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A closer look at the role of parenting-related influences on verbal intelligence over the life course: Results from an adoption-based research design

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ABSTRACT

The association between family/parenting and offspring IQ remains the matter of debate because of threats related to genetic confounding. The current study is designed to shed some light on this association by examining the influence of parenting influences on adolescent and young adult IQ scores. To do so, a nationally representative sample of youth is analyzed along with a sample of adoptees. The sample of adoptees is able to more fully control for genetic confounding. The results of the study revealed that there is only a marginal and inconsistent influence of parenting on offspring IQ in adolescence and young adulthood. These weak associations were detected in both the nationally representative sample and the adoptee subsample. Sensitivity analyses that focused only on monozygotic twins also revealed no consistent associations between parenting/family measures and verbal intelligence. Taken together, the results of these statistical models indicate that family and parenting characteristics are not significant contributors to variation in IQ scores. The implications of this study are discussed in relation to research examining the effects of family/parenting on offspring IQ scores.

1. Introduction

Of all the debates that have been waged in science, perhaps the most contentious one of all revolves around the factors that are responsible for producing variation in human intelligence (Miele, 2002). In what would eventually evolve into the nature–nurture debate, some of the earliest and most heated disputes centered on whether environmental or genetic factors were involved in the etiology of intelligence. Findings from a large body of contemporary empirical research, however, have revealed that the nature–nurture debate represents a false dichotomy and that variation in intelligence is produced by a multifactorial arrangement of genetic and environmental factors that work both independently and interactively (Devlin, Daniels, & Roeder, 1997; Tucker-Drob, Briley, & Harden, 2013). As a result, more recently the debate transformed into one of relative influence, with arguments centered on the influence of genetic factors in comparison with the influence of environmental factors. With research consistently revealing that genetic factors account for more than one-half of the variance in intelligence (Deary, Johnson, & Houlihan, 2009; Tucker-Drob et al., 2013), the new focal point of concern has been on trying to identify the specific socialization factors that might be involved in the development of intelligence (Nisbett et al.,

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2012). Addressing this issue has proven to be quite difficult as isolating the effects of socialization factors from potential confounding influences continues to represent a threat to the existing literature (Johnson, Turkheimer, Gottesman, & Bouchard, 2009; McGue, Osler, & Christensen, 2010).

Perhaps nowhere is this more problematic than when it comes to examining the influence of parenting and family-related factors on variation in intelligence. At first glance this would seem to be a bit of an overstatement as there is a long line of scholarship revealing that a range of parenting and family influences are associated with variation in intelligence and cognitive ability (Bradley et al., 1993; DeBaryshe, Patterson, & Capaldi, 1993; Steinberg, Lamborn, Dornbusch, & Darling, 1992). For instance, a wide range of heterogeneous studies have found empirical evidence linking variation in human intelligence to parental encouragement (Campbell & Mandel, 1990; Koutsoulis & Campbell, 2001), involvement (Fan & Chen, 2001; Marchant, Paulson, & Rothlisberg, 2001; Steinberg et al., 1992), autonomy support (Joussemet, Koestner, Lekes, & Landry, 2005), and affection (Guo & Harris, 2000; Wadsworth, 1986) along with a broad range of other family and parenting measures.

Virtually all of these studies, however, are host to the same problem — that is, they do not employ genetically sensitive research designs capable of controlling for genetic influences. This is particularly problematic for two main reasons. First, one of the most widely reported findings in the intelligence literature is that about 60–80% of the variance in intelligence is the result of genetic influences (Deary et al., 2009; Jensen, 1998; Nisbett et al., 2012; Plomin & Spinath, 2004; Tucker-Drob et al., 2013). Second, the family and parenting measures that are typically examined in relation to intelligence have also been found to be substantially heritable, with estimates suggesting that about 25% of the variance in these measures being attributable to genetic factors (Kendler & Baker, 2007). The end result is that studies that do not use a genetically sensitive research design are unable to rule out the potential that genetic confounding is driving the association between parenting/family variables and measures of intelligence. In a recent comprehensive review of the field of intelligence, Nisbett and colleagues (2012) echoed these methodological concerns when they noted that "there is no way of knowing how much of the IQ advantage for children with excellent environments is due to the environments per se and how much is due to the genes that parents creating those environments pass along to their children" (p. 136). Of course, genetic confounding is only a concern if genetic influences on intelligence overlap with the genetic influences on family/parental socialization measures. Importantly, there is some emerging evidence suggesting that this might be the case.

To illustrate, in a recent study Trzaskowski et al. (2014) examined genetic influences on family socioeconomic (SES) status and childhood intelligence. To do so, they analyzed a sample of children from the Twins Early Development Study using Genome-wide Complex Traits Analysis (GCTA). The results generated from the GCTA analysis revealed that the genes accounting for variance in intelligence are the same genes that account for variance in family SES, with genetic correlations ranging between .66 and 1.00. Moreover, between 56 and 94% of the covariance between SES and childhood intelligence was due to shared genetic influences.

Furthermore, these results strongly indicate that in order to estimate the effects of family SES on intelligence a genetically informative research design must be employed. Whether these findings would apply to a broader range of family and parenting variables remains to be determined, but the available evidence in relation to other phenotypes, such as personality traits, has revealed similar findings (Harden, Mendle, Hill, Turkheimer, & Emery, 2008; McGue et al., 2010; Wright & Beaver, 2005). For instance, without controlling for genetic influences, family/parenting factors have been shown to have a consistent and statistically significant influence on variation in levels of self-control and other individual-level traits and behaviors (Armour & Haynie, 2007; Gibbs, Giever, & Martin, 1998; Hay, 2001). After adequately controlling for genetic influences, though, the effects of these family/parenting influences often dissipate from statistical significance (Harden et al., 2008, Harris, 1995, 1998; Wright & Beaver, 2005).

Taken together, these findings suggest that when it comes to isolating the effects of family/parenting influences on individual-level traits, including intelligence, a methodology capable of controlling for genetic confounding must be employed. The current study is designed to take a step in that direction by estimating the influence of family and parenting variables on measures of intelligence drawn from adolescence and adulthood, net of genetic confounding. What is unique about this study is that a sample of adoptees is analyzed which allows genetic confounding to be eliminated.

Limiting the final analytic sample to adoptees results in a powerful research design which is ideal for isolating the effects of parental socialization techniques on a particular outcome that has been found to be under genetic influence. While adoptees share 50% of their genes with their biological mother and the remaining 50% with their biological father, they do not share any genetic material with their adoptive parents as long as their adoptive parent(s) is not biologically related to them. Based on this simple observation, it becomes possible to isolate the effects of parental socialization practices carried out by adoptive parents on genetically influenced outcomes without the threat of genetic confounding. More specifically, since adoptees and their adoptive parents do not share any genetic material unless they are adopted by a biological relative (e.g., an aunt), any observed association between parenting practices and intelligence would be robust to genetic confounding. Should the adoptee be adopted by a biological relative, then family and parenting parameter estimates could be upwardly biased owing to genetic confounding. Importantly, the adoption-based research design has been used widely and has been described as a powerful and highly conservative quasi-experimental research design (Deater-Deckard & Plomin, 1999; Moffitt, 2005; Natsuaki et al., 2013; Rutter, 2006; Rutter, Pickles, Murray, & Eaves, 2001).

Previous studies have used adoption-based research designs to examine genetic and environmental influences on IQ. For example, Loehlin, Horn, and Willerman (1989) employed data from the Texas Adoption Project to estimate genetic and environmental contributors to change in IQ over a ten-year time period. The results of their analysis revealed that family factors and genetic influences were related to variation in IQ at the first wave of data collection. At the second wave of data, however, genetic influences became even stronger. While this study did not directly examine whether family effects were the result of confounding, it did show the application of an adoption-based research design to the study of genetic and environmental issues related to the development of IQ scores.

2. Methods

2.1. Data

This study analyzes data from the National Longitudinal Study of Adolescent Health (Add Health). The Add Health is a widely used sample and, as a result, extensive discussions regarding the data are available in previously published reports (Harris et al., 2003; Resnick et al., 1997). In short, the Add Health is a prospective study of a nationally representative sample of middle and high school students who were attending one of the 132 schools included in the sample during the 1994–1995 academic year. Four waves of data have been collected to date. The first wave of data—referred to as the wave 1 in-school component—was collected via self-report surveys that were administered to all students who were in attendance during a specific school day. Overall, about 90,000 students participated in this component to the study. A subsample of the original respondents was selected to be reinterviewed in their homes along with their primary caregiver. This component of the study—known as the wave 1 in-home component—included 20,745 youth and their primary caregivers. Wave 2 of the sample was collected about 1.5 years later, with 14,738 participants being reinterviewed. In 2001 and 2002, the third round of surveys was completed for 15,197 participants. Wave 4 of the data was collected in 2007–2008 when most of the 15,701 respondents were 24–32 years of age.

One of the unique characteristics about the Add Health data is that a sample of adopted adolescents was nested within the nationally representative sample of youth. During wave 1 of data collection, respondents were asked whether they were adopted and whether they currently resided with either of their biological parents. By using responses to these two questions, it was possible to determine which youth resided with one biological parent and one non-biological parent (e.g., a stepparent) versus which youth resided with two adoptive non-biological parents. The final sample employed in the current study only contained youth who reported that they were adopted and who also reported that they did not live with either of their biological parents. Importantly, this same way of identifying adopted youth in the Add Health has been used in previous research (Beaver, 2011). While this does not preclude the possibility that a biological relative could have adopted them, if that was the case it should only lead to upwardly biased parameter estimates for the parenting measures. After removing cases with missing data via listwise deletion, the final sample of adoptees ranged between N = 229 and N = 286 across the statistical models.

3. Measures

3.1. Verbal intelligence measures

Two measures of verbal intelligence were used in the current study. First, during wave 1 interviews, youth were instructed to complete the Picture Vocabulary Test (PVT), which is a shortened version of the well-known Peabody Picture Vocabulary Test Revised (PPVT-R). Scores on the PVT test are designed to measure individual variation in verbal skills and receptive vocabulary. Each of these wave-specific PVT measures were z-transformed for analyses (though descriptive information is presented for the non-transformed variables) so that they more accurately approach normality and to aid in interpretation. The PVT was administered a second time during wave 3 interviews. Importantly, these PVT scores have been used previously as measures of verbal intelligence (Rowe, Jacobson, & van den Oord, 1999; Schwartz & Beaver, 2013). Table 1 provides descriptive statistics for the verbal intelligence measures along with all of the other variables and scales used in the current study.

3.2. Parenting measures

In order to examine the potential influence of parenting-related influences on verbal IQ, eight parenting measures were included in the analyses. All of the parenting measures were drawn from the first wave of data. The first set of measures was directly related to the adoptive mothers of the youth and measured variation in maternal disengagement, maternal attachment, maternal involvement, and maternal education. First, following previous research (Beaver, 2011), a five-item maternal disengagement was created that included items capturing the interaction between each respondent and their mother. Adolescents, for instance, were asked to report how warm and loving their mother was, how much they talk with their mother, and the overall quality of their relationship with their mother. These items were then summed to create the maternal disengagement scale where higher scores represent more maternal disengagement ($\alpha = .72$). Second, in line with previous research (Schreck, Fisher, & Miller, 2004), a two-item maternal attachment scale was developed. This scale included two questions asked to the adolescent about how close they feel to their mother and how much they think their mother cares about them. Responses to items were summed with higher values representing more maternal attachment ($\alpha = .70$). Third, and similar to previous scales (Crosnoe & Elder, 2004), a maternal involvement index was included in the analyses. This index was developed from questions asking each respondent about their interactions with their mother during the previous four weeks. For example, youth were asked to indicate whether they had engaged in 10 different activities with their mothers during the previous four weeks, such as going shopping, playing a sport, and going to the movies together. Responses were coded dichotomously (0 = no, 1 = yes) and were summed together to create the maternal involvement index ($\alpha = .60$). Fourth, a maternal education variable was included that indexed the mother's highest level of education successfully completed.

The next series of scales were directly related to adoptive fathers of the youth and measured variation in paternal attachment, paternal involvement, and paternal education. Similar to the maternal attachment scale, the paternal attachment scale was developed from two items. Youth, for instance, were asked to report how close they feel to their father and how much they think their father cares about them. These two items were summed together with higher values representing more paternal attachment ($\alpha = .77$). Second, paternal involvement was measured with the same

Table 1
Descriptive statistics for all parenting, IQ, and control measures.

	Non-adoptee sample			Adoptee sample			
	Mean	SD	Variance	Mean	SD	Variance	*F*-statistic
Parenting measures							
Maternal disengagement	8.99	3.48	12.11	9.37	3.75	14.03	9.30**
Maternal attachment	9.40	1.11	1.24	9.23	1.26	1.59	19.03**
Maternal involvement	3.98	1.99	3.95	4.11	2.12	4.48	6.57**
Maternal education	5.10	2.37	5.64	5.38	2.56	6.54	12.37**
Paternal attachment	9.00	1.44	2.07	9.07	1.46	2.12	.01
Paternal involvement	2.95	1.96	3.86	3.19	2.22	4.94	18.83**
Paternal education	5.33	2.46	6.08	5.54	2.58	6.65	2.00
Parental permissiveness	5.17	1.56	2.44	5.18	1.49	2.22	1.00
IQ measures							
Wave I IQ	99.64	15.13	229.05	100.55	14.59	212.97	2.77†
Wave III IQ	101.30	16.11	259.44	102.01	17.13	293.47	.04
Control measures							
Age	16.12	1.69	2.86	16.24	1.65	2.72	.75
Gender	.48	.50	–	.53	.50	–	–
Caucasian	.61	.49	–	.66	.47	–	–
African-American	.24	.43	–	.19	.39	–	–
Other race	.15	.36	–	.15	.36	–	–
Neighborhood disadvantage	4.61	1.54	2.37	4.48	1.48	2.18	2.29
N		14,280			646		

† $p \leq .10$.
** $p \leq .01$.

strategy used to measure maternal involvement. Specifically, youth were asked to report how many of ten different activities they had done with their father during the past four weeks. Items were coded dichotomously and the responses were then summed to create a paternal involvement index ($\alpha = .65$). Third, a paternal education variable was included that indexed the father's highest level of education successfully completed.

The final parenting measure included in the analysis was a parental permissiveness scale. This scale measured variation in the amount of monitoring, supervision, and autonomy that mothers and fathers provided to the youth. During wave 1 data collection, adolescents were asked questions about the degree to which their parents allow them to make their own decisions about watching television, their choice of friends, and their bedtimes. A total of seven items were included in the parental permissiveness index with all responses coded dichotomously ($0 =$ no, $1 =$ yes). The scale was coded such that higher values represent greater levels of parental permissiveness ($\alpha = .58$). It is noteworthy to point out that this same scale has been used previously (Barnes & Morris, 2012).

3.3. Control variables

In order to account for the potentially confounding influences of salient variables, a total of four control variables were included in the analyses. First, age was measured in years at wave 1. Second, gender was included as a dichotomous dummy variable, where $0 =$ female and $1 =$ male. Third, race was included in the analyses with a series of dummy variables, with African-American, other race, and Caucasian each coded as dichotomous dummy variables. Caucasian was used as the reference category and thus omitted from all of the analyses. Fourth, a neighborhood disadvantage scale was developed. This scale was created from three items during wave 1 interviews, wherein each youth's primary caregiver was asked to report the degree to which their neighborhood is 1) affected by litter and trash and 2) affected by drug dealers and drug users. Respondents were also asked a third question related to how much they would prefer to move from their current neighborhood. These three item responses were added to create a summated scale of neighborhood disadvantage ($\alpha = .65$).

4. Results

Prior to examining the potential association between parenting and verbal intelligence, a series of diagnostics were estimated for each of the parenting measures included in the current study. More specifically, in an effort to ensure an adequate amount of variation existed within each parenting measure, the variance of each measure was calculated separately for the non-adoptee and adoptee samples. In addition, Levene's tests for the equality of variances were estimated in an effort to determine whether the observed variances within each group were equivalent. The resulting *F*-statistics are reported in Table 1 and revealed significant differences in the amount of variance between the two groups for all but three parenting measures (paternal attachment, paternal education, and parental permissiveness). Importantly, for all of the parenting measures which had significantly different variances between the adoptee and non-adoptee groups, each measure had a greater value within the adoptee sample indicating a significantly greater amount of variation.[1] Taken together, these findings indicate that the examined parenting measures contain at least as much variation within the adoptee sample as within the non-adoptee sample.

[1] Typically adoption designs are host to truncated variation on key covariates; that we find the opposite in the Add Health is surprising.

Table 2
Parenting predicting wave 1 IQ and wave 3 IQ.

	Full sample						Adoption sample					
	Wave I IQ			Wave III IQ			Wave I IQ			Wave III IQ		
	b	*SE*	*Beta*	*b*	*SE*	*Beta*	*b*	*SE*	*Beta*	*b*	*SE*	*Beta*
Parenting measures												
Maternal disengagement	.01†	.00	.03	.01	.00	.02	.02	.02	.06	.00	.02	−.01
Maternal attachment	−.03*	.01	−.04	−.02	.01	−.02	−.02	.07	−.02	−.02	.06	−.04
Maternal involvement	.03**	.00	.06	.03**	.01	.07	.01	.04	.02	.03	.03	.10
Maternal education	.04**	.01	.09	.03**	.01	.08	.08**	.03	.21	.03	.02	.10
Paternal attachment	−.03**	.01	−.04	−.01	.01	−.02	−.01	.05	−.01	−.06	.04	−.12
Paternal involvement	.01†	.01	.03	.00	.01	.00	.03	.03	.08	.00	.03	−.02
Paternal education	.04**	.00	.11	.04**	.01	.10	−.01	.03	−.02	.04†	.02	.16
Parental permissiveness	.08**	.01	.14	.07**	.01	.12	.17**	.04	.26	.03	.03	.07
Control measures												
Age	−.05**	.01	−.09	−.01	.01	−.01	−.06	.04	−.10	−.03	.03	−.06
Gender	.13**	.02	.07	.10**	.02	.06	.04	.11	.02	.15†	.08	.12
African-American	−.49**	.03	−.19	−.56**	.03	−.23	−.46**	.16	−.17	−.45**	.13	−.22
Other race	−.42**	.03	−.17	−.39**	.03	−.16	−.13	.15	−.05	−.20†	.12	−.11
Neighborhood disadvantage	−.02**	.01	−.04	−.02*	.01	−.03	.02	.04	.02	.00	.03	.00
N		7006			5550			286			229	

† $p \leq .10$.
* $p \leq .05$.
** $p \leq .01$.

Table 2 presents the findings from a series of ordinary least squares (OLS) regression equations predicting variation in the wave 1 verbal IQ measure and the wave 3 verbal IQ measure within the full sample and the sample of adoptees.[2] In respect to wave 1 verbal IQ, all eight examined parenting measures were significantly associated with verbal IQ within the full sample.[3] While all of the measures were significant, it is important to point out that the effect sizes were relatively small (no betas were greater than .14) and that several measures were not associated in the expected direction (e.g., parental permissiveness). This was true for the models predicting the wave 1 and the wave 3 IQ scores. Importantly, the small effect sizes reached standard levels of statistical significantly largely because of the sample sizes that increased the statistical power in the models with the full sample (Ns ranging between 5550 and 7006).

The available evidence thus far provides relatively little evidence that parenting measures are strongly associated with IQ scores even when genetic influences are not taken into account. Even so, we followed up these non-genetically sensitive analyses with a genetically sensitive analysis by using the sample of adoptees. The last two equations in Table 2 present the results of these models. As can be seen, only two parenting measures—maternal education and parental permissiveness—exerted a statistically significant effect on the wave 1 verbal IQ measure. In addition, and directly in line with the full sample, parental permissiveness was not in the expected direction. For the wave 3 IQ measure, paternal education was the only parenting measure to reach statistical significance and even this effect was only marginally significant. While the adoption models contained far fewer statistically significant effects for the parenting measures than did the full sample, in most cases the effect sizes were approximately comparable and the reduction in statistically significant effects was due, in large part, to the reduction in statistical power owing to the significantly smaller sample size.

So far, the results have revealed relatively inconsistent and null associations between the parenting measures and IQ scores, particularly within the adoptee sample. Perhaps part of the reason for the relatively inconsistent effects of the parenting measures is because they might only have influences within the tails of the IQ distribution; that is, parenting might only be related to verbal IQ scores that are either very high or very low. In the next series of analyses, we examined this possibility by estimating the effects of parenting on scoring in the top 10th percentile of the verbal IQ measures using binary logistic regression models. Table 3 displays the results of these models for the full and the adoptee samples. Within the full sample, maternal education, paternal education, and parental permissiveness were all significantly associated with scoring in the top 10th percentile on both the wave 1 and wave 3 verbal IQ measures. Maternal attachment was related to wave 1 IQ scores, but not wave 3 IQ scores. Again, however, the effect sizes were relatively small in magnitude.

With regard to the adoptee sample, both maternal involvement and parental permissiveness were marginally associated with scoring in the top 10th percentile on the

[2] A reviewer wondered why we did not include a control variable for family socioeconomic status. We recalculated all of the models with a measure of family income (logged) and the general pattern of results remained the same. This measure also had a significant number of missing cases. In addition, the measures of parental education also overlapped significantly with the measure of income. As a result, we decided not to include the measure of income in the analyses.

[3] The relatively small effect sizes of the parenting variables might be due to the inclusion of a broad set of covariates. For example, parental education and IQ usually are significantly correlated at a much higher magnitude (here we show the $Beta = .10$). As a result, we estimated bivariate associations as a check on whether the bivariate associations would fall more in line with some of the findings from existing studies. These results showed convergence. Maternal education and wave 1 IQ scores, for instance, revealed a bivariate correlation of $r = .21$.

Table 3
Parenting measures predicting scoring in the top 10th percentile of IQ.

	Full sample						Adoption sample					
	Wave I IQ			Wave III IQ			Wave I IQ			Wave III IQ		
	b	*SE*	*OR*	*b*	*SE*	*OR*	*b*	*SE*	*OR*	*b*	*SE*	*OR*
Parenting measures												
Maternal disengagement	.01	.01	1.01	.02	.02	1.02	.08	.07	1.08	.05	.08	1.05
Maternal attachment	−.10*	.04	.91	−.04	.05	.96	.03	.25	1.04	−.09	.26	.92
Maternal involvement	.04	.03	1.04	.02	.03	1.02	.21†	.16	1.24	.33*	.23	1.40
Maternal education	.10**	.02	1.10	.08**	.02	1.08	.08	.10	1.09	−.01	.12	.99
Paternal attachment	−.01	.03	.99	−.04	.04	.96	.01	.16	1.01	−.16	.17	.85
Paternal involvement	.03	.03	1.03	.04	.03	1.04	−.05	.11	.95	−.13	.13	.88
Paternal education	.13**	.02	1.14	.13**	.02	1.14	−.03	.09	.97	.08	.12	1.09
Parental permissiveness	.22**	.04	1.24	.17**	.04	1.18	.24†	.18	1.27	.15	.20	1.17
Control measures												
Age	−.19**	.02	.83	.06*	.03	1.06	−.15	.11	.86	.22	.20	1.24
Gender	.13†	.09	1.14	.20*	.11	1.22	−.02	.36	.98	.97*	1.18	2.63
African-American	−.87**	.05	.42	−1.37**	.05	.25	−1.11	.25	.33	−1.49	.24	.23
Other race	−.39**	.08	.68	−.43**	.08	.65	−.37	.37	.69	−.85	.29	.43
Neighborhood disadvantage	.02	.03	1.02	−.03	.03	.97	.05	.15	1.05	.09	.19	1.10
N		7006			5550			286			229	

† $p \le .10$.
* $p \le .05$.
** $p \le .01$.

wave 1 verbal IQ measure. Only maternal involvement was significantly associated with scoring in the top 10th percentile on the wave 3 verbal IQ measure within the adoptee sample. Keep in mind, though, that the effect sizes for the full sample and the adoption sample were comparable across most of the covariates and the differences in statistically significant effects were largely due to differences in statistical power.

The last set of analyses examined the effects of parenting on scoring in the bottom 10th percentile of the examined verbal IQ scores. Once again, binary logistic regression models were estimated because examined verbal IQ scores were dichotomous. Table 4 contains the findings from these models. Within in the full sample, maternal involvement, maternal education, paternal attachment, and parental permissiveness were significantly associated with scoring in the bottom 10th percentile of both the wave 1 and wave 3 verbal IQ measures. Turning to the sample of adoptees, parental permissiveness was the only parenting measure to be significantly associated with scoring in the bottom 10th percentile on the wave 1 verbal IQ measure, and none of the parenting measures were associated with scoring in the bottom 10th percentile of the wave 3 measure. Again, it is important to point out that while the number of significant effects was significantly different between the full sample and the adoption sample, the effect sizes between the two samples were not consistently or substantively different.

Table 4
Parenting measures predicting scoring in the bottom 10th percentile of IQ.

	Full sample						Adoption sample					
	Wave I IQ			Wave III IQ			Wave I IQ			Wave III IQ		
	b	*SE*	*OR*	*b*	*SE*	*OR*	*b*	*SE*	*OR*	*b*	*SE*	*OR*
Parenting measures												
Maternal disengagement	.03	.02	1.03	.01	.02	1.01	−.02	.12	.98	.10	.16	1.11
Maternal attachment	.11	.08	1.12	.07	.08	1.07	.13	.69	1.13	.27	.78	1.31
Maternal involvement	−.08*	.03	.92	−.10*	.04	.90	.30	.32	1.35	.12	.31	1.13
Maternal education	−.05†	.03	.95	−.08*	.03	.92	−.16	.14	.85	.03	.20	1.03
Paternal attachment	.17**	.06	1.19	.09†	.06	1.10	.28	.68	1.31	.66	1.29	1.93
Paternal involvement	−.02	.04	.98	−.07	.04	.94	−.23	.18	.19	−.11	.23	.89
Paternal education	−.01	.03	.99	−.03	.03	.97	−.22	.14	.80	−.25	.15	.78
Parental permissiveness	−.28**	.03	.75	−.23**	.03	.79	−.56*	.15	.57	−.30	.23	.74
Control measures												
Age	.24**	.05	1.27	.11**	.04	1.11	.40	.37	1.49	.28	.28	1.33
Gender	−.29**	.09	.74	−.27*	.10	.76	−.17	.60	.85	−.98	.33	.37
African-American	.98**	.38	2.66	1.65**	.74	5.21	1.72*	4.53	5.59	2.44**	10.29	11.49
Other race	1.48**	.55	4.41	1.41**	.60	4.10	2.06*	6.63	7.88	1.45	4.40	4.26
Neighborhood disadvantage	−.01	.04	.99	.04	.04	1.04	−.20	.23	.82	.23	.37	1.26
N		7006			5550			286			229	

† $p \le .10$.
* $p \le .05$.
** $p \le .01$.

4.1. Sensitivity analyses

The results thus far have revealed that parenting measures tend to have very little influence on variation in IQ scores in adolescence and young adulthood. In order to examine the robustness of these results, we have conducted some additional statistical models. These models only include the subsample of monozygotic (MZ) twin pairs embedded within the Add Health data. To analyze them, we use the MZ difference-scores method, where difference scores for IQ and all of the covariates are estimated and the twin pair is the unit of analysis. By using this approach, genetic and shared environmental influences are held constant (i.e., the only reason that there would be differences between MZ twins is because of nonshared environmental influences) and, in line with the adoption design, the effects of the parenting measures are not confounded by genetic influences. Importantly, though, the MZ difference score directly models the parenting measures as nonshared environments. This is particularly salient because findings from behavioral genetic studies have shown that nonshared, not shared, environments are the most influential for adolescent and adulthood IQ (Plomin & Spinath, 2004). Without directly modeling parenting as a nonshared environment, it is quite possible that we were setting up the previous statistical models to not detect significant associations. The results of these sensitivity analyses are presented in Table 5 wherein the within-MZ twin pair differences in parenting are used to predict within-MZ twin pair differences in IQ.[4] As can be seen, none of the parenting measures maintained a statistically significant association with IQ measured at Wave 1 or at Wave 3 (the largest effect size was *Beta* = .18).

Table 5
Parenting predicting wave 1 IQ and wave 3 IQ within the MZ twin subsample.

	Wave I IQ			Wave III IQ		
	b	*SE*	*Beta*	*b*	*SE*	*Beta*
Parenting measures						
Maternal disengagement	.00	.01	−.01	−.01	.01	−.09
Maternal attachment	.00	.02	−.01	.01	.02	.03
Maternal involvement	−.02	.01	−.11	−.01	.02	−.06
Paternal attachment	−.02	.02	−.07	−.02	.03	−.08
Paternal Involvement	.00	.02	−.02	.00	.02	.02
Parental permissiveness	.03*	.01	.18	.02	.02	.11
N		161			129	

* $p \leq .05$.

5. Discussion

The role that family and parental socialization has on the development of variation in individual-level traits, such as intelligence, has been at the heart of much research and a lot of debate (Harris, 1995, 1998; Jensen, 1998; Pinker, 2002). Part of the reason that the debate continues is because of a lack of research examining family/parenting variables on IQ using an appropriately specified research design capable of controlling for salient sources of confounding. The goal of the current study was to partially address this gap in the literature by examining the influence of eight family and parenting measures on adolescent and young adulthood IQ. The analyses performed in the current study revealed three key findings.

First, the effects of the parenting measures on the wave 1 IQ and the wave 3 IQ measures of verbal IQ were relatively small and inconsistent within both the full and the adoptee samples. Given that the effects of the parenting measures on IQ were inconsistent in the full sample, genetic confounding did not appear to be upwardly biasing these associations. These inconsistent effects were somewhat surprising for the full sample because previous research has consistently revealed parenting influences to be related with variation in IQ when using a non-genetically informative design. While admittedly speculative, we offer two reasons why the results generated with the Add Health respondents are different from those of previous studies. First, the developmental time period that we focus on—adolescence and young adulthood—might seriously reduce any apparent parenting influences as other factors (e.g., peers) might appear to be more dominant. While we included multiple measures of parenting during adolescence, perhaps these measures did not tap the dimensions of parenting early in life that would have their strongest effect on later-life IQ. Findings from studies, for example, have showed that when it comes to accounting for stability in cognitive abilities, shared environmental factors are most important during childhood, but by adolescence and adulthood genetic influences become the dominant influence (Tucker-Drob & Briley, 2014; see also Loehlin et al., 1989). Whether these findings might account for part of the results of our study remains unclear at this point. Second, the Add Health is a nationally and contemporary sample of American youth. As a result, the findings generated from the full sample of respondents might be a more accurate reflection of the parenting–IQ link than is captured in previous studies that might use non-representative samples. Regardless of the reasons, the findings from the full sample, the adoption sample, and even the MZ sample converge to suggest that parenting has either null or extremely limited effects on variation in IQ during adolescence and adulthood.

The second main set of findings from this study centered on the extremes analysis that predicted scoring in the top 10th percentile and bottom 10th percentile of the IQ measures. The results from both the full and adoptee samples once again revealed a limited number of significant associations between each of the examined parenting measures and scoring in the extremes of the IQ distribution. Moreover, even when statistically significant associations did not emerge, they tended to be relatively small in magnitude. Once again, these findings tend to suggest that parenting has only limited influences in the development of extremely low or extremely high IQ scores in adolescents and young adults.

Third, and relatedly, we also calculated sensitivity analyses by using MZ difference scores. This approach represents a methodologically rigorous method to use that is also able to rule out the possibility of genetic confounding and, at the same time, measures the parenting variables as nonshared environments. The results generated from these models were in line with those from the full and the adoption samples,

[4] Note that environments that are inherently measured as shared environment cannot be included in an MZ difference score approach because they do not vary across any of the twin pairs. As a result, parental education and neighborhood disadvantage, along with demographic control variables, were omitted because they do not differ between MZ twins.

wherein none of the within-twin pair differences in the parenting measures were predictive of within-twin pair differences in the wave 1 or wave 3 IQ scores. Collectively, the available evidence generated from the Add Health data revealed that parenting measures account for relatively little variation in IQ scores. This conclusion was reached in cross-sectional models and longitudinal models and it was reached when using the full sample of respondents, only adoptees, and only MZ twin pairs. Moreover, this same conclusion was reached whether the environments were measured as shared environments or nonshared environments and whether or not the effects of the parenting measures were isolated from potential genetic confounding influences.

Although the statistically significant effects for the full sample and the adoption sample were different, these differences were largely grounded in differences in statistical power. As a result, it begs the question of what is the most appropriate modeling strategy to use when examining the influence of parenting on later-life IQ scores. While the results of the current study revealed convergence across all of the modeling strategies, we would advocate that the most methodologically defensible approach to use is a genetically sensitive research design. Two reasons inform this recommendation. First, there is ample empirical evidence showing that genetic influences account for a significant proportion of variance in IQ scores and in parenting measures (Jensen, 1998; Kendler & Baker, 2007) and that at least some of these genetic influences overlap between IQ and family/parenting (e.g., Trzaskowski et al., 2014). What this necessarily creates is a prime example of a confounding variable, one that must be taken into account in order to rule out spuriousness. Second, even though the results from our non-genetically informative analysis revealed very little parenting influences on IQ, a large body of existing studies shows a very different pattern of results. It is quite possible that these significant parenting effects are simply due to genetic confounding (Harris, 1998) and the only way to know for certain is to employ methodologies capable of ruling out this explanation. Moving forward, therefore, studies need to more fully rule out genetic confounding before claiming that family and parenting influences represent causal contributors to IQ. Failure to do so will leave them open to attacks based on model misspecification and erroneous conclusions regarding the true effect of parental and family socialization effects on IQ.

While this is not the first study to use an adoption-based research design in relation to IQ (e.g., Loehlin et al., 1989; Plomin, Fulker, Corley, & DeFries, 1997; Turkheimer, 1991), to our knowledge, this is the first study using a contemporary sample of adoptees to examine the effect of family and parenting influences on intelligence net of genetic confounders. As with all research, however, the results reported in the current study need to be viewed cautiously in light of a number of limitations. First, IQ was measured using a shortened version of the PPVT-R. While this measure has been used previously as a measure of IQ (Rowe et al., 1999), it is possible that there is something unique to this measure that would make the findings not generalizable to other standardized IQ tests. Future research should address this issue by examining a broader range of IQ measures. Unfortunately, the Add Health only collected information regarding the PPVT-R and so we were unable to explore the robustness of the results across different measures of IQ. Second, given that the results are based on analysis of adoptees, the question remains as to whether the findings would be generalizable to samples of non-adoptees. This is an important question, but one that is not fully addressable in the current study. We did, however, show convergence in the results with a sample of MZ twins. Nonetheless, additional research is needed to determine whether these findings would hold when using different research methodologies with different samples. Third, only a limited number of parenting variables were available in the Add Health. While these parenting measures have been used extensively in previous research (Barnes & Morris, 2012; Beaver, 2011; Crosnoe & Elder, 2004), it would have been useful had a larger array of parenting and family variables been able to be examined. And, it would also be interesting to explore in detail whether the effects of the parenting variables have non-linear associations with IQ scores. It is quite possible, for example, that only parenting in the tails of the distributions exert much of an influence on the development of IQ scores. Fourth, all of the parenting variables were based on self-reports. This necessarily raises questions about the accuracy of the responses and whether the same pattern of results would be detected with other measurement strategies (e.g., interviewer ratings). As a result, replication studies are needed to examine whether different types of reporting sources would produce the same set of findings.

In summary, the results of the current study call into question whether family and parental influences have much of an impact on creating variation in intelligence during adolescence and early adulthood. As a result, future studies that wish to explore the role of the family and parenting on IQ scores should use genetically sensitive research designs capable of controlling for confounding influences. Failure to do so may result in misspecified findings that provide inaccurate information about the true nature of the association between family/parenting influences and offspring IQ.

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References

Armour, S., & Haynie, D. L. (2007). Adolescent sexual debut and later delinquency. *Journal of Youth and Adolescence*, *36*, 141–152.

Barnes, J. C., & Morris, R. G. (2012). Young mothers, delinquent children assessing mediating factors among American youth. *Youth Violence and Juvenile Justice*, *10*, 172–189.

Beaver, K. M. (2011). The effects of genetics, the environment, and low self-control on perceived maternal and paternal socialization: Results from a longitudinal sample of twins. *Journal of Quantitative Criminology*, *27*, 85–105.

Bradley, R. H., Whiteside, L., Caldwell, B. M., Casey, P. H., Kelleher, K., Pope, S., et al. (1993). Maternal IQ, the home environment, and child IQ in low birthweight, premature children. *International Journal of Behavioral Development*, *16*, 61–74.

Campbell, J. R., & Mandel, F. (1990). Connecting math achievement to parental influences. *Contemporary Educational Psychology*, *15*, 64–74.

Crosnoe, R., & Elder, G. H. (2004). Family dynamics, supportive relationships, and educational resilience during adolescence. *Journal of Family Issues*, *25*, 571–602.

Deary, I. J., Johnson, W., & Houlihan, L. M. (2009). Genetic foundations of human intelligence. *Human Genetics*, *126*, 215–232.

Deater-Deckard, K., & Plomin, R. (1999). An adoption study of the etiology of teacher and parent reports of externalizing behavior problems in middle childhood. *Child Development*, *70*, 144–154.

DeBaryshe, B. D., Patterson, G. R., & Capaldi, D. M. (1993). A performance model for academic achievement in early adolescent boys. *Developmental Psychology*, *29*, 795–804.

Devlin, B., Daniels, M., & Roeder, K. (1997). The heritability of IQ. *Nature*, *388*, 468–471.

Fan, X., & Chen, M. (2001). Parental involvement and students' academic achievement: A meta-analysis. *Educational Psychology Review*, *13*, 1–22.

Gibbs, J. J., Giever, D., & Martin, J. S. (1998). Parental management and self-control: An empirical test of Gottfredson and Hirschi's general theory. *Journal of Research in Crime and Delinquency*, *35*, 40–70.

Guo, G., & Harris, K. M. (2000). The mechanisms mediating the effects of poverty on children's intellectual development. *Demography*, *37*, 431–447.

Harden, K. P., Mendle, J., Hill, J. E., Turkheimer, E., & Emery, R. E. (2008). Rethinking timing of first sex and delinquency. *Journal of Youth and Adolescence*, *37*, 373–385.

Harris, J. R. (1995). Where is the child's environment? A group socialization theory of development. *Psychological Review*, *102*, 458–489.

Harris, J. R. (1998). *The nurture assumption: Why children turn out the way they do.* New York, NY: Free Press.

Harris, K. M., Florey, F., Tabor, J., Bearman, P. S., Jones, J., & Udry, R. J. (2003). The National Longitudinal Study of Adolescent Health: Research design [www document]. http://www.cpc.unc.edu/projects/addhealth/design

Hay, C. (2001). Parenting, self-control, and delinquency: A test of self-control theory. *Criminology*, *39*, 707–736.

Jensen, A. R. (1998). *The g factor.* Westport, CN: Praeger.

Johnson, W., Turkheimer, E., Gottesman, I. I., & Bouchard, T. J. (2009). Beyond heritability: Twin studies in behavioral research. *Current Directions in Psychological Science*, *18*, 217–220.

Joussemet, M., Koestner, R., Lekes, N., & Landry, R. (2005). A longitudinal study of the relationship of maternal autonomy support to children's adjustment and achievement in school. *Journal of Personality*, *73*, 1215–1236.

Kendler, K. S., & Baker, J. H. (2007). Genetic influences on measures of the environment: A systematic review. *Psychological Medicine*, *37*, 615–626.

Koutsoulis, M. K., & Campbell, J. R. (2001). Family processes affect students' motivation, and science and math achievement in Cypriot high schools. *Structural Equation Modeling*, *8*, 108–127.

Loehlin, J. C., Horn, J. M., & Willerman, L. (1989). Modeling IQ change: Evidence from the Texas Adoption Project. *Child Development*, *60*, 993–1004.

Marchant, G. J., Paulson, S. E., & Rothlisberg, B. A. (2001). Relations of middle school students' perceptions of family and school contexts with academic achievement. *Psychology in the Schools*, *38*, 505–519.

McGue, M., Osler, M., & Christensen, K. (2010). Causal inference and observational research: The utility of twins. *Perspectives on Psychological Science*, *5*, 546–556.

Miele, F. (2002). *Intelligence, race, and genetics: Conversations with Arthur R. Jensen.* Boulder, CO: Westview Press.

Moffitt, T. E. (2005). The new look of behavioral genetics in developmental psychopathology: Gene–environment interplay in antisocial behaviors. *Psychological Bulletin*, *131*, 533–554.

Natsuaki, M. N., Leve, L. D., Harold, G. T., Neiderhiser, J. M., Shaw, D. S., Ganiban, J., et al. (2013). Transactions between child social wariness and observed structured parenting: Evidence from a prospective adoption study. *Child Development*, *84*, 1750–1765.

Nisbett, R. E., Aronson, J., Blair, C., Dickens, W., Flynn, J., Halpern, D. F., et al. (2012). Intelligence: New findings and theoretical developments. *American Psychologist*, *67*, 130–159.

Pinker, S. (2002). *The blank slate: The modern denial of human nature.* New York, NY: Viking.

Plomin, R., Fulker, D. W., Corley, R., & DeFries, J. C. (1997). Nature, nurture, and cognitive development from 1 to 16 years: A parent–offspring adoption study. *Psychological Science*, *8*, 442–447.

Plomin, R., & Spinath, F. M. (2004). Intelligence: Genetics, genes, and genomics. *Journal of Personality and Social Psychology*, *86*, 112–129.

Resnick, M. D., Bearman, P. S., Blum, R. W., Bauman, K. E., Harris, K. M., Jones, J., et al. (1997). Protecting adolescents from harm: Findings from the National Longitudinal Study of Adolescent Health. *Journal of the American Medical Association*, *278*, 823–832.

Rowe, D. C., Jacobson, K. C., & van den Oord, E. J. C. G. (1999). Genetic and environmental influences on vocabulary IQ: Parental education level as a moderator. *Child Development*, *70*, 1151–1162.

Rutter, M. (2006). *Genes and behavior: Nature–nurture interplay explained.* Malden, MA: Blackwell.

Rutter, M., Pickles, A., Murray, R., & Eaves, L. J. (2001). Testing hypotheses on specific environmental causal effects on behavior. *Psychological Bulletin*, *127*, 291–324.

Schreck, C. J., Fisher, B. S., & Miller, J. M. (2004). The social context of violent victimization: A study of the delinquent peer effect. *Justice Quarterly*, *21*, 23–47.

Schwartz, J. A., & Beaver, K. M. (2013). Examining the effects of dopamine genes on verbal IQ within and between families. *Journal of Neural Transmission*, *120*, 477–486.

Steinberg, L., Lamborn, S. D., Dornbusch, S. M., & Darling, N. (1992). Impact of parenting practices on adolescent achievement: Authoritative parenting, school involvement, and encouragement to succeed. *Child Development*, *63*, 1266–1281.

Trzaskowski, M., Harlaar, N., Arden, R., Krapohl, E., Rimfeld, K., McMillan, A., et al. (2014). Genetic influence on family socioeconomic status and children's intelligence. *Intelligence*, *42*, 83–88.

Tucker-Drob, E. M., & Briley, D. A. (2014). Continuity of genetic and environmental influences on cognition across the life span: A meta-analysis of longitudinal twin and adoption studies. *Psychological Bulletin*, http://dx.doi.org/10.1037/a0035893 (Advance online publication).

Tucker-Drob, E. M., Briley, D. A., & Harden, K. P. (2013). Genetic and environmental influences on cognition across development and context. *Current Directions in Psychological Science*, *22*, 349–355.

Turkheimer, E. (1991). Individual and group differences in adoption studies of IQ. *Psychological Bulletin*, *110*, 392–405.

Wadsworth, M. E. (1986). Effects of parenting style and preschool experience on children's verbal attainment: Results of a British longitudinal study. *Early Childhood Research Quarterly*, *1*, 237–248.

Wright, J. P., & Beaver, K. M. (2005). Do parents matter in creating self-control in their children? A genetically informed test of Gottfredson and Hirschi's theory of low self-control. *Criminology*, *43*, 1169–1202.