average rate of change from age 10 to 19 (i.e., the mean of the slopes); and (2) the age-to-age growth over time for latent basis models, if applicable (i.e., the slope coefficients). If freely estimating the parameter did not significantly change the fit of the model, we retained the constraints and continued to build the model with the remaining parameters.[5]

Conditional LGC analyses.—To examine the association between antecedents assessed at only one time point (i.e., fluid and verbal IQ, school SES, and neighborhood SES) and the development of effortful control, we conducted conditional LGC models. In these models, the antecedent is entered into the model as a predictor of the level and slope of effortful control.

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[5]It is not possible to examine differences between groups in the level of effortful control at age 10 in second-order latent growth curve models. The level has to be fixed to zero in second-order models, in order for the model to be identified.

Bivariate LGC analyses.—To examine the associations between antecedents assessed at multiple time points (i.e., family SES, parenting practices, peer and sibling deviance, school and neighborhood violence, perceived discrimination, and Mexican cultural values) and change over time in effortful control, we conducted bivariate LGC models. Prior to implementing the bivariate models, we first conducted univariate LGC analyses with each of the multi-wave constructs using the same model comparison process as noted above (i.e., no change, linear change, latent basis change), in order to find the best-fitting trajectory of change for each antecedent. Then, we conducted bivariate LGC models by specifying correlations among the levels, slopes, and level-to-slopes of the antecedent trajectory and the effortful control trajectory.

Results

Table 1 shows a summary of the measurement methods (e.g., child-report, mother-report, etc.) and assessments, the omega reliabilities of the latent factors, the longitudinal measurement invariance model that was retained for each construct, and the univariate trajectories for all constructs. Table S1 (supplemental material) shows the descriptive statistics (i.e., means, standard deviations) of the observed variables. Tables S2 and S3 (supplemental material) show all model comparisons from the tests of longitudinal measurement invariance for all study constructs.

Stability and Change in Effortful Control from Late Childhood to Young Adulthood

Rank-order stability.—Table 2 shows the test-retest correlations of effortful control (and facets) from late childhood to young adulthood. The two- and three-year correlations suggest that effortful control (.64 to .73), inhibitory control (.69 to .89), activation control (.65 to .79), and attention control (.74 to .88) were all moderately-to-highly stable during this developmental period. Similarly, the test-retest correlation across the entire period from age 10 to 19 was also moderately high for effortful control (.41), inhibitory control (.59), activation control (.57), and attention control (.59).[6]

Mean-level change.—Table S4 (supplemental material) shows the model comparisons of the univariate LGC analyses for effortful control (and facets). Figure 1 shows the best-fitting trajectories for effortful control (and facets) from age 10 to 19. On average, effortful control shows a slight decline from age to 10 to 14 and then rapidly increases from age 16 to 19, consistent with the idea of a self-regulatory dip. The activation control facet mirrors the overall trend for effortful control, but shows a much larger decline from age 10 to 14, before increasing from age 14 to 19.[7] Youths inhibitory control increases linearly from age 10 to 19, whereas attention control decreases linearly from age 10 to 19, on average. These

[6]When we use only the effortful control items that are consistent across all assessments, the rank-order stability of effortful control from age 10 to 19 was similar (.40) to when we used the modified/added items at age 19.

[7]The latent basis models for overall effortful control and activation control suggest a quadratic pattern. Thus, we also tested a model with a quadratic slope factor. The means and variances of the quadratic slope factor were statistically significant for both overall effortful control and activation control. The fit differences between the latent basis and quadratic models were minimal; thus, we decided to retain the latent basis model for parsimony and to more accurately represent the precise shape of the non-linear slope observed in the present study.

divergent trajectories highlight the importance of examining facet-level change in effortful control.

Antecedents of Effortful Control Development

Tables S5–S8 (supplemental material) show the model comparisons for the univariate trajectories of the antecedent factors that have multi-wave data. Table 3 shows a summary of the findings from the conditional and bivariate LGC models with effortful control (measured via self- and parent-reports).[8]

Individual factors.

Gender.: To examine whether boys and girls show different developmental trajectories of effortful control from age 10 to 19, we conducted multiple-group LGC models and removed equality constraints across boys and girls for the average rate of change (mean of the slope), variability in change (variance of slope), and age-to-age rate of change (slope coefficients). Freely estimating these parameters across groups did not significantly improve model fit, which suggests that the trajectory of effortful control does not significantly differ for boys and girls (see Table 4 for model comparisons).

Fluid and verbal IQ.: Findings from the conditional LGC models show that fluid and verbal IQ were both significantly positively correlated with the level of effortful control at age 10 ($r = .24$, $p < .001$ and $r = .23$, $p < .001$, respectively). However, fluid and verbal IQ at age 10 did not predict the slope of effortful control from age 10 to 19 ($r = -.02$, $p = .74$ and $r = -.09$, $p = .12$, respectively).

Familial factors.

Family socioeconomic status.: Results from the bivariate LGC models showed that there was a significant concurrent association between family socioeconomic status at age 10 and effortful control at age 10, in that youth whose families had higher socioeconomic statuses were more likely to be higher in effortful control ($r = .14$, $p =.002$). However, no other significant associations emerged between the slopes or level-slopes of family socioeconomic status and effortful control.

Parenting practices.: Results from the bivariate LGC models demonstrated that there were significant concurrent correlations between all forms of parenting practices and effortful control at age 10. Parental warmth and monitoring were positively associated with effortful control at age 10 ($r = .48$, $p = .01$ and $r = .50$, $p < .001$, respectively), whereas parental hostility was negatively associated with effortful control at age 10 ($r = -.60$, $p < .001$). However, the correlations between the slopes of parenting practices (warmth, hostility, monitoring) and effortful control were non-significant ($r = -.10$, $p = .24$ for warmth, $r = -.14$, $p = .11$ for hostility, and $r = .02$, $p = .80$ for monitoring).

[8] All of the results remain statistically significant when we trim outliers that were +/− 3 SD away from the mean of the level and the slope factors.

In terms of the correlations between the level of parenting practices and slope of effortful control (and vice versa), we found two significant associations. First, parental hostility and parental monitoring at age 10 predicted the slope of effortful control from age 10 to 19 ($r = .29$, $p < .001$ and $r = -.15$, $p = .03$, respectively). Specifically, youth who have more harsh and hostile parents (and less monitoring) at age 10 show a slightly larger dip in effortful in adolescence, before increasing from age 16 to 19. However, their effortful control trajectory is much lower, on average, than youth who do not have harsh and hostile parents (or parents who have more monitoring practices) at age 10 (e.g., see Figures B-1 and B-2 for parental hostility and monitoring, respectively). Second, the level of effortful control at age 10 predicted the slope of parental monitoring from age 10 to 16 ($r = .14$, $p = .04$). Specifically, youth who are low in effortful control at age 10 have parents who show greater *decreases* in parental monitoring from age 10 to 16 (see Figure B-3), suggesting as impulsive youth enter the teen years parents are increasingly giving up on attempts to monitor their behavior.

Social influence factors.

Peer and sibling deviance.: Results from the bivariate LGC models demonstrated that there were significant negative concurrent associations between peer deviance and effortful control ($r = -.39$, $p < .001$) and sibling deviance and effortful control at age 10 ($r = -.26$, $p < .001$). However, the correlations between the slopes of peer and sibling deviance and effortful control were non-significant ($r = .001$, $p = .99$ for peer deviance, and $r = -.17$, $p = .21$ for sibling deviance). There were significant level-slope correlations between peer deviance and effortful control. Specifically, peer deviance at age 10 predicted the slope of effortful control from age 10 to 19 ($r = .22$, $p = .004$), in that youth who had more deviant peers at age 10 had a more pronounced dip in adolescence and a lower overall trajectory for effortful control than youth who did not have as many deviant peers at age 10 (e.g., see Figure B-4). Further, effortful control at age 10 predicted the slope of peer deviance ($r = -.24$, $p < .001$), in that youth who were lower on effortful control at age 10 showed higher trajectories of and greater increases in deviant peer associations from age 10 to 16, when compared to youth who were higher on effortful control at age 10 (see Figure B-5). The level-slope correlations between sibling deviance and effortful control were weaker in terms of statistical significance; though, the direction of the effects paralleled what was found with peer deviance. Specifically, youth who had more deviant siblings at age 10 showed a slightly more pronounced dip in adolescence and a lower overall trajectory for effortful control than youth who did not have as many deviant siblings at age 10 ($r = .20$, $p = .05$). Effortful control at age 10 did not predict the slope of sibling deviance ($r = -.11$, $p = .32$).

Community factors.

Neighborhood socioeconomic status (SES).: Findings from the conditional LGC models show that neighborhood SES was significantly positively correlated with the level of effortful control at age 10 ($r = .11$, $p = .01$). However, neighborhood SES at age 10 did not predict the slope of effortful control from age 10 to 19 ($r = -.01$, $p = .93$).

School socioeconomic status.: Findings from the conditional LGC models demonstrated that there was a significant positive concurrent correlation between school SES and effortful control at age 10, in that youth who attended more affluent schools also had higher effortful control ($r = .14$, $p = .001$). However, school SES at age 10 was not significantly associated with the slope of effortful control ($r = -.05$, $p = .37$).

Neighborhood violence.: There was a significant negative concurrent association between neighborhood violence and effortful control ($r = -.24$, $p < .001$) at age 10. Further, there was a significant correlation between the slopes of neighborhood violence and effortful control ($r = -.24$, $p = .002$), in that greater *increases* in neighborhood violence were associated with greater *decreases* in effortful control from age 10 to 19 (see Figure S1). There were no significant correlations between the levels and slopes.

School violence.: Findings from the bivariate LGC models showed that there was a significant negative concurrent association between school violence and effortful control ($r = -.54$, $p < .001$) at age 10. However, the correlation between the slopes of school violence and effortful control was non-significant ($r = .01$, $p = .91$). School violence at age 10 predicted the slope of effortful control from age 10 to 19 ($r = .40$, $p < .001$), in that youth who attend schools with more violence at age 10 show a greater dip in effortful control in adolescence and have lower trajectories overall, when compared to youth who did not attend more violent schools at age 10 (see Figure B-6).

Cultural factors.

Nativity status.: Results from multiple-group LGC models showed that removing the equality constraints across Mexico-born and US-born youth for the average rate of change, variability in change, and age-to-age rate of change did not significantly improve model fit. Therefore, we concluded that the trajectory of effortful control does not significantly differ for Mexico-born and US-born youth in this sample (see Table 5 for model comparisons).

Perceived ethnic discrimination.: There was a significant negative concurrent association between perceived ethnic discrimination and effortful control at age 10 ($r = -.35$, $p < .001$). However, there was no significant association between the slopes of perceived discrimination and effortful control ($r = -.22$, $p = .09$). In terms of the level-slope correlations, perceived ethnic discrimination at age 10 predicted the slope of effortful control from age 10 to 19 ($r = .25$, $p = .02$), in that youth who perceived the highest levels of ethnic discrimination at age 10 had an overall lower effortful control trajectory from age 10 to 19, with a more exacerbated dip in adolescence, compared to youth who did not perceive as much ethnic discrimination (see Figure B-7). Additionally, the level of effortful control at age 10 significantly predicted the slope of perceived ethnic discrimination ($r = .23$, $p = .03$), in that youth who were higher on effortful control at age 10 had greater increases in personal experiences of discrimination from age 10 to 19, although their overall trajectory of discrimination was lower than youth who had low effortful control at age 10 (see Figure B-8).

Mexican cultural values.: There was a significant positive concurrent association between Mexican cultural values and effortful control at age 10 ($r = .27$, $p < .001$). However, no other significant associations emerged between the slopes ($r = .07$, $p = .47$), between the level of

Mexican cultural values and the slope of effortful control ($r = -.02$, $p = .79$), or between the level of effortful control and the slope of Mexican cultural values ($r = .14$, $p = .06$).

Facet-level results.: We conducted follow-up analyses to examine the results for each of the three facets of effortful control (i.e., inhibitory control, activation control, attention control). Tables 4 and 5 show the results from the multiple-group LGC models across gender and nativity status for all three facets. There were no gender differences in activation control and attention control trajectories; however, there was a significant gender difference in the inhibitory control trajectory, in that girls showed greater increases than boys in inhibitory control from age 10 to 19 (see Table 4). There were no nativity status differences in any of the facet trajectories (see Table 5).

Table 6 shows a summary of the bivariate LGC results for each of the three facets of effortful control (Tables S9–S11 in the Supplemental Material show the confidence intervals for all effects). In general, most of the concurrent correlations between the antecedent factors and effortful control replicated across all three facets. In terms of the slope-slope correlations, we found that the correlation between the slopes of neighborhood violence and overall effortful control was primarily driven by attention control (see Figure S2), in that greater increases in neighborhood violence were associated with greater decreases in attention control. In addition, several new slope-slope correlations emerged that were not evident with overall effortful control. First, greater increases in parental warmth were associated with greater decreases in activation control (see Figure S3). Second, greater increases in parental hostility were related to greater decreases in inhibitory control and attention control (see Figure S4). Third, greater increases in parental monitoring were associated with greater increases in inhibitory control and attention control (see Figure S5). Fourth, greater increases in Mexican cultural values were associated with greater increases in inhibitory control and attention control (see Figure S6). Last, greater increases in neighborhood violence and perceived discrimination were associated with greater decreases in attention control (see Figure S7).

In terms of the associations between the levels of the antecedents and the slopes of the facets, we found that the correlation between the level of parental hostility and the slope of overall effortful control was driven by the inhibitory control and attention control facets (see Figure B-9). The correlation between the level of peer deviance and the slope of overall effortful control was primarily driven by inhibitory control (see Figure B-10). The correlation between the level of parental monitoring and the slope of overall effortful control was driven by attention control (see Figure B-11). Contrary to the findings for overall effortful control, the levels of family SES and parental warmth at age 10 were associated with the slope of attention control (see Figure B-12).

Last, in terms of the associations between the level of effortful control at age 10 and the slopes of the antecedents, we found that the correlation between the level of effortful control and the slope of peer deviance was primarily driven by activation control (see Figure B-13). Additionally, the correlation between the level of effortful control and the slope of perceived ethnic discrimination was driven by inhibitory control and attention control (see Figure B-14). We also found that the levels of all three facets at age 10 were associated with the slope of parental hostility (see Figure B-15), and the level of attention control at age 10 was associated with the slope of neighborhood violence (see Figure B-16).

In summary, the facet-level analyses show that there are nuanced associations between developmental precursors and the different components of effortful control. Overall, the facet-level results suggest that the antecedents have more longitudinal associations (i.e., significant slope-slope and level-slope correlations) with inhibitory control and attention control than with activation control.

Discussion

The present study used multi-method data from a longitudinal study of 674 Mexican-origin youth to investigate the developmental trajectory of effortful control from late childhood (age 10) to young adulthood (age 19), as well as the antecedents of change over time in effortful control (measured via a composite of self- and parent-reports). Specifically, we investigated *individual* (i.e., gender, IQ), *familial* (i.e., family SES, parenting practices), *social* (i.e., sibling and peer deviance), *school* (i.e., school SES and violence), *neighborhood* (i.e., neighborhood SES and violence), and *cultural* (i.e., nativity status, ethnic discrimination, familism) influences on the development of effortful control and its facets.

Broadly, our findings suggest that adolescence is a particularly difficult and vulnerable period, during which youth struggle with some aspects of effortful control. Moreover, there is a constellation of both general and culture-specific antecedents that exacerbate or mitigate the self-regulatory dip. Our results also support the idea that youth are not passively molded by risk and resilience factors, but rather they serve as active agents shaping their social contexts in important ways. Moreover, when investigating the facet-level trajectories and correlates, we found divergent growth patterns and a differential pattern of results, with most longitudinal associations evident for the inhibitory control and attention control facets but not activation control. Below we describe the findings in more detail, and discuss their broader theoretical and practical implications.

Effortful Control Shows a Temporary Dip in Adolescence, but Not All Facets Change in the Same Way

Previous research has found that the rank-order stability of effortful control across a 4–5 year span in adolescence ranges from .50 to .68 (Laceulle et al., 2012; Vijayakumar et al., 2014). In the present study, the two- and three-year rank-order stability of effortful control during the same developmental period ranged from .64 to .73. Given the shorter time interval between assessments in the present study, it is not surprising that the rank-order stability of effortful control is slightly higher than in previous research. The facets of effortful control were even more stable than the superordinate construct, with inhibitory control showing the highest (.69 to .89) and activation control showing the lowest (.65 to .79) rank-order stabilities. Thus, it appears that adolescents maintain their rank ordering to a greater extent on the conceptually homogeneous facets of inhibitory control, activation control, and attention control, compared to the broader and more heterogeneous construct of effortful control.

In terms of mean-level change, we found that the normative trajectory of effortful control decreases from age 10 to 14 before increasing from age 14 to 19, which is consistent with previous research suggesting that youth experience a temporary dip in broad self-regulatory traits during adolescence (Borghuis et al., 2017; De Fruyt et al., 2006; Klimstra et al., 2009; Leon-Carrion, Garcia-Orza, Perez-Santamaria, 2004; Soto et al., 2011; Soto & Tackett, 2015; Tackman, Srivastava, Pfeifer, & Dapretto, 2017; Van den Akker, Dekovic, Asscher, & Prinzie, 2014). Although effortful control showed a temporary dip during adolescence, there were significant individual differences in the degree to which participants followed this normative trajectory. That is, some youth showed particularly profound declines in effortful control, whereas others did not experience a “dip” at all, or increased over time. These individual differences imply that although many youth struggle with the developmental task of attaining personality maturity during adolescence, others experience few difficulties, and perhaps even thrive, during this period.

Effortful control is conceptualized within Rothbart’s temperament theory as comprised of three components – inhibitory control, attention control, and activation control – that are conceptually and empirically interrelated, but tap into at least partially distinct processes. The present study extended previous research by examining the developmental trajectories of these three facets. Interestingly, they showed divergent mean-level trends. Although activation control (motivating the self towards a goal when there are competing desires) showed the same trajectory as overall effortful control, but with a more pronounced dip, attention control linearly *decreased* from age 10 to 19 whereas inhibitory control (controlling one’s impulses in the face of temptations) linearly *increased* from age 10 to 19. As distinct processes, it is not surprising that the facets change at different rates from late childhood to young adulthood. Given that we know of no other research on how the facets of effortful control change over time, we review our findings in light of the literature on executive function, a construct that is most closely aligned with the inhibitory and attention control facets of effortful control.

The linear increases in inhibitory control found in the present study largely mirror research on the development of executive function across adolescence. Specifically, cognitive/behavioral task-based measures of executive function, including measures of inhibition, attention, and working memory, do *not* show a dip in adolescence, but rather show linear increases across adolescence before plateauing in young adulthood (Best & Miller, 2010; Boelema et al., 2014; Casey & Caudle, 2013; Friedman et al., 2016; Zelazo & Carlson, 2012). This is particularly noteworthy because often when researchers discuss the “dip” in self-regulation during adolescence, they argue that youth have trouble regulating their impulses, given the number of temptations that youth face in the form of risky behaviors (e.g., drug use, sexual behavior, delinquency). However, based on findings from the present study combined with the extant literature on executive function, youths’ capacities to regulate their dominant impulses actually improve, on average, over the course of adolescence. Thus, it may not be the case that inhibitory control (i.e., the capacity to regulate one’s impulses) is the aspect of self-regulation most affected during adolescence.

In contrast to inhibitory control, the present findings diverge from the literature on executive function for attention control. Specifically, we found linear *decreases* in attention control, indicating that youth seem to be struggling with focusing and shifting their attention from late childhood to young adulthood, whereas the executive function literature (which is largely cross-sectional) shows that attention control improves across adolescence (Best & Miller, 2010; Boelema et al., 2014; Casey & Caudle, 2013; Friedman et al., 2016; Zelazo & Carlson, 2012). Further research is needed to replicate the present findings and to determine why divergent trends may exist for attention control when using questionnaire versus cognitive task-based measures, and when using longitudinal versus cross-sectional data to examine attention control trajectories.

Interestingly, the present study showed that the activation control facet was primarily responsible for the “dip” in overall effortful control. Activation control (comprised of motivational and goal pursuit tendencies) is typically not measured by executive function tasks, and therefore, we know little about how motivational and goal pursuit tendencies change over the course of adolescence. It is possible that youth struggle with activation control because of the number of biological, social, and psychological changes that occur during this period (*disruption hypothesis*; Soto & Tackett, 2015), and the increasing number of demands placed on them by parents, teachers, and peers. For example, parents increasingly expect youth to manage their own schedules, do a wider range of chores, and help take care of younger siblings. In the school context, teachers demand more in terms of homework and academic rigor, students must learn to navigate multiple classroom settings, and the academic environment becomes increasingly competitive and consequential. Further, peer relationships become more psychologically complex, as youth organize into more distinct peer groups, begin romantic relationships, and struggle to balance their academic and social needs. With all of these new challenges, many youth may find that the self-regulatory strategies and skills that served them well in childhood fall short in the psychosocial labyrinth of early adolescence, leading to a temporary decline in motivational processes (i.e., activation control tendencies). Once youth learn how to deal with the increasing responsibilities and demands placed on them, their activation control capacities begin to improve in late adolescence and young adulthood. Future work should evaluate these various possibilities to better understand how and why the demands placed on youth lead many youth to struggle with initiating goal-directed behaviors following the transition into adolescence.

Moreover, with respect to activation control, it is not clear whether adolescents are having trouble setting goals for themselves, or pursuing the goals they have set. Given that goal pursuit is a crucial aspect of self-regulation, as well as a critical feature of effective personality and behavioral change (e.g., Hennecke, Bleidorn, Dennissen, & Wood, 2014), future research would benefit from more closely examining the role of self-regulatory goals in adolescent personality development. Further, it will be important for future work to determine how the capacity to manage conflicting goals in the school, peer, and relationship contexts is associated with the development of effortful control.

Taken together, the present findings add to the longstanding view that adolescence is a particularly sensitive period of development (Hall, 1904). Further supporting this view, recent research has documented increases in reward seeking (Casey & Caudle, 2013; Shulman, Harden, Chein, & Steinberg, 2014) and a dip in emotion differentiation (Nook et al., 2018) during adolescence, which suggests that adolescence may be uniquely consequential in terms of disruptions in personality development, when compared to other stages of development. Researchers should investigate how struggling with certain aspects of personality maturation during adolescence hinders youth from making a successful transition into young adulthood. It is possible that youth who experience a larger decline in attention and activation control during adolescence have more difficulty recovering and preparing to meet the demands of adult life, thus making the transition into adult social roles, such as starting a full-time job, getting married, and becoming a parent, all the more challenging. Future research should examine whether experiencing a greater disruption in personality maturity during adolescence has downstream consequences for the transition into young adulthood.

Antecedent Factors from Multiple Levels of Analysis are Associated with the Development of Effortful Control

By taking an ecological systems approach to understanding the development of effortful control (Bronfenbrenner, 1979), we gleaned several insights into how adolescents become increasingly better or worse at self-regulating. In terms of concurrent associations, we found that all of the antecedents we examined were significantly related to effortful control in the expected directions, replicating much of the previous cross-sectional research in this area. Although the concurrent associations are interesting in and of themselves, they do not tell us which antecedent factors are associated with *change* in effortful control. With the paucity of research in this area, we aimed to fill this gap by utilizing unique longitudinal data to conduct a comprehensive investigation of the antecedents of effortful control change from late childhood to young adulthood.

We found numerous longitudinal associations between the antecedent factors and developmental change in effortful control. First, we found that youth who experience more hostility from their parents, associate more with deviant peers, attend more violent schools, and experience more ethnic discrimination tend to experience an exacerbated dip in effortful control from late childhood to young adulthood. In contrast, youth with parents who closely monitor their behavior and whereabouts have a more shallow dip in effortful control during adolescence. Second, we found a significant correlation between the slopes of neighborhood violence and effortful control. Specifically, adolescents who lived in neighborhoods that became increasingly violent over time tended to show larger decreases in effortful control over time. Together, these findings suggest that there are multiple risk and resilience factors that exacerbate or mitigate the self-regulatory dip during adolescence.

Despite the number of significant influences on effortful control, many longitudinal effects did not emerge. For example, we did not find any significant gender or nativity status differences, nor did we find a significant influence of IQ, family SES, parental warmth, sibling deviance, school SES, neighborhood SES, or Mexican cultural values on the slope of effortful control. Some of these non-significant findings are consistent with previous longitudinal work in adolescence, such as the lack of a longitudinal effect of family SES on personality development (Ayoub et al., 2018; Sutin et al., 2017). For other non-significant findings, the literature has produced inconsistent results, or there is no relevant literature.

Additionally, we know little about how precursors to personality development differ across developmental periods (i.e., childhood vs. adolescence vs. adulthood). Thus, some of the antecedents factors that failed to show significant effects may be more consequential earlier (or later) in development. For example, in research on children, family SES has a significant effect on executive control trajectories, with middle and upper class youth showing larger increases in executive control than youth from impoverished or low-income groups (Lengua et al., 2015). However, the influence of income and family SES may not extend to self-regulatory development in adolescence or adulthood as shown in the present study and in other studies (Ayoub et al., 2018; Sutin et al. 2017). In summary, we have much to learn about how, why, and to what extent the precursors of effortful control vary across development periods.

The antecedent findings for overall effortful control need to be qualified by the divergent pattern of results observed at the facet level. Although most of the concurrent associations replicated across the three facets, there were more subtleties to the slope-to-slope and level-slope associations between the antecedent factors and the facets. Generally, the longitudinal associations were mostly evident for the inhibitory control and attention control components, whereas there were few longitudinal associations with activation control. For all significant effects, negative antecedent factors (e.g., parental hostility) were associated with fewer increases in inhibitory control and greater decreases in attention control from late childhood to young adulthood. It will be important for future research to investigate whether the precursors to the development of activation control are markedly different from the precursors that allow youth to develop better or worse inhibitory and attention control. These results suggest that we have much to learn about the nuances in how developmental precursors shape different components of effortful control from late childhood to young adulthood.

Taken together, the present findings have several implications. First, the findings suggest that antecedent factors from multiple levels of analysis, in varying degrees of proximity to the developing child, have important consequences for personality development during adolescence. Longitudinal associations with change over time in effortful control (and its facets) were evident at the family, social, community, and cultural levels. Second, although we largely examined *risk* factors for poor effortful control in the present study (e.g., parental hostility, peer deviance), we also identified several resilience factors (e.g., parental monitoring) that showed protective effects on effortful control change. Third, although the increasing demands and responsibilities of adolescence seem to erode effortful control, most youth bounce back and increase in their self-regulatory capacities in late adolescence/young adulthood, suggesting that despite all of the negative environmental influences, youth show remarkable recovery in effortful control as they transition out of those toxic contexts later in development. Fourth, the divergent trajectories and correlates observed for the three facets of effortful control suggest that there is a great deal of nuance to the ways in which youth become better or worse at self-regulating as they traverse the adolescent years. Last, given our use of an ethnic minority sample of Mexican-origin youth, we were able to investigate the role of cultural factors (both risk and resilience) on the development of effortful control. We found that ethnic discrimination was particularly problematic for the development of effortful control in our sample of Mexican-origin youth. Overall, then, our findings suggest that interventions aiming to improve adolescents' self-regulatory abilities may be particularly effective with a *culturally-sensitive* approach that incorporates risk and resilience factors from *multiple* systems.

Effortful Control is Associated with Change Over Time in Environmental Factors

The present findings further support the view that developing youth are not only the recipients of environmental influences, their personalities and behaviors actively shape, and evoke changes in, their environment (Atherton, Donnellan, & Robins, in press). Specifically, we found that the child's level of effortful control at age 10 predicted the slopes of parental monitoring, peer deviance, and ethnic discrimination. In other words, youth with lower effortful control at age 10 had parents who monitored them even less over time, which may indicate that parents become exhausted by their children's impulsive tendencies and give up on any attempt to regulate their behavior and whereabouts. Additionally, youth with lower effortful control at age 10 showed an increasing tendency to associate with deviant peers over the course of adolescence, presumably because youth lower in effortful control are seeking out peer groups that have similar levels of under-controlled and deviant behaviors (and this effect was driven by the activation control component). This finding builds on past studies showing that lower levels of effortful control at age 4.5 (Laible, Carlo, Davis, & Karahuta, 2016) and 10 (Burt, Simons, & Simons, 2006) are associated with having more deviant peers at age 12. In terms of perceived ethnic discrimination, we found that higher levels of effortful control (specifically, inhibitory control and attention control) were associated with greater increases in perceived ethnic discrimination over time, and moreover, by late adolescence, perceived ethnic discrimination becomes a more frequent experience for youth who are both low and high on effortful control.

These findings are intriguing and suggest a process by which adolescents' personalities and behaviors have important influences on the people and environments around them, which may also subsequently reinforce existing personality tendencies, creating a recursive cycle. For example, youth with lower effortful control select into more deviant peer groups, and by being a part of these deviant peer groups, their effortful control may erode even further. Future research should investigate the underlying conditions and mechanisms responsible for such person-environment transactions that promote personality continuity during adolescence. Doing so will better inform researchers and practitioners on how to break detrimental cycles of maladaptive adolescent personality traits and disadvantageous environments influencing each other over time.

Limitations and Future Directions

The present study has several limitations that warrant attention. First, in many cases, the antecedent factors were not assessed at the same waves as effortful control. For example, effortful control was assessed at ages 10, 12, 14, 16, and 19, but many individual, family, social, community, and cultural factors were assessed at ages 10, 12, 14, and 16 years. Additionally, IQ, school SES, and neighborhood SES were assessed only at age 10, and therefore we could not examine co-developmental patterns with effortful control. It would be beneficial for future research to have matched time-periods of assessment when examining co-developmental processes, as mismatched intervals could attenuate longitudinal relations.

Second, we examined a broad set of antecedent factors from multiple systems (i.e., individual, family, peer, school, neighborhood, cultural) that varied in proximity to the child, but we did not examine other potentially relevant precursors to the development of effortful control (e.g., closeness to deviant friends, parent personality). Future work in this area should replicate and extend the present study by examining other theoretically relevant risk and resilience factors. Moreover, the current study was not able to examine genetic influences on the development of effortful control, which have been found to account for a large portion of the variance in effortful control (Lemery-Chalfant, Doelger, & Goldsmith, 2008; Yamagata et al., 2005). Accounting for the heritability of effortful control could attenuate the influence of environmental factors on its development; therefore, future research would benefit from utilizing longitudinal twin designs to partition the genetic and environmental variance responsible for the development of effortful control and its covariation with family, peer, school, neighborhood, and cultural factors.

Third, given that our study spans three developmental periods (childhood, adolescence, young adulthood), some of the measures (i.e., effortful control, ethnic discrimination, Mexican cultural values) had different items across waves. Consequently, what appears to be mean-level change in one of these constructs could reflect the change in items across assessments. However, we ameliorated this issue, in part, by testing for longitudinal measurement invariance for all constructs. Given that most constructs were either partially strong or strong invariant over time, we are more confident that we are measuring the same latent construct across ages and can draw inferences about true mean-level change.

Fourth, future work should examine whether the present research generalizes across other samples and methods of assessment. Although one of the strengths of the present study is our focus on an understudied ethnic minority group, it is important to replicate the present findings in other ethnic groups to establish generalizability of the findings beyond Mexican-origin youth. Additionally, future research should investigate whether the observed developmental trajectory of effortful control is unique to parent- and child-reports, or generalizes to other methods (e.g., cognitive/behavioral tasks). For example, to the extent that parents have heightened expectations for their children’s capacity to regulate their behavior during adolescence, they may view their child’s effortful control through a more critical lens, and consequently provide less favorable reports when they complete the temperament questionnaire, contributing to a dip in parent reports of effortful control. Similarly, to the extent that youth internalize their parents’ heightened expectations (and the heightened expectations of teachers and other socializing agents), they will also view their effortful control through a more critical lens, leading to a dip in self-reported effortful control. Thus, it would be informative to replicate the present findings with other methods of assessing effortful control, such as cognitive/behavioral tasks. However, caution is warranted in using these tasks to measure individual differences in self-regulation, given recent work showing that they have low test-retest reliability even across relatively short time intervals (e.g., Enkavi et al., 2019).

Fifth, it was beyond the scope of the present study to examine whether the factors associated with the decline in effortful control from early to mid-adolescence are the same as those associated with the improvement in effortful control from mid-adolescence to young adulthood. Future work should explore this issue to determine which risk and resilience factors predict both sides of the non-linear change pattern (dip and recovery) observed from late childhood to young adulthood. Likewise, one limitation of using bivariate latent growth curve models is that we were not able to capture wave-to-wave, reciprocal influences between antecedent factors and effortful control. Future work should extend the present work to different longitudinal models of change to determine whether bidirectional effects exist at a more fine-grained level.

Conclusion

Effortful control and other self-regulatory traits are gaining increasing attention among researchers, policy-makers, and parents alike given their importance for numerous aspects of adaptive functioning. Despite the multiple adverse consequences of low effortful control, we are just beginning to understand how effortful control develops across the lifespan, as well as which factors predict who will become better or worse at regulating their impulses, pursuing their goals, and focusing their attention. The present study suggests that adolescence may be uniquely characterized by disruptions in effortful control, given the observed drop in self-regulatory capacities during this time. This self-regulatory dip was driven mainly by the activation control and attention control facets, whereas inhibitory control linearly improved over the course of adolescence. Moreover, youth who experienced more hostility from their parents, associated with more deviant peers, attended more violent schools, lived in more violent neighborhoods, and experienced more ethnic discrimination tended to exhibit an exacerbated dip in effortful control. In contrast, youth with parents who closely monitored their behavior and whereabouts exhibited a shallower dip in effortful control. It seems likely that the larger the dip in effortful control that youth experience during adolescence, the harder it may be for them to recover and mature to meet the demands of adult life. Given the numerous risk and resilience factors that were associated with the development of effortful control and its facets, researchers should consider investigating the effectiveness of targeting multiple environmental systems in culturally-sensitive interventions to improve effortful control and reduce the likelihood that Mexican-origin youth will engage in maladaptive behaviors during adolescence and young adulthood.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

This research was supported by a grant from the National Institute on Drug Abuse and the National Institute on Alcohol Abuse and Alcoholism (DA017902) to Richard W. Robins and Rand D. Conger. A full list of CFP publications can be found here: https://osf.io/rn34p/. The materials can be found here: www.icpsr.umich.edu/icpsrweb/NAHDAP/studies/35476. The Mplus syntax and output for all analyses can be found here: https://osf.io/tcdy7/. Please email the corresponding author for access to the data.

Appendix A

Effortful Control Items Used at Each Assessment

Ages 10, 12, 14, and 16 (16 items)	Age 19 (18 items)
Activation Control	
You have a hard time finishing things on time.	*You have a hard time finishing things on time.*
If you have a hard assignment to do, you get started right away.	*If you have a hard assignment to do, you get started right away.*
You put off working on projects until right before they're due.	*You put off working on projects until right before they're due.*
You finish your homework before the due date.	You usually finish doing things before they are actually due (e.g., paying bills, finishing homework, etc.)
You do something fun for a while before starting your homework, even when you're not supposed to.	You can keep performing a task even when you would rather not do it.
--	You often make plans you do not follow through with.
Inhibitory Control	
When someone tells you to stop doing something, it is easy for you to stop.	*When someone tells you to stop doing something, it is easy for you to stop.*
The more you try to stop yourself from doing something you shouldn't, the more likely you are to do it.	*The more you try to stop yourself from doing something you shouldn't, the more likely you are to do it.*
It's easy for you to keep a secret.	*It's easy for you to keep a secret.*
You can stick with your plans and goals.	*You can stick with your plans and goals.*
It's hard for you not to open presents before you're supposed to.	You usually have trouble resisting your cravings for food, drink, etc.
--	You often avoid taking care of responsibilities by indulging in pleasurable activities.
Attention Control	
You are good at keeping track of several different things that are happening around you.	*You are good at keeping track of several different things that are happening around you.*
You pay close attention when someone tells you how to do something.	*You pay close attention when someone tells you how to do something.*
You tend to get in the middle of one thing, then go off and do something else.	*You tend to get in the middle of one thing, then go off and do something else.*
When trying to study, you have difficulty tuning out background noise and concentrating.	When you are trying to focus your attention, you are easily distracted.
You find it hard to shift gears when you go from one class to another at school.	It's often hard for you to alternate between two different tasks.
It is easy for you to concentrate on homework problems.	When interrupted or distracted, you usually can easily shift your attention back to whatever you were doing before.

Note. Items in *italics* were asked at all assessments.

Appendix B

For all of the Figures in Appendix B, each thin line represents one participant, and each thick line represents the average group trend for participants who fall in the top-, middle-, and bottom-third of the predictor variable.

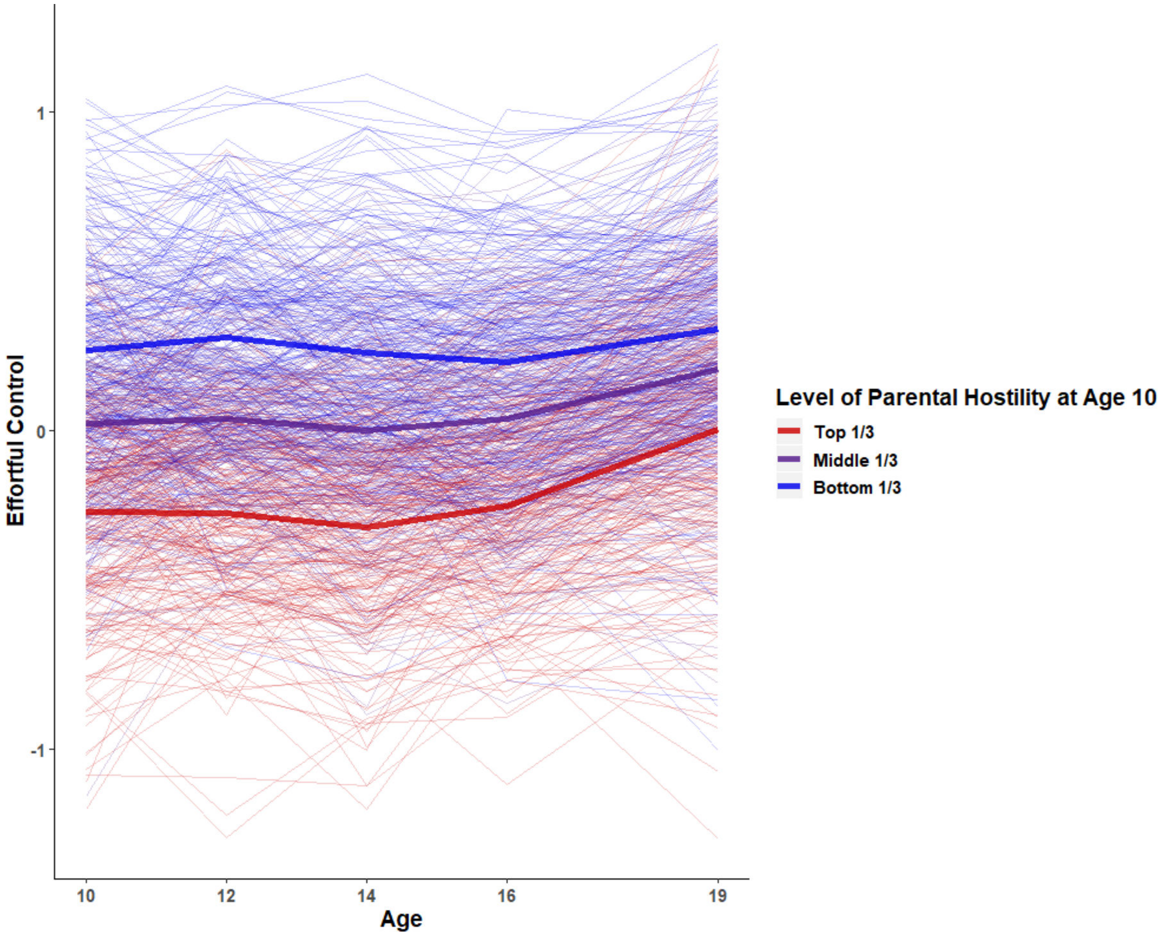

Figure B-1.
Visual depiction of the correlation between age and effortful control, separately for high, medium, and low levels of parental hostility at age 10

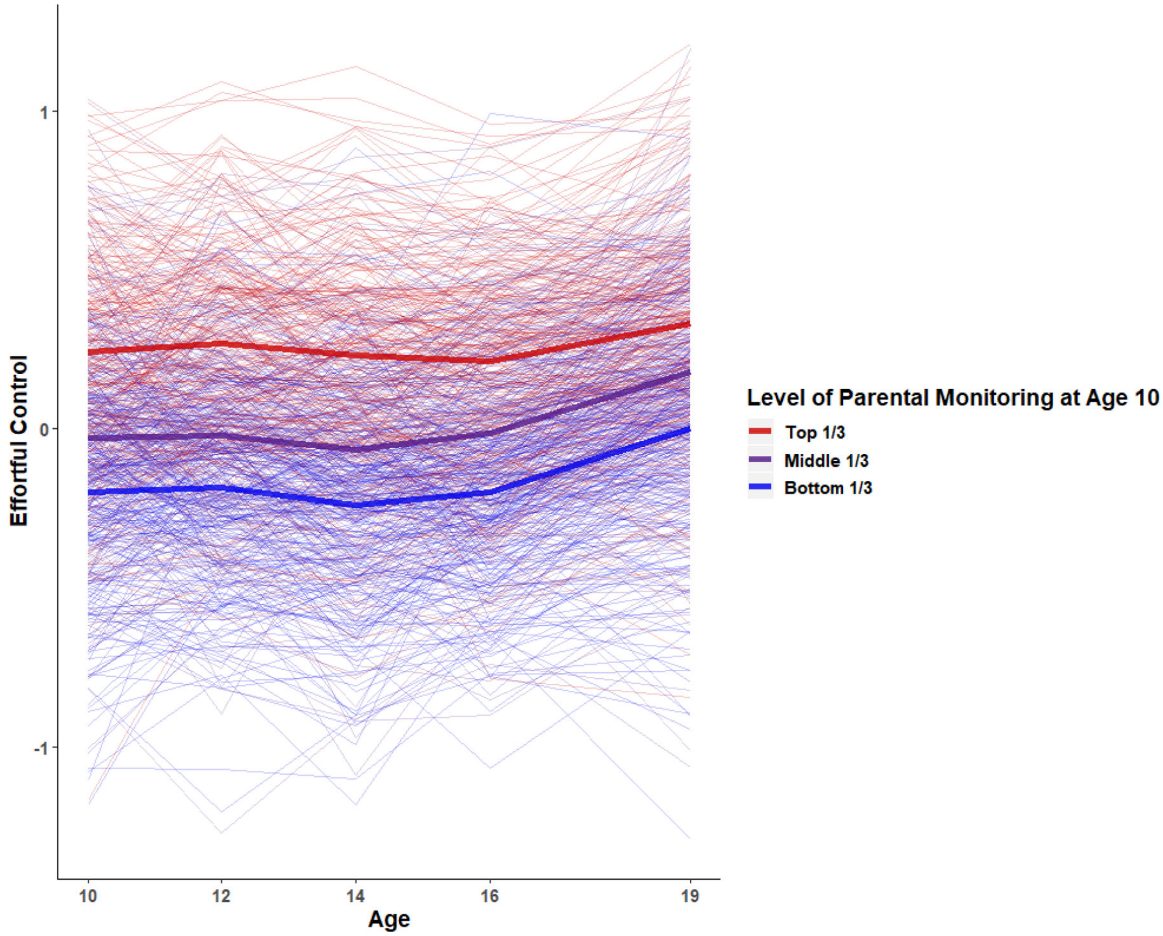

Figure B-2.
Visual depiction of the correlation between age and effortful control, separately for high, medium, and low levels of parental monitoring at age 10

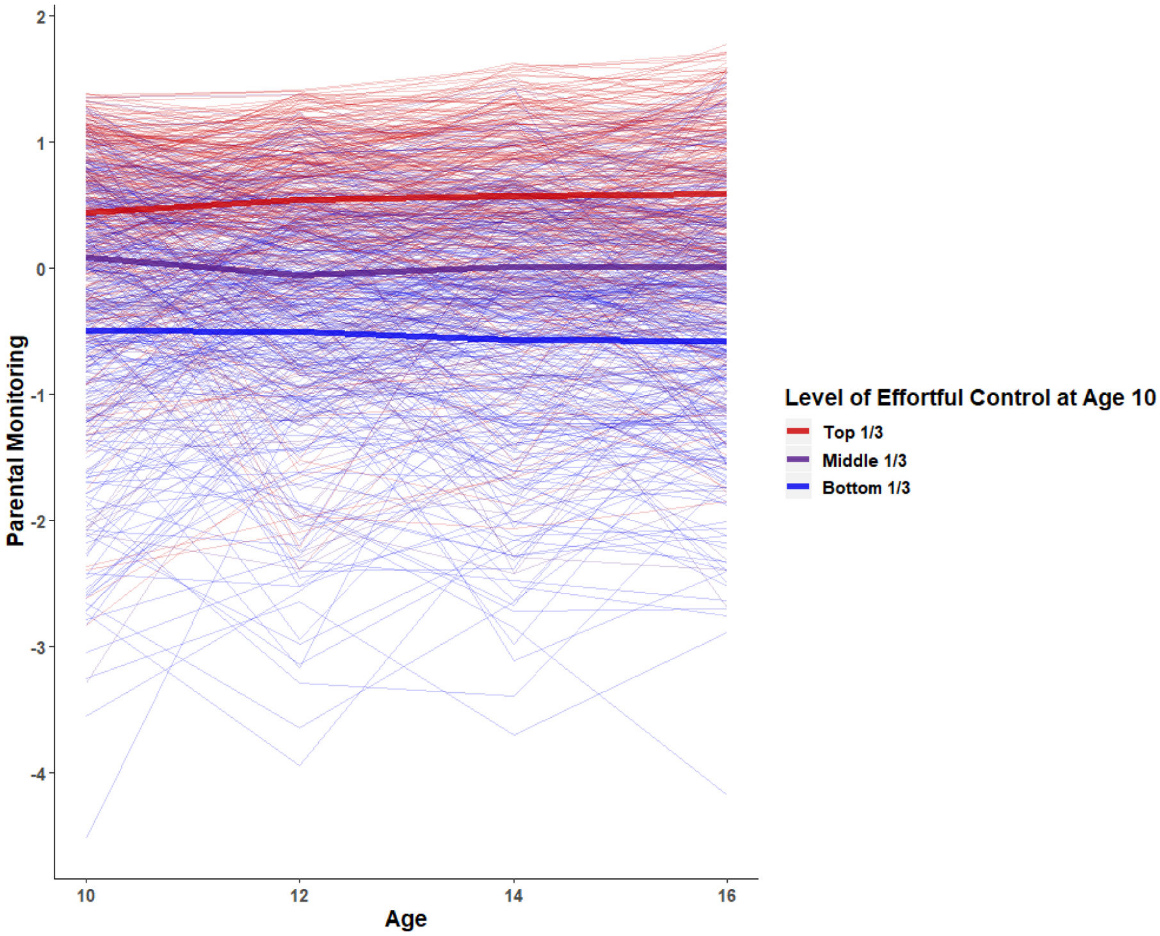

Figure B-3.
Visual depiction of the correlation between age and parental monitoring, separately for high, medium, and low levels of effortful control at age 10

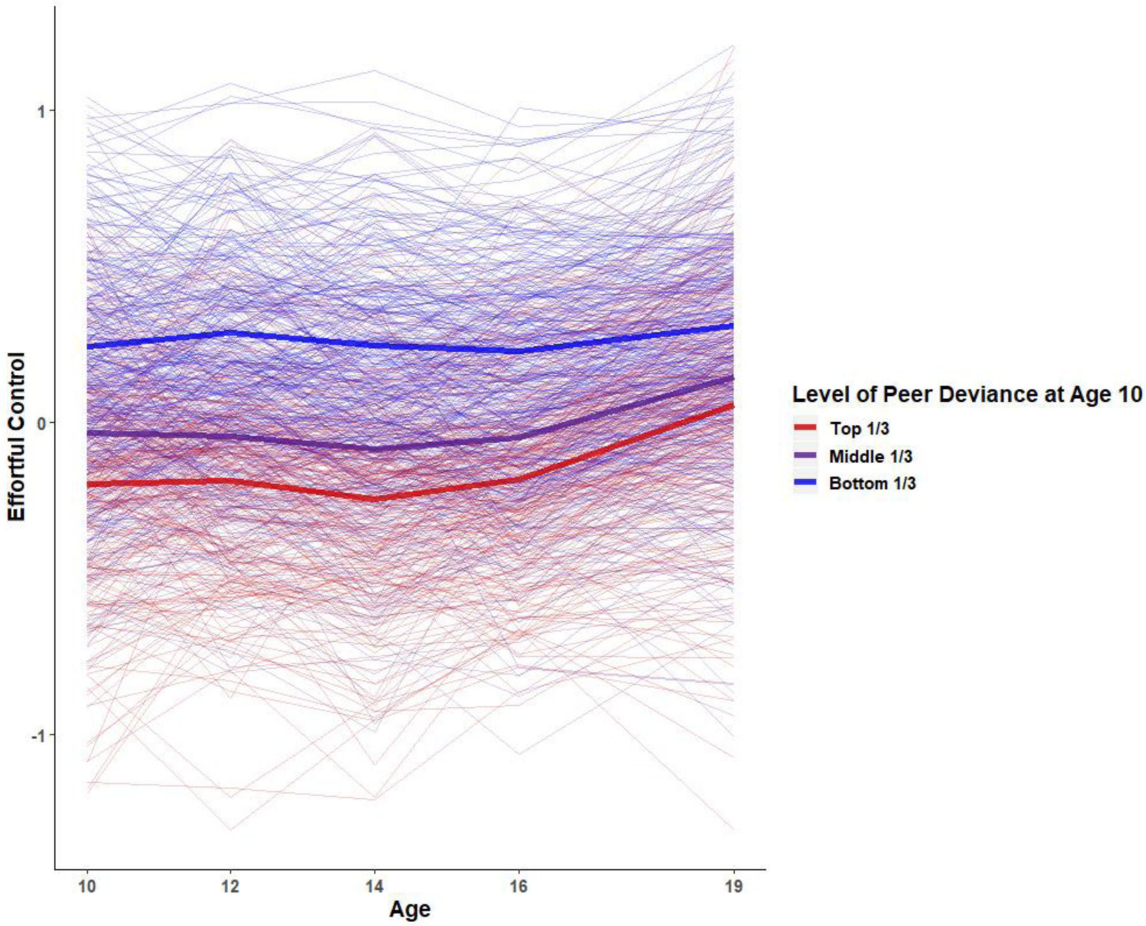

Figure B-4.
Visual depiction of the correlation between age and effortful control, separately for high, medium, and low levels of peer deviance at age 10

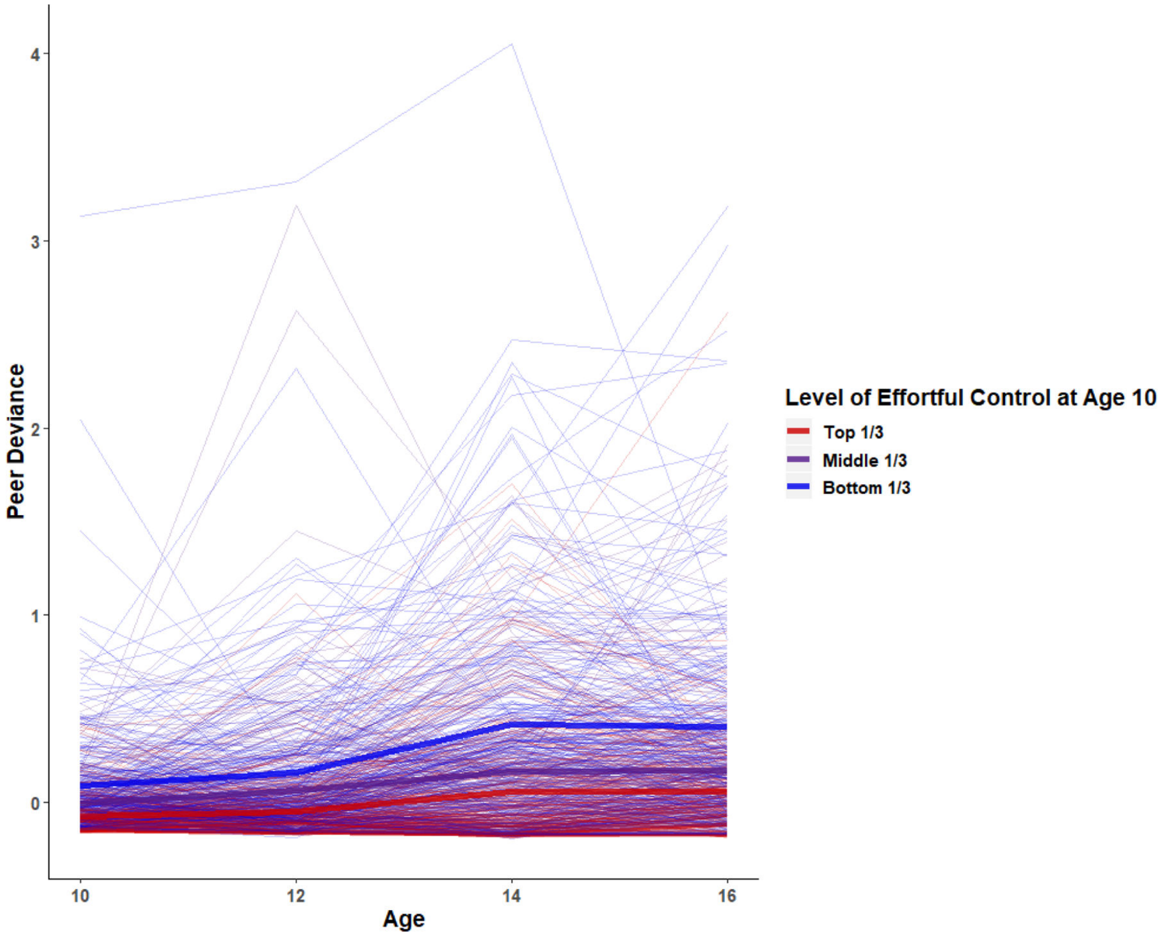

Figure B-5.

Visual depiction of the correlation between age and peer deviance, separately for high, medium, and low levels of effortful control at age 10

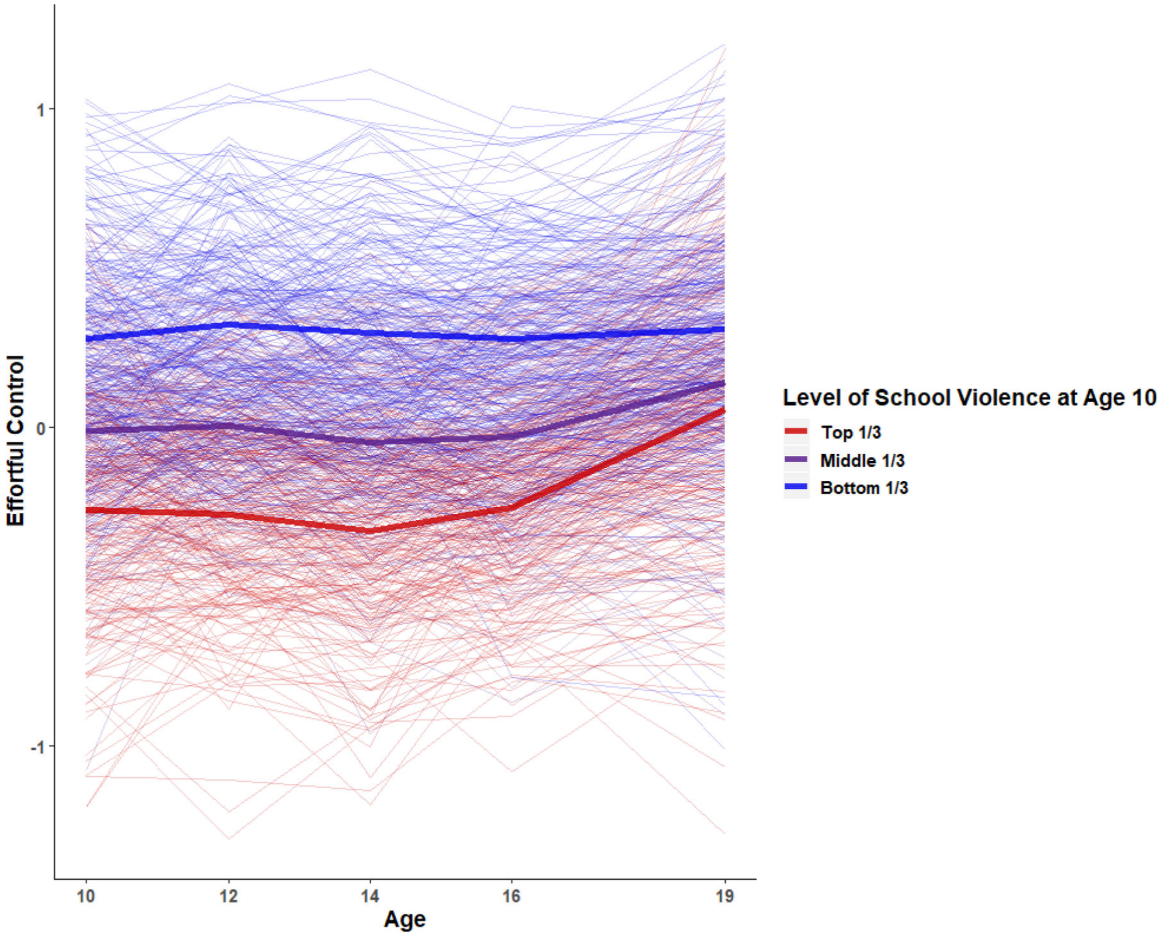

Figure B-6.
Visual depiction of the correlation between age and effortful control, separately for high, medium, and low levels of school violence at age 10

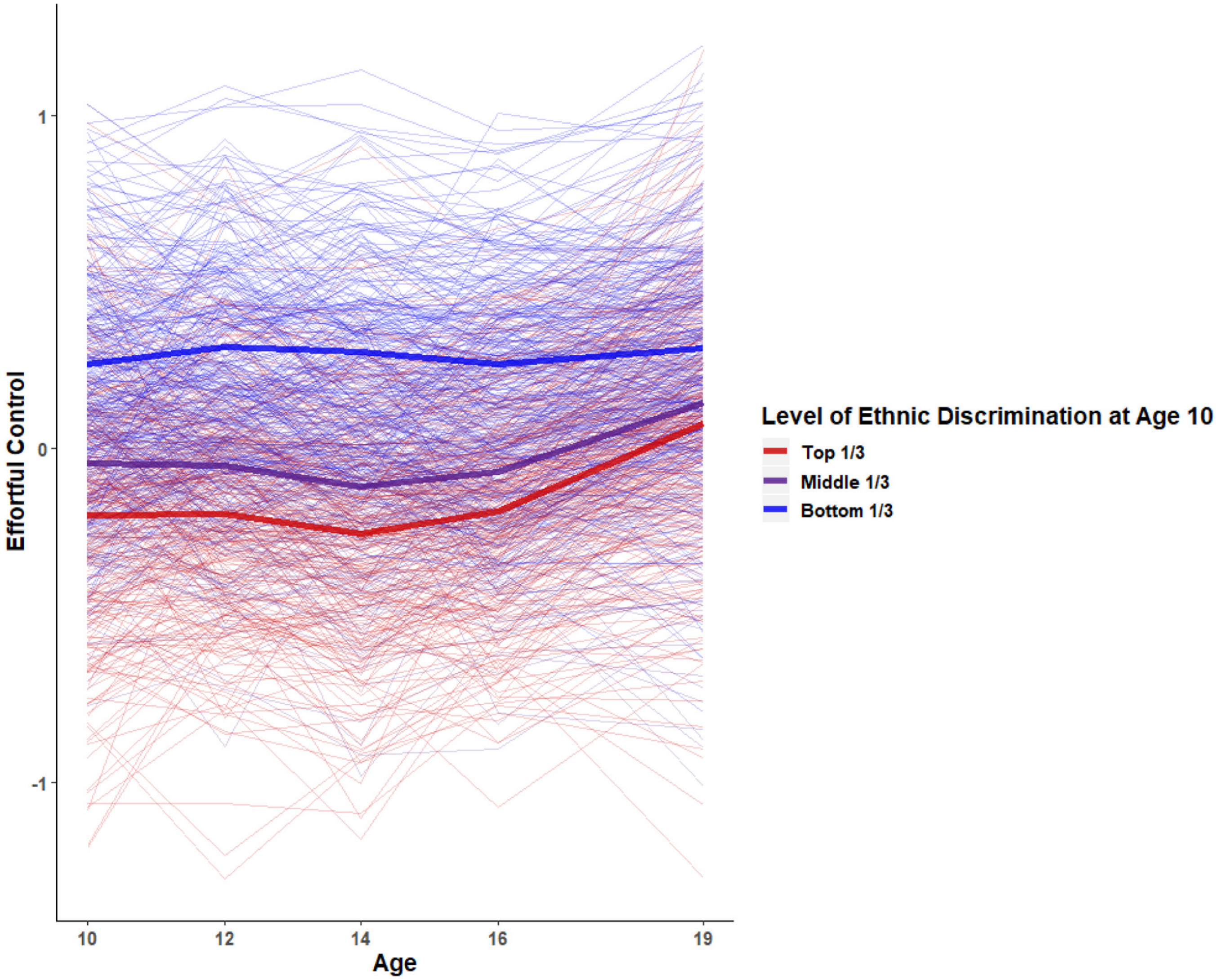

Figure B-7.
Visual depiction of the correlation between age and effortful control, separately for high, medium, and low levels of ethnic discrimination at age 10

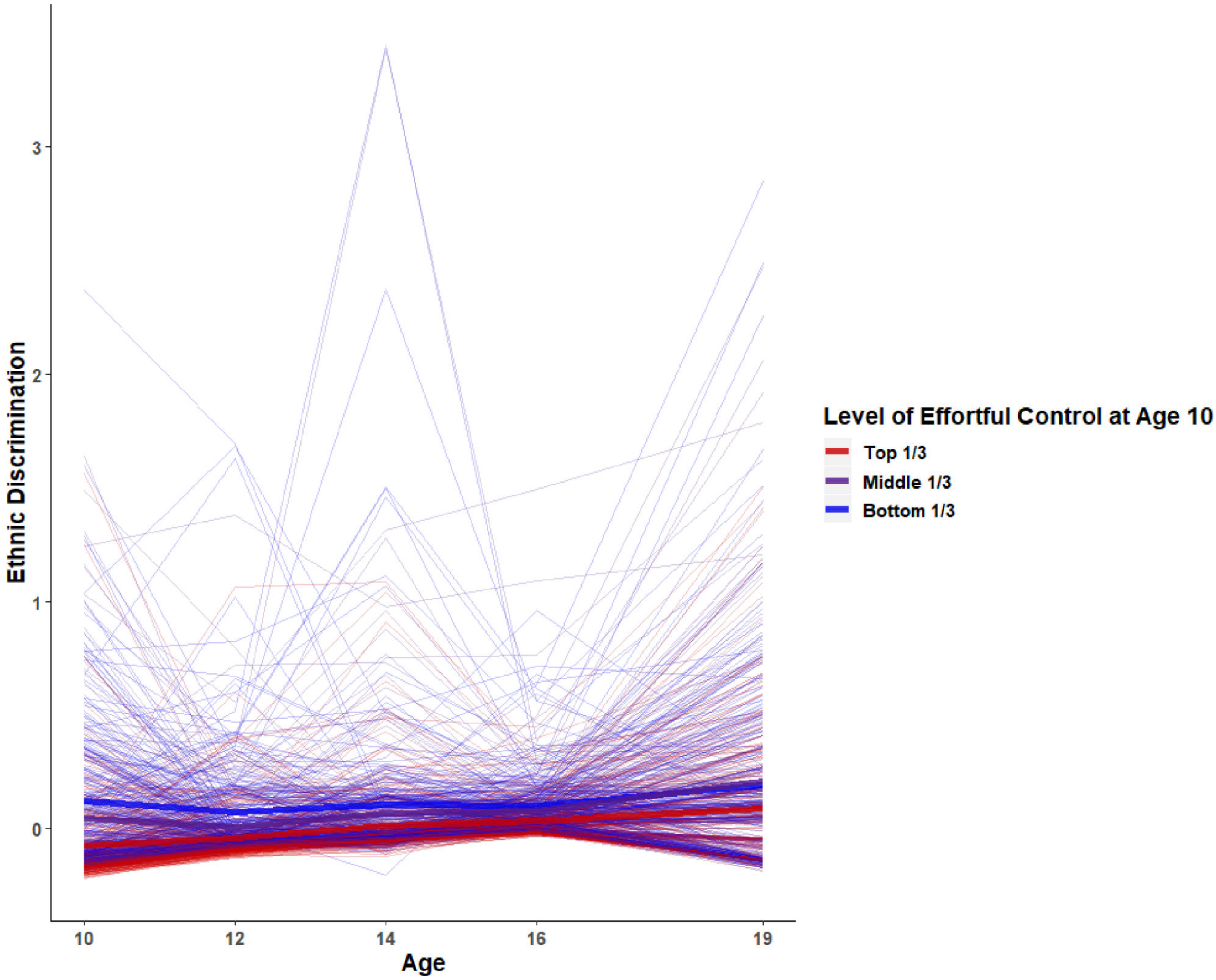

Figure B-8.

Visual depiction of the correlation between age and ethnic discrimination, separately for high, medium, and low levels of effortful control at age 10

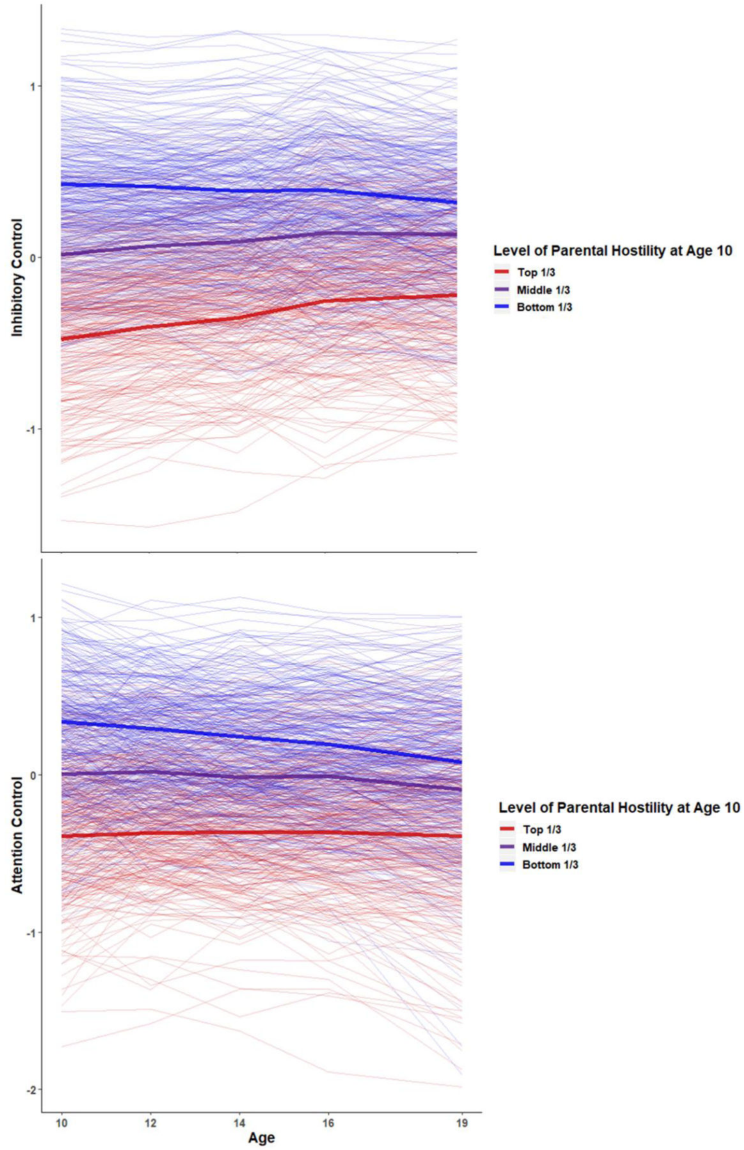

Figure B-9.

Visual depictions of the correlation between age and attention control, separately for high, medium, and low levels of parental hostility at age 10

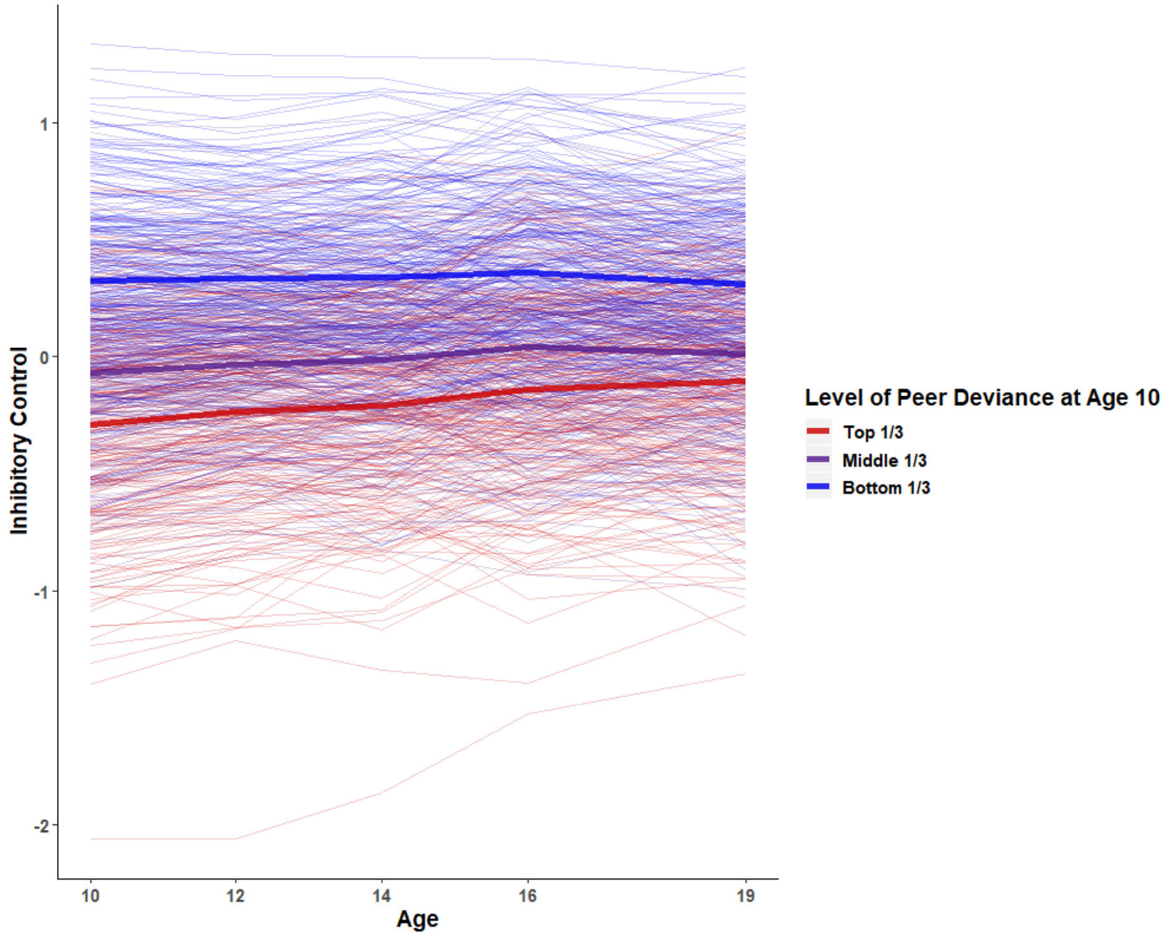

Figure B-10.
Visual depiction of the correlation between age and inhibitory control, separately for high, medium, and low levels of peer deviance at age 10

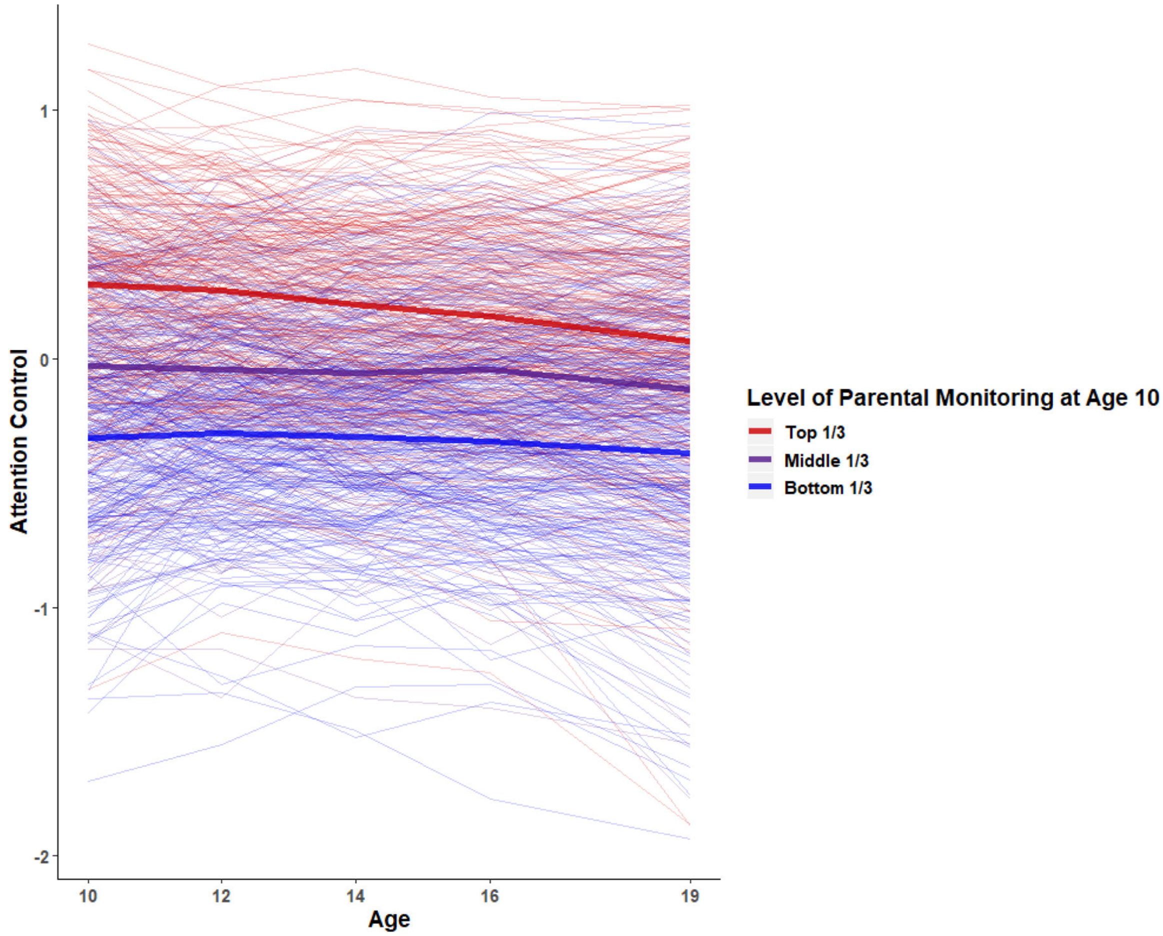

Figure B-11.
Visual depiction of the correlation between age and attention control, separately for high, medium, and low levels of parental monitoring at age 10

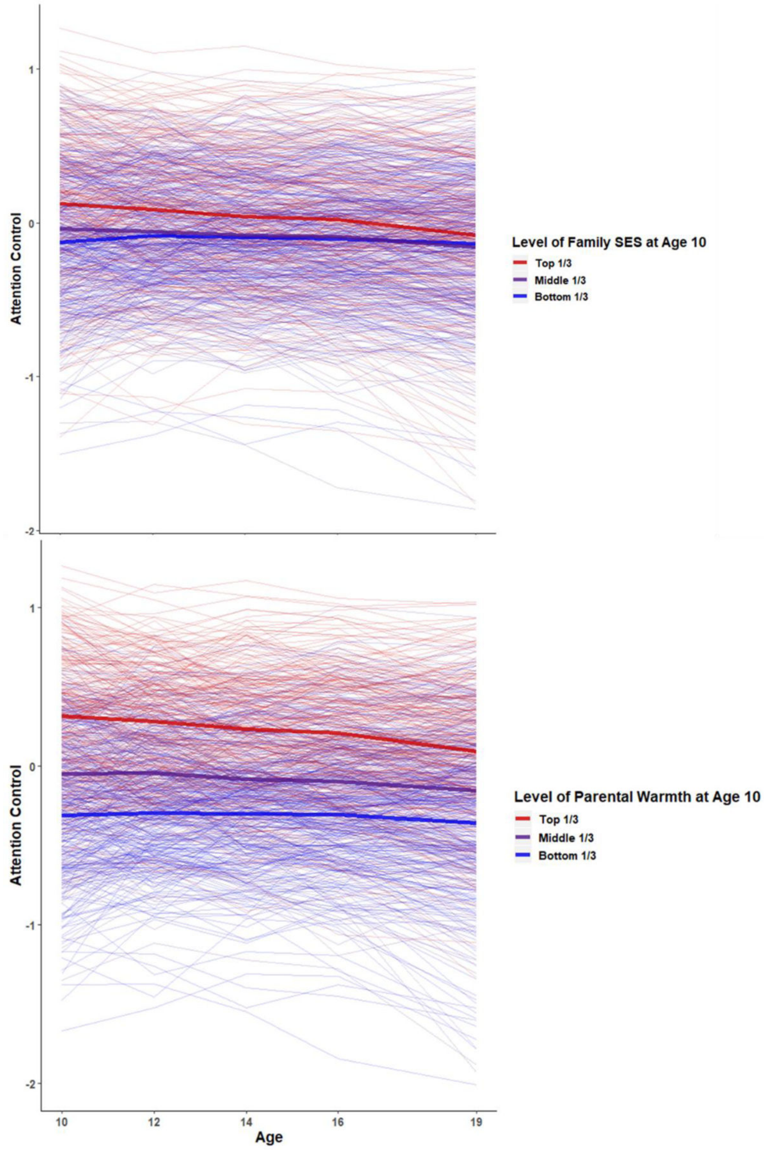

Figure B-12.

Visual depictions of the correlations between age and attention control, separately for high, medium, and low levels of parental warmth at age 10

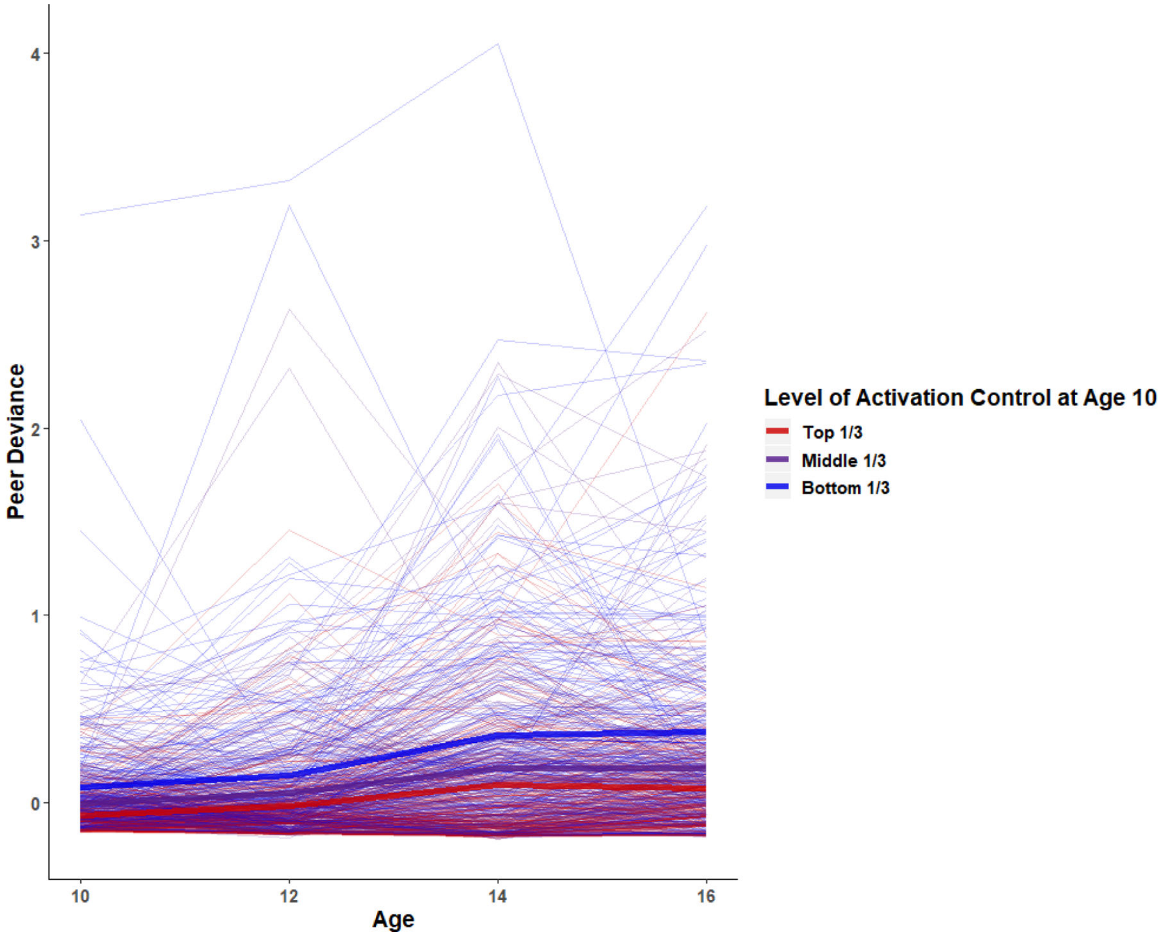

Figure B-13.
Visual depiction of the correlation between age and peer deviance, separately for high, medium, and low levels of activation control at age 10

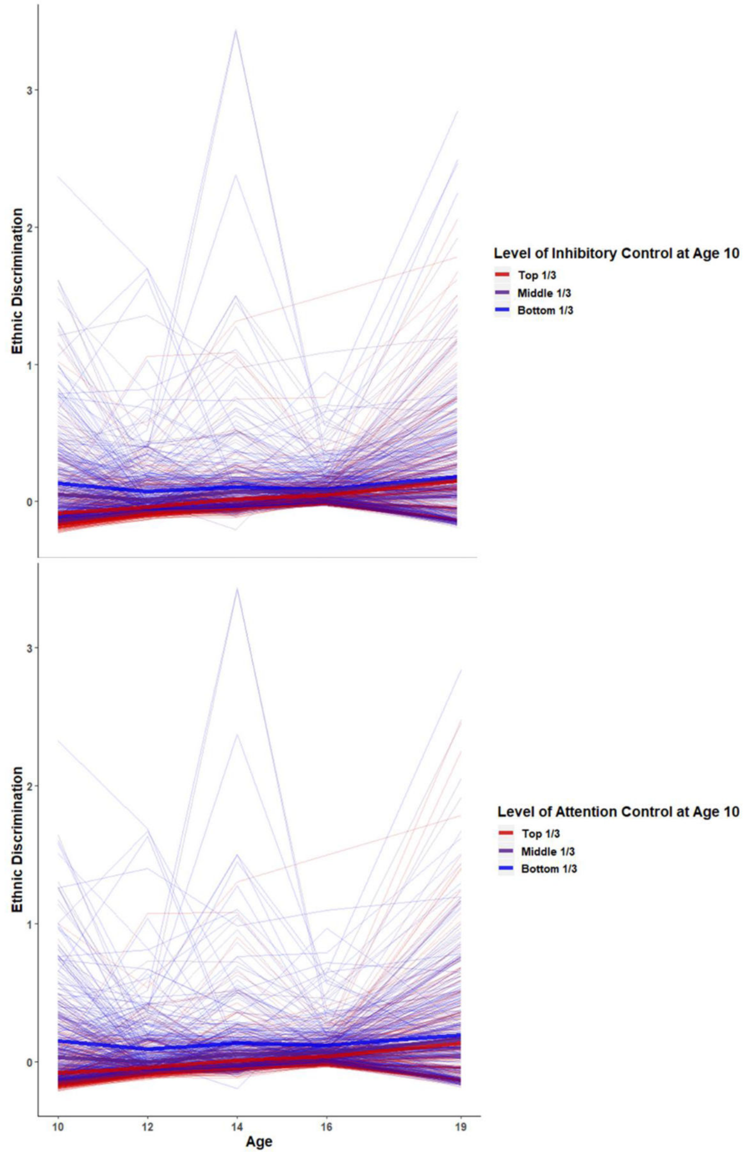

Figure B-14.

Visual depictions of the correlations between age and ethnic discrimination, separately for high, medium, and low levels of inhibitory control and attention control at age 10

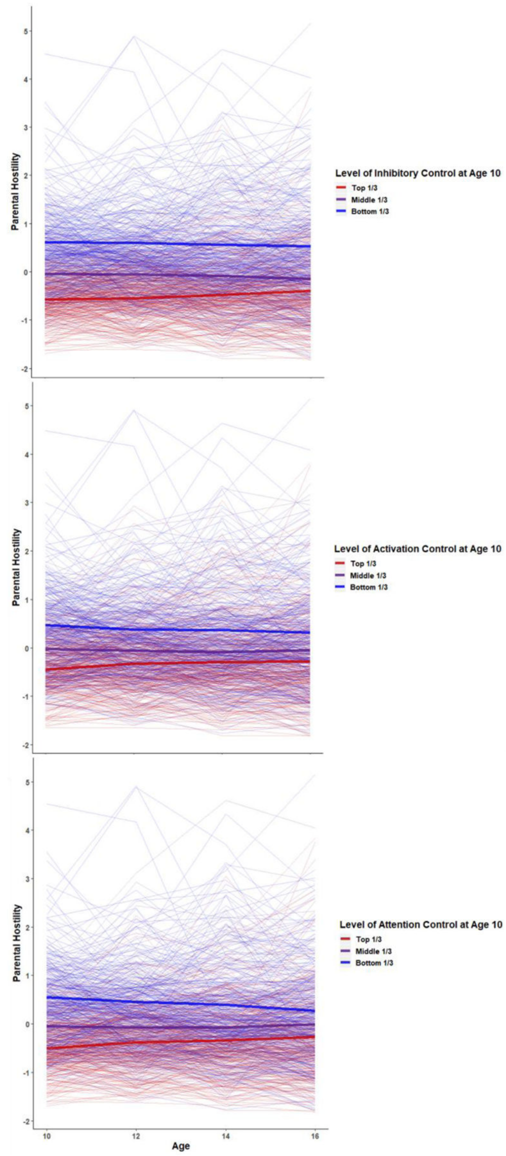

Figure B-15.

Visual depictions of the correlations between age and parental hostility, separately for high, medium, and low levels of inhibitory, activation, and attention control at age 10

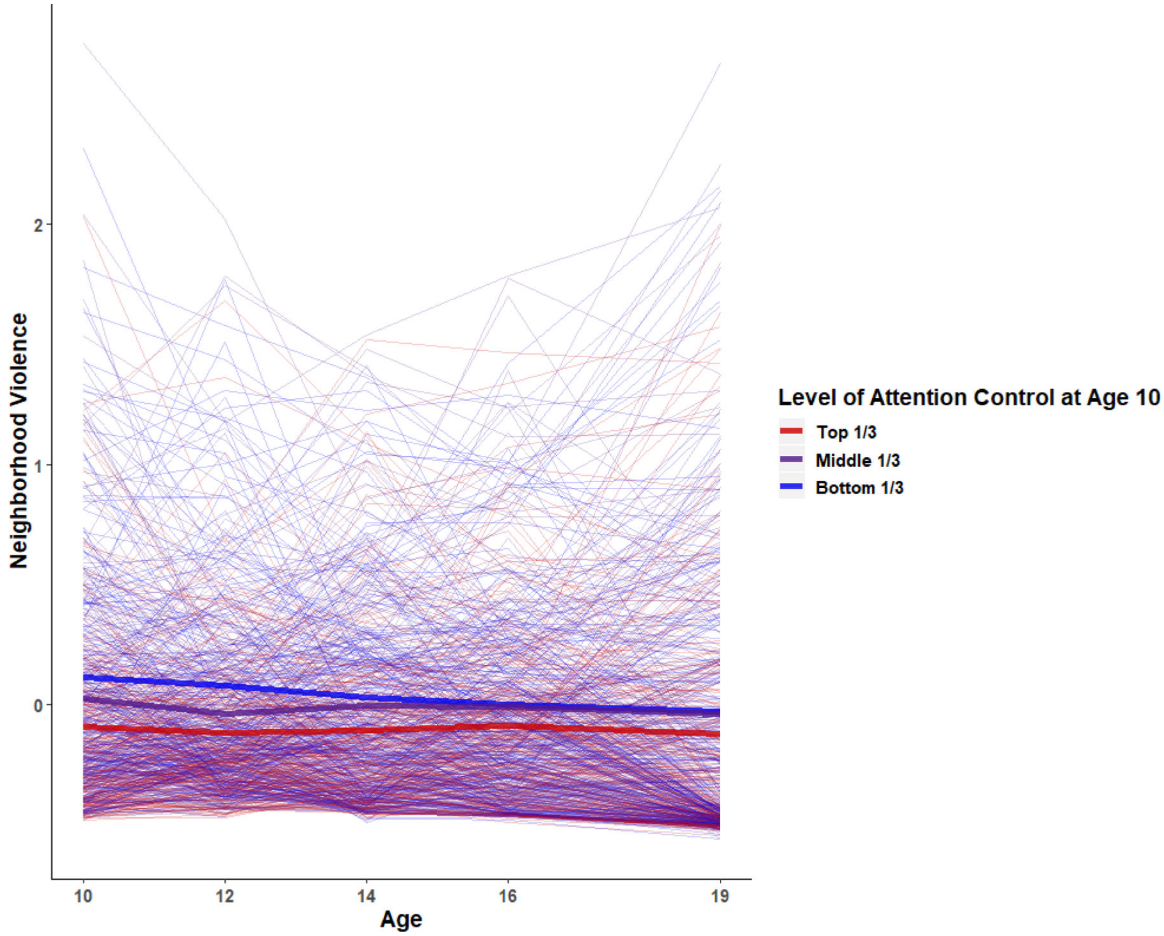

Figure B-16.
Visual depiction of the correlation between age and neighborhood violence, separately for high, medium, and low levels of attention control at age 10

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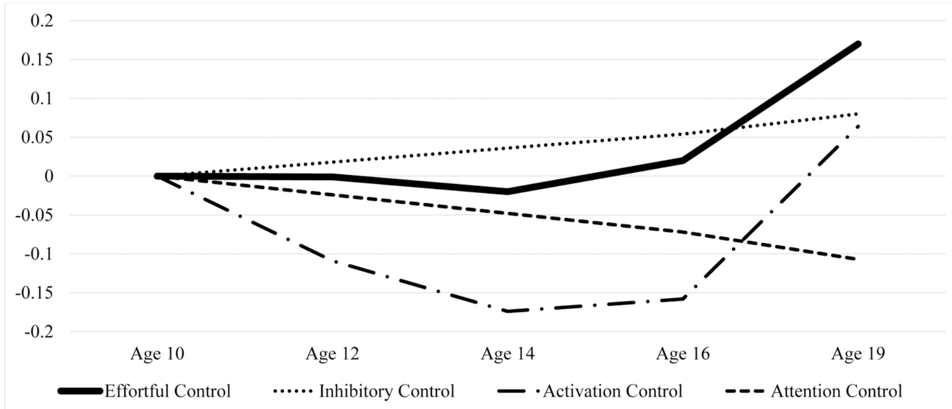

Figure 1.
Mean-level trajectories of effortful control and its facets (assessed via a composite of self- and parent-reports)

Table 1

Summary of Measures and Descriptive Information

	Assessment Ages	Methods	Descriptive Information		
			Omega Reliabilities	Measurement Invariance	Univariate Trajectory
Effortful Control	10, 12, 14, 16, 19	Child-report Mother-report	.82, .85, .87, .85, .88	Partial strong	Latent basis (+)
Inhibitory Control	10, 12, 14, 16, 19	Child-report Mother-report	.40, .42, .47, .50, .48	Partial strong	Linear (+)
Activation Control	10, 12, 14, 16, 19	Child-report Mother-report	.61, .66, .66, .64, .58	Partial strong	Latent basis (+)
Attention Control	10, 12, 14, 16, 19	Child-report Mother-report	.58, .57, .60, .62, .62	Partial strong	Linear (−)
Individual Factors					
Gender	10	Child-report	--	--	--
IQ	10	Child-report	--	--	--
Family Factors					
Family SES	10, 12, 14, 16	Mother-report Father-report	--	--	Linear (+)
Parental Warmth	10, 12, 14, 16	Child-report Spouse-report Observational	.81, .85, .93, .94	Strong	Latent basis (−)
Parental Hostility	10, 12, 14, 16	Child-report Spouse-report Observational	.71, .76, .89, .91	Strong	Linear (+)
Parental Monitoring	10, 12, 14, 16	Child-report Mother-report Father-report Spouse-report Observational	.92, .93, .95, .95	Strong	Linear (+)
Social Influence Factors					
Peer Deviance	10, 12, 14, 16	Child-report	.87, .94, .96, .95	Partial strong	Latent basis (+)
Sibling Deviance	10, 12, 14, 16	Child-report	.84, .85, .86, .86	Strong	Linear (+)
School Factors					

			Descriptive Information		
	Assessment Ages	Methods	Omega Reliabilities	Measurement Invariance	Univariate Trajectory
School Violence	10, 12, 14, 16	Child-report	.80, .91, .91, .92	Partial strong	Latent basis (+)
School SES	10	School records	--	--	--
Neighborhood Factors					
Neighborhood Violence	10, 12, 14, 16, 19	Child-report Mother-report	.93, .92, .93, .93, .89	Partial strong	Latent basis (−)
Neighborhood SES	10	Census data	--	--	--
Cultural Factors					
Nativity Status	10	Child-report	--	--	--
Ethnic Discrimination	10, 12, 14, 16, 19	Child-report	.61, .63, .75, .61, .88	Partial strong	Linear (+)
Mexican Cultural Values	10, 12, 14, 16, 19	Child-report	.82, .88, .89, .89, .91	Partial strong	Latent basis (−)

Note. SES=Socioeconomic status. The ‘+’ and ‘−’ signs in parentheses in the ‘Univariate trajectory’ column indicate whether the slope is increasing (+) or decreasing (−) over time. We used observed variables, instead of latent variables, for family SES and school SES.

Table 2

Rank-Order Stabilities of Effortful Control (and Facets)

	1.	2.	3.	4.	5.
1. Effortful Control (age 10)	--				
2. Effortful Control (age 12)	**.65**	--			
3. Effortful Control (age 14)	.58	**.73**	--		
4. Effortful Control (age 16)	.51	.66	**.73**	--	
5. Effortful Control (age 19)	.41	.47	.54	**.64**	--
1. Inhibitory Control (age 10)	--				
2. Inhibitory Control (age 12)	**.89**	--			
3. Inhibitory Control (age 14)	.82	**.89**	--		
4. Inhibitory Control (age 16)	.70	.82	**.82**	--	
5. Inhibitory Control (age 19)	.59	.70	.63	**.69**	--
1. Activation Control (age 10)	--				
2. Activation Control (age 12)	**.69**	--			
3. Activation Control (age 14)	.63	**.79**	--		
4. Activation Control (age 16)	.54	.69	**.73**	--	
5. Activation Control (age 19)	.57	.65	.67	**.65**	--
1. Attention Control (age 10)	--				
2. Attention Control (age 12)	**.74**	--			
3. Attention Control (age 14)	.65	**.75**	--		
4. Attention Control (age 16)	.61	.69	**.88**	--	
5. Attention Control (age 19)	.59	.53	.65	**.75**	--

Note. Values are correlation coefficients of latent variables across ages. Bolded values indicate the adjacent assessment stabilities.

Table 3

Results from Conditional and Bivariate Latent Growth Curve Models of Antecedent Factors and Effortful Control

	r **(Level$_1$, Level$_2$)**	***r*** **(Slope$_1$, Slope$_2$)**	***r*** **(Level$_1$, Slope$_2$)**	***r*** **(Level$_2$, Slope$_1$)**
Individual Factors				
Fluid IQ	.24* [.15, .32]	--	−.02 [−.13, .09]	--
Verbal IQ	.23* [.15, .31]	--	−.09 [−.20, .02]	--
Family Factors				
Family Socioeconomic Status	.14* [.05, .23]	.08 [−.11, .28]	−.10 [−.21, .02]	.10 [−.05, .25]
Parental Warmth	.48* [.13, .82]	−.10 [−.27, .07]	−.13 [−.29, .04]	.06 [−.10, .18]
Parental Hostility	−.60* [−.69, −.50]	−.14 [−.31, .03]	.29* [.14, .44]	.05 [−.08, .18]
Parental Monitoring	.50* [.41, .59]	.02 [−.16, .20]	−.15* [−.29, −.01]	.14* [.01, .28]
Social Influence Factors				
Peer Deviance	−.39* [−.51, −.28]	.00 [−.15, .15]	.22* [.07, .36]	−.24* [−.35, −.13]
Sibling Deviance	−.26* [−.42, −.10]	−.17 [−.45, .10]	.20 [.00, .40]	−.11 [−.33, .11]
Community Factors				
Neighborhood Socioeconomic Status	.11* [.03, .20]	--	−.01 [−.12, .11]	--
School Socioeconomic Status	.14* [.06, .22]	--	−.05 [−.16, .06]	--
Neighborhood Violence	−.24* [−.34, −.14]	−.24* [−.39, −.09]	.09 [−.04, .23]	.06 [−.06, .17]
School Violence	−.54* [−.73, −.35]	.01 [−.12, .14]	.40* [.17, .63]	−.09 [−.19, .02]
Cultural Factors				
Perceived Ethnic Discrimination	−.35* [−.51, −.19]	−.22 [−.48, .03]	.25* [.05, .45]	.23* [.02, .43]
Mexican Cultural Values	.27* [.14, .39]	.07 [−.12, .27]	−.02 [−.19, .14]	.14 [−.00, .28]

Note. *r* = Correlation. Values in brackets are the 95% confidence intervals. The ‘1’ and ‘2’ in subscripts of the level and slope correspond to the antecedent (“1”) and effortful control (“2”) variables, in order to distinguish which constructs are the levels and which are the slopes in the analyses.

* $p < .05$.

Table 4

Model Comparisons of Gender Differences in the Trajectory of Effortful Control (and Facets)

	χ^2/DF	RMSEA	CFI	χ^2/Δ DF	Sig.
Effortful Control					
All constrained	524.88 / 314	.045	.969	--	--
Slope mean free	521.56 / 313	.044	.969	3.32 / 1	.07
Slope coefficients free	521.47 / 311	.045	.969	3.41 / 3	.33
Inhibitory Control					
All constrained	567.83 / 316	.049	.880	--	--
Slope mean free	562.34 / 315	.048	.882	5.49 / 1	.02
Slope coefficients free	N/A	N/A	N/A	N/A	N/A
Activation Control					
All constrained	866.10 / 314	.072	.830	--	--
Slope mean free	865.18 / 313	.072	.830	.91 / 1	.34
Slope coefficients free	861.40 / 311	.072	.831	4.70 / 3	.20
Attention Control					
All constrained	983.40 / 316	.079	.799	--	--
Slope mean free	979.40 / 315	.079	.800	3.99 / 1	.05
Slope coefficients free	N/A	N/A	N/A	N/A	N/A

Note. It is only possible to test the 'slope coefficients free' model when the overall model is specified as a latent basis model. For the linear models, we can only test whether the slope means are different across groups.

Table 5

Model Comparisons of Nativity Status Differences in the Trajectory of Effortful Control (and Facets)

	χ^2/DF	RMSEA	CFI	$\Delta\chi^2$/Δ DF	Sig.
Effortful Control					
All constrained	539.40 / 314	.046	.967	--	--
Slope mean free	537.94 / 313	.046	.967	1.46 / 1	.23
Slope coefficients free	531.57 / 311	.046	.968	7.83 / 3	.05
Inhibitory Control					
All constrained	524.30 / 316	.044	.900	--	--
Slope mean free	523.51 / 315	.045	.900	.78 / 1	.38
Slope coefficients free	N/A	N/A	N/A	N/A	N/A
Activation Control					
All constrained	878.97 / 314	.074	.833	--	--
Slope mean free	874.88 / 312	.074	.834	4.09 / 2	.13
Slope coefficients free		*no convergence			
Attention Control					
All constrained	977.37 / 316	.079	.804	--	--
Slope mean free	977.35 / 315	.079	.804	.02 / 1	.88
Slope coefficients free	N/A	N/A	N/A	N/A	N/A

Note. It is only possible to test the ‘slope coefficients free’ model when the overall model is specified as a latent basis model. For the linear models, we can only test whether the slope means are different across groups.

Table 6

Results from Conditional and Bivariate Latent Growth Curve Models of Antecedent Factors and Facets of Effortful Control

	r **(Level$_1$, Level$_2$)**	***r*** **(Slope$_1$, Slope$_2$)**	***r*** **(Level$_1$, Slope$_2$)**	***r*** **(Level$_2$, Slope$_1$)**
Individual Factors				
Fluid IQ	.14* / .33* / .33*	--	.05 / .33 / −.11	--
Verbal IQ	.18* / .14* / .31*	--	.05 / .17 / −.15	--
Family Factors				
Family Socioeconomic Status	.28* / .08 / .23*	.22 / .16 / .21	−.12 / .27 / −.20*	.07 / .16 / −.00
Parental Warmth	.48* / .45* / .53*	.24 / −.55* / .21	-.23 / .16 / −.26*	.01 / −.13 / −.12
Parental Hostility	−.71* / −.53* / −.64*	−.57* / .40 / −.50*	.61* / .24 / .40*	.17* / .18* / .27*
Parental Monitoring	.52* / .45* / .53*	.61* / −.46 / .56*	−.28 / .20 / −.30*	−.00 / .08 / −.07
Social Influence Factors				
Peer Deviance	−.43* / −.32* / −.37*	−.22 / .37 / −.19	.32* / .29 / .14	−.13 / −.16* / −.06
Sibling Deviance	−.19 / −.14 / −.11	−.52 / .15 / .16	.20 / .57 / .00	.07 / −.13 / −.13
Community Factors				
Neighborhood Socioeconomic Status	.13* / .08 / .12*	--	−.03 / .03 / −.02	--
School Socioeconomic Status	.11* / .07 / .12	--	.08 / −.27 / .01	--
Neighborhood Violence	−.17* / −.22* / −.23*	−.14 / −.18 / −.26*	−.06 / .16 / −.03	.07 / .03 / .15*
School Violence	−.58* / −.39* / −.52*	−.13 / .19 / −.06	.46 / .43 / .32	.04 / −.06 / −.04
Cultural Factors				
Perceived Ethnic Discrimination	−.42* / −.23* / −.42*	−.38 / −.01 / −.50*	.19 / .09 / .30	.40* / .18 / .32*
Mexican Cultural Values	.34* / .17* / .46*	.52* / −.45 / .70*	−.17 / .04 / −.23	−.10 / .08 / −.16

Note. *r* = Correlation. The ‘1’ and ‘2’ in subscripts of the level and slope correspond to the antecedent (“1”) and effortful control (“2”) variables, in order to distinguish which constructs are the levels and which are the slopes in the analyses. In all columns, the value listed first is for ‘Inhibitory Control’, the value listed second is for ‘Activation Control’, and the value listed last is for ‘Attention Control’.

* $p < .05$.