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The Predictability of IQ on Delinquency: A Structural Equation Model (SQM)

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Abstract

Long years of studies on IQ and delinquency have generated competing explanations. In this study, to test these competing explanations, we revisited Wolfgang et al.'s (1973) birth cohort dataset of 9,944 boys whose ages ranged between 10 and 18 years old. We conducted a Structural Equation Model (SQM) by using an SPSS AMOS software. This model enabled us to see the strength of the direct and indirect relationship between endogenous and exogenous variables as well as total effects on delinquency. Overall results suggest that environmental variables significantly affect the relationship between IQ and delinquency through schooling time. To be more specific, the direct impact of IQ level on offense is weak and ignorable, and indirect effects through schooling length and socio-economic status are insignificant.

Keywords: Intelligence (IQ), Delinquency, Structural Equation Model.

Introduction

IQ studies date back to Lombroso's atavistic perspective. This perspective implies that genius students rarely engage in deviant behaviors (Lombroso, 1968). The focus on the IQ-crime relationship had remained extensive until the birth of the Chicago School of Sociology, which shifted the scholarly attention from trait-based factors to criminogenic environments (Walsh, 1987). The abandoned research interest in IQ revitalized after Hirschi and Hindelang (1977) introduced a new construct "school performance" to the causal relationship between IQ and delinquency. Hirschi and Hindelang (1977) proposed

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that the impact of IQ on delinquency is through school performance that plays a mediating role between the two. In this study, we used students' disciplinary warnings and length of staying in school as indicators of school performance.

To date, studies on the IQ-delinquency relationship have offered contradictory findings that have hovered around three major competing assumptions. First, IQ is a strong predictor for delinquent behaviors even controlling for other variables, such as Socio-Economic Status (SES), race, and social class (Beaver et al, 2013; Nedelec et al., 2014; Schwartz et al., 2015; Lynam et al., 1993; Moffitt et al., 1981; Wolfgang et al., 1972). Second, IQ does not lead to delinquent behavior because environmental factors largely influence it (Simons, 1978; Menard and Morse, 1984). For example, criminogenic environments negatively affect the cognitive ability of lower-class juveniles, thereby increasing the risk of their engagement in deviant behaviors (Ward and Title, 1994). The third assumption, inspired by Hirschi's (1969) social bond theory, proposes that the impact of IQ on delinquency is through school failure (Hirschi and Hindelang, 1977). Putting it differently, low IQ leads to school failure, in turn, causes less social bond, low self-esteem, and frustration, then yield to delinquent behaviors (Fergusson and Horwood, 1995).

Drawing a clear distinction between these competing assumptions is quite difficult because of a high correlation between IQ and school achievement, which ranges from .53 to .93 in various studies (Sternberg et al., 2001). Although research consistently shows that students with lower IQ scores display poor school achievement (Broody, 1997), IQ explains only 25% of the variation in school achievement (Sternberg et al., 2001). Therefore, further research is needed to explore unobserved variables. For example, in the examination of early conduct problems, some research draws attention to other factors, such as socio-economic disadvantage, nutrition, parental discipline, exposure to violence at an early age, and parental social support (Feritas and Downey, 1998; Reiss and Rhodes, 1961; Schoenthaler and Bier, 2000; Golmaryami, et al. 2016).

The current study investigates the explanatory power of IQ on delinquency. The literature highlights three issues regarding the relationship between IQ and delinquency: IQ stability and change, the mediating role of school performance, and spuriousness. In this context, we employed Wolfgang et al.'s data (ICPSR, 2008) to test these competing hypotheses of IQ and delinquency.

Moderating effect of environmental factors

Environmental factors have been extensively guiding contemporary criminology for a long time (Cullen, 2011; Lilly et al., 2010; Walsh, 2010; Wright & Miller, 1998). Especially social control and social learning theories, and a large volume of research testing these theories emphasize the strength of environmental factors in explaining crime. Also, recent biosocial studies do not reject the impact of environmental factors (Silver and Nedelec, 2018). Researchers tend to add them to their models to see how and to what extent they influence the relationship between IQ and crime (Silver and Nedelec, 2018).

In their review of meta-analyses, Cullen et al. (1997) report that the power of IQ on explaining delinquency ranges from weak to modest since other relevant variables (i.e., SES, parental discipline, gender, school failure) moderate the strength of the relationship between the two. Menard and Morse (1984) stress that sociological variables shrink the magnitude of IQ but are not affected by IQ. On the other hand, a recent study by Silver

and Nedelec (2018) reject the idea that IQ is a passive factor in moderating the relationship between environmental variables and antisocial behavior. This study offers that the impact of environmental factors (i.e., neighborhood disadvantage, school attachment, and parental supervision) on antisocial behavior is significantly varied depending on the level of IQ. Therefore, based on existing research, both IQ and environmental factors moderate each other's effects on delinquency.

IQ stability versus change

Another issue raised by researchers is whether IQ is stable or changeable over the life course. Investigating the stability and changeability of IQ is essential since some research report that delinquents, on average score, eight IQ points lower than non-delinquents (Huesmann et al., 1987; White et al, 1989; Lynam et al., 1993; see Oleson & Chappell, 2012). Holding any of these two assumptions-- IQ is stable or can change--leads to different policy and research implications. For example, if the assumption that IQ can change is valid, then it would be difficult to establish a stable causal link between IQ and crime. Some previous studies argue that IQ is stable (Hirschi & Hindelang, 1977; Moffit, 1984). Even some large-scale intervention programs cause a minor improvement in IQ level (Sternberg et al., 2001).

On the other hand, a large body of research supports the idea of IQ changeability (Whitaker, 2008; Honzik, Macfarlane, & Allen, 1948; Flynn, 1987) and especially the role of environmental factors in changing people's IQ level (Simon 1978). Some research examined a bunch of environmental factors such as nutrition, technological developments, and better schooling (Sternberg et al., 2001). In this context, James R. Flynn (1987) made a noteworthy contribution by analyzing fourteen nations' data. His study suggests that environmental factors can lead to an IQ improvement ranging from 5 to 25 points in a single generation.

Another evidence appears in genetic studies that advocate the heritability of IQ. For example, in their examination of previous technical research, Rushton and Jensen (2005) identify that 80 percent of IQ difference between Blacks and Whites in the United States can be attributed to heritable conditions. Developments in genetics have provided scientists with extensive opportunities to assess the predictability of the shared environment, unique environment, and genes. For example, research on dizygotic (DZ) and monozygotic (MZ) twins reveal that IQ is heritable up to 80% independent of the shared and unique environment (Kendler and Prescott, 2006). The flip side of these is that other factors can influence IQ development greater than 20%.

IQ and school achievement

Previous studies showed a strong positive relationship between IQ and school achievement (Lynam, Moffitt, & Stouthamer-Loeber, 1993). A plausible explanation for this relationship is that highly intelligent students are more likely than lower intelligent ones to stay in the school. Some research found that high IQ explains 60% of the variation in school staying (Sternberg et al, 2001) and 25% of the variation in school achievement. On the other hand, the relationship between IQ and the length of staying in school/school achievement is not straightforward. For example, Ceci and Williams (1997) point out the presence of a reciprocal relationship between IQ and school staying. According to

them, students with higher IQ are more likely to stay longer in school. On the other hand, they also support that each additional stay in school increases students' IQ level compared to dropouts.

The relationship between IQ and school achievement becomes more complicated when the would-be impact of economic and parental factors on school achievement are considered (Deslandes, Royre, Turcotte, & Bertrand, 1997; Gutman & Midgley, 2000). For instance, independent of social class and SES, children are more likely to be successful when they receive high academic aspirations from their parents. In the absence of IQ scores, empirical studies reveal that parental efficacy accounted for 58% variation in explaining school achievement (Sternberg et al., 2001).

The flip side of this issue is that economic disadvantage factors are negatively correlated with both school achievement and delinquency. In a longitudinal experimental study, Pagani et al. (1999:1209) found that poverty strongly predicts serious delinquency and academic failure after controlling "maternal education and early childhood behavior." In light of existing literature, we can hypothesize that IQ moderately influences school achievement. On the other hand, researchers should control theoretically relevant variables, such as the length of schooling and parental support, to see the magnitude of IQ on delinquency.

Spuriousness

Some researchers claim that the relationship between IQ and delinquency is spurious (Gottfredson & Hirschi, 1990; Hirschi & Hindelang, 1977). In other words, the influence of IQ on delinquency is confounded by environmental factors, such as socio-economic status, which have significant effects on both IQ and delinquency (Jolliffe & Farrington, 2010; Moffitt, Gabrielli, Mednick, & Schulsinger, 1981). Several studies which address the spuriousness concerns still provide considerable support to the power of IQ on predicting delinquency (Lynam et al., 1993; Moffitt et al., 1981; Kanazawa & Hellberg, 2010; Mears & Cochran, 2013). However, a primary limitation of these studies is that they utilized only socio-economic status as a control variable. Especially, Block (1995) is critical about Lynam et al.'s study because of an omitted variable bias. The author postulates that controlling only SES does not necessarily indicate that the relationship between IQ and delinquency is nonspurious. Other environmental variables are still related to both IQ and delinquency. By referring to Ceci (1993), Block holds that schooling time may affect delinquency through the cognitive skills of students. Therefore, he recommends broadening the number of environmental variables in testing the spuriousness argument.

Sample

We used Wolfgang's et al. (1973) dataset for this study to test the assumptions mentioned above about the IQ delinquency relationship. Wolfgang's et al. (1973) collected this data at an individual level to investigate the history of delinquency in a birth cohort of 9,944 boys whose ages ranged from 10 to 18. These cohorts were born in 1945, residing in Philadelphia, PA. The data covers the years between 1945 and 1963 and was obtained from three institutions: schools (public, private and parochial), Philadelphia Police Department's Juvenile Aid Division, and selective service records (ICPSR, 2009). Overall the data include information about the onset and cessation process of delinquent

behavior, demographic characteristics of the subjects and victims, academic performance, and offense information.

Endogenous Variables

Number of Offenses

The dependent variable of this study is the number of offenses. We examined it under three categories: (1) non-index offenses (misdemeanors), (2) index offenses (homicide, rape, robbery, aggravated assault, burglary, larceny, motor vehicle theft, and arson), and (3) combined offenses that include both index and non-index *modus operandi* in a single event. Measuring crime at a three category enables us to compare whether low IQ is associated with seriousness or non-seriousness of crime. We summed the number of offenses committed by each student, then classified them into three categories.

Disciplinary

Hirschi and Hindelang (1977) stress that IQ operates through school-level factors that are highly correlated with the social bonds of students. Among the school-level factors, school achievement received considerable attention for its statistically significant relationship with both IQ and delinquency (Fergusson & Horwood, 1995; Lynam et al., 1993). In this case, we used school disciplinary warnings as a proxy measure to estimate school achievement and measured it as a dichotomous variable (received warning=1; received no warning=0). Previous research report that IQ is associated with antisocial behavior (Silver & Nedelec, 2018; Mears & Cochran, 2013). Therefore, we reasonably expect that school disciplinary problems play a mediating role between IQ and delinquency.

Schooling time

There are two distinct views concerning the relationship between IQ and schooling time. According to Ceci (1993), there is a reciprocal relationship between the length of staying in school and IQ scores. The first view suggests that IQ explains 60% of the variation in staying in school longer. The second view proposes that the length of staying in school is significantly and positively related to IQ scores (Hirschi and Hindelang, 1977). Recent studies found that each extra year of staying in school improves IQ between one to five points (Ritchie & Tucker-Drob, 2018). We measured the length of staying in school as the number of years that students stay in school. The data report that 9,857 students have records for 'total schooling years.' Including the variable 'the length of staying in school' into our model contributes to the debate that students staying in school longer are less likely to commit crimes.

IQ Scores

In their book, *Delinquency in a Birth Cohort*, Wolfgang et al. (1972) depict how they obtain the IQ scores of students:

The intelligent tests administered to the boys in school varied considerably from one system to another. Group tests predominated everywhere. Of the 8,700 boys

(87.5 percent of 9,945) tested, at least 86 percent had been scored on group tests. The most common test in the public schools was the Philadelphia Verbal Ability Test, usually given during the second term of the second and sixth grades. The scores on this test were converted into standard IQ scores, which were recorded on the termination cards of 5,168 (79.8 percent) of the 6,472 boys in public school. For an additional 311 pupils (4.8 percent), scores were derived almost entirely from some of the Otis Mental Ability tests (Alpha, Beta, or Gamma Forms), the Wechsler-Bellevue test, the Wechsler Intelligence Scale for Children, or the Stanford-Binet test. No scores were recorded for 993 (15.3 percent) of the public schoolboys (p.41-42).

As noted above, IQ scores were measured through three waves. We will use the third wave IQ scores (N=6,930) to see the effect of schooling length on IQ.

Exogenous Variables

Socio-economic Status (SES)

Wolfgang et al. (1972) did not directly obtain SES from school records. They used the median family based on the calculation of the Community Renewal Program of the City of Philadelphia (CRP) in 1964. CRP calculated the median income of families according to “housing quality, overcrowding, occupation, and family income (p.47).” Running a Pearson correlation on these four factors and income, Wolfgang et al. (1972) noticed very high correlations between them that ranged from .8105 to .8655. For this reason, merging their data with the CRP, they constructed a new median income of family variable which was constructed at a five-level ordinal scale as: (1) income below \$4,000, (2) income \$4,001 - \$4,500, (3) income \$4,501 - \$5,783, (4) income \$5,784 - \$6,790, and (5) income above \$6,790.

Race

Table 1. Descriptive Statistics

	N	Min-Max	Mean	SD
Number of Offenses	6805	0 - 23	0.84	2.07
Number of Non-Index Offenses	6805	0 - 16	0.57	1.41
Number of Index Offenses	6805	0 - 19	0.27	0.91
Race (African American)	6805	0 - 1	0.24	0.43
Disciplinary Warnings	6805	0 - 1	0.07	0.26
Schooling Length	6805	4 - 15	12.29	1.10
Income	6805	1 - 5	3.67	1.17
IQ Score	6805	14 - 150	99.30	17.98

Since the purpose of this study is to analyze whether IQ predicts delinquency independent of other relevant variables, we aimed to control the impact of the race variable. We measured race as a dichotomous variable (African Americans=0; Whites=1).

Wolfgang et al.'s data provide the racial status of the research subjects that enable us to examine the direct and indirect effects of race on crime.

As shown in Figure 1, 2, and 3, race indirectly affects crime in three ways: Race->IQ->Crime, Race->SES->Schooling Length->Crime, Race->SES->Crime

Table 1 provides descriptive statistics of the variables used in this study. Students, on average, commit less than one offense. African Americans constitute 24% of the sample, and the average length of staying in school is approximately 12 years. A small percentage of students (7%) receive disciplinary warnings. The median income level is between \$4,501 and \$5,783, and the average IQ score is approximately 99.

Analytical Plan and Model Fit Analysis

Previous studies suggest that there is an indirect relationship between IQ and crime. Therefore, using SPSS AMOS, we applied a Structural Equation Modeling rather than conventional regression analysis to identify direct and indirect variable impacts on outcome variables. Below, we have discussed the model fit analysis for a path model and conducted separate analysis on three different offense categories (i.e., all/combined crimes, index crimes, and non-index crimes).

Table 1 shows that the distribution of crime variables is highly skewed, that is, one-standard-deviation changes in any crime category yields to negative values in the sample distributions. For this reason, the model fit statistics of SPSS AMOS suggest that the observed data do not fit the proposed model based on the assumption of multivariate normality. The high chi-square value (1021.45; $p < .05$), for instance, confirmed this poor fit. As a solution, we implemented 95% bias-corrected confidence intervals to figure out the significance level of relationships. Bias-corrected confidence intervals better handle non-normality of the data compared to z-test procedures by generating sub-samples ($b=2,000$ in the current study) of the same size data from the original data/sample to compute the parameter estimates (MacKinnon, Kisbu-Sakarya, & Gottschall 2013; Pituch and Stapleton 2008).

Results

Table 2. Zero Order Correlations (N=6,805)

	Combined Crimes	Non- Index Crimes	Index Crimes	Disciplinary	School Length	IQ Score	Race
Non-Index Crimes	.933**						
Index Crimes	.830**	.574**					
Disciplinary	.480**	.419**	.443**				
Schooling Length	-.252**	-.232**	-.215**	-.278**			
IQ Score	-.197**	-.175**	-.178**	-.195**	.255**		
Race	.305**	.270**	.277**	.352**	-.256**	-.338**	
Income	-.250**	-.224**	-.222**	-.261**	.262**	.300**	-.595**

** Correlation is significant at the 0.01 level (2-tailed).

Zero-order correlations and collinearity diagnosis indicate that there is no severe multicollinearity problem between independent variables. Further analysis reveals that income level and race (African American) are the most strongly ($r = -.595$) correlated variables.

**Table 3. Bias Corrected 95% Confidence Intervals
Between Exogenous and Mediating Variables**

	b	95% CI
SES=>Schooling time	0.244*	0.222 ; 0.269
SES=>IQ Score	3.829*	3.497 ; 4.181
Schooling time=>IQ Score	3.116*	2.695 ; 3.478
IQ Score=> Disciplinary	-0.003*	-0.003 ; 0.002
Race =>SES	-0.216*	-0.222 ; -0.21

Table 3 shows the direct effects between the exogenous and mediating variables. There is a significant positive direct effect of SES on schooling time and IQ score ($b=0.244$; $b=3.829$) as well as schooling time on IQ score ($b=3.116$). There is also a significant, but negative direct effect of IQ score on disciplinary ($b=-0.003$), and race on SES ($b=-0.222$).

**Table 4. Bias Corrected 95% Confidence Intervals
for Combined, Index, and Non-Index Crimes.**

	Combined Crimes		Index Crimes		Non-Index Crimes	
	b	95% CI	b	95% CI	b	95% CI
Disciplinary	3.19*	2.77 ; 3.603	3.19*	1.125 ; 1.508	1.873*	1.599 ; 2.157
IQ Score	-0.006*	-0.008 ; -0.004	-0.006*	-0.003 ; -0.001	-0.003*	-0.005 ; -0.002
Schooling time	-0.172*	-0.222 ; -0.12	-0.172*	-0.077 ; -0.033	-0.117*	-0.155 ; -0.083
SES	-0.09*	-0.139 ; 0.043	-0.09*	-0.056 ; -0.01	-0.059*	-0.092 ; -0.023
Race	0.459*	0.326 ; 0.61	0.459*	0.125 ; 0.251	0.272*	0.175 ; 0.384

Table 4 shows the significant value of coefficients based on the bias confidence intervals across three crime groups (combined, index, and non-index). The direct effect of disciplinary on the three crime variables are positive and significant. Students who received disciplinary warnings were more likely to involve in delinquency. Also, the direct effects of schooling time and IQ on crime variables are significant, but the relationship is negative. This finding indicates that students who had lower IQ and poor length of stay in the school (in years) were more likely to involve in delinquency.

Figure 1, 2, and 3 below depict the recursive path models of the proposed relationships that show the direct and indirect effects of exogenous and endogenous variables on three crime types (combined, index, and non-index). It is noteworthy to mention that we considered the cultural and political conditions of the 1950s in the United States when deciding to include the observed variables into our model and determining the direction of relationships (i.e., temporal ordering) between these variables. Overall results indicate that there is no substantial crime type-based difference in the effects exogenous and mediating variables. Standardized coefficients in all the models (Figure, 1, 2, and 3) suggest that SES significantly explains IQ scores for 6% ($b=3.83$; $p \leq 0.001$). The significant positive relationship between SES and IQ implies that nutrition and environmental factors might influence the IQ level. This finding is consistent with some previous research. As noted above, based on bias-corrected 95% confidence intervals ($b=-.216$; $p \leq 0.001$), race significantly explains socioeconomic status (SES) for 35%. Figure 1, 2, and 3 show that SES leads to a significant increase in the length of staying in school ($b=.244$; $p \leq 0.001$) and explains 6.8% of the variation.

On the other hand, figure 1 shows that the direct effect of SES on combined crimes is weak ($b= -0.09$; $p \leq 0.001$) and explains only 0.25% of the variation in outcome variable (we obtained similar results for index and non-index crimes). This finding suggests that affluent families' kids less likely (0.25% less) commit crimes compared to non-affluent families' kids. The total effect of SES variable on combined crimes is 3.02%, and the indirect effects of SES variable count 69.5% variation (SES- \rightarrow IQ- \rightarrow Combined Crimes = $.25 \star -.05 = .0125$; SES- \rightarrow Race- \rightarrow Combined Crimes = $.59 \star -.10 = .059$; SES- \rightarrow Schooling Length- \rightarrow Combined Crimes = $.26 \star -.09 = .0234$; SES- \rightarrow IQ- \rightarrow Disciplinary- \rightarrow Combined Crimes = $.25 \star -.20 \star .41 = .0205$).

The length of staying in school is positively and significantly related to IQ scores ($b=3.12$; $p \leq 0.001$) and explains 3.61% of the variation on IQ. The slope of the length of staying in school display that one unit (year) increase in schooling length corresponds with a 3.12 increase in IQ. On the other hand, the indirect effect of the length of staying in school through IQ on the outcome variables is very minimal (for example, it is $.19 \star -.05 = .0095$ for combined crimes). The total effect of the length of staying in school explains 1.4% of the variation.

Race variable is significantly related to, however, does not explain much variation in outcome variables (combined, index, and non-index crimes). For example, the explained variation of race in combined crimes is less than 1%. Likewise, there is a significant negative relationship between IQ and all three categories of crimes. The direct effect of IQ scores explains only .025% (a quarter of 1%) of the total variation on combined crimes. The indirect effect of SES through IQ to the outcome variable is highly small or ignorable. Finally, the variable "school disciplinary warnings" has the strongest effect on all three types of delinquency (combined, index and non-index crimes) which significantly explains 16.7% of the variation ($b=3.19$; $p \leq 0.001$).

Figure 1. Path Analysis for Combined Crimes with Standardized Coefficients .

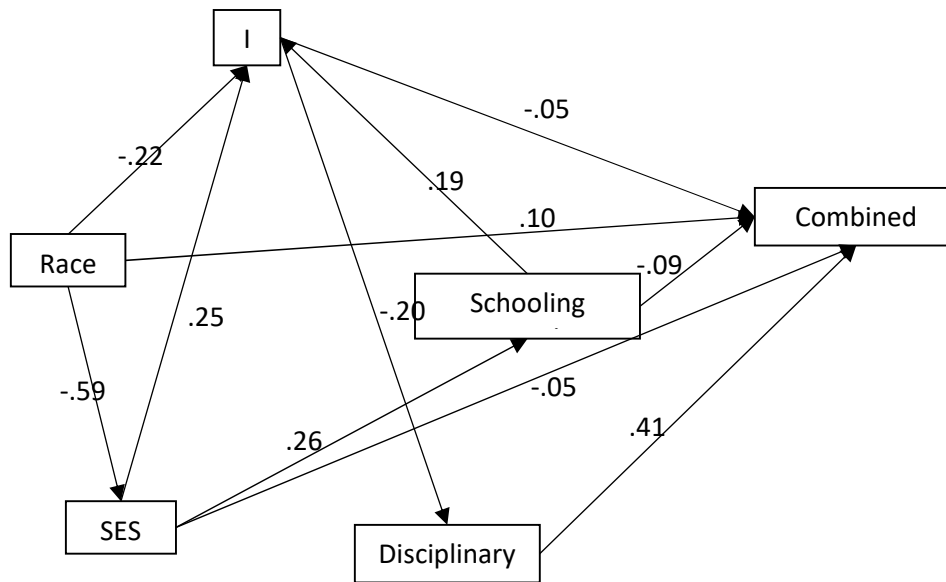


Figure 2. Path Analysis for Index Crimes with Standardized Coefficients .

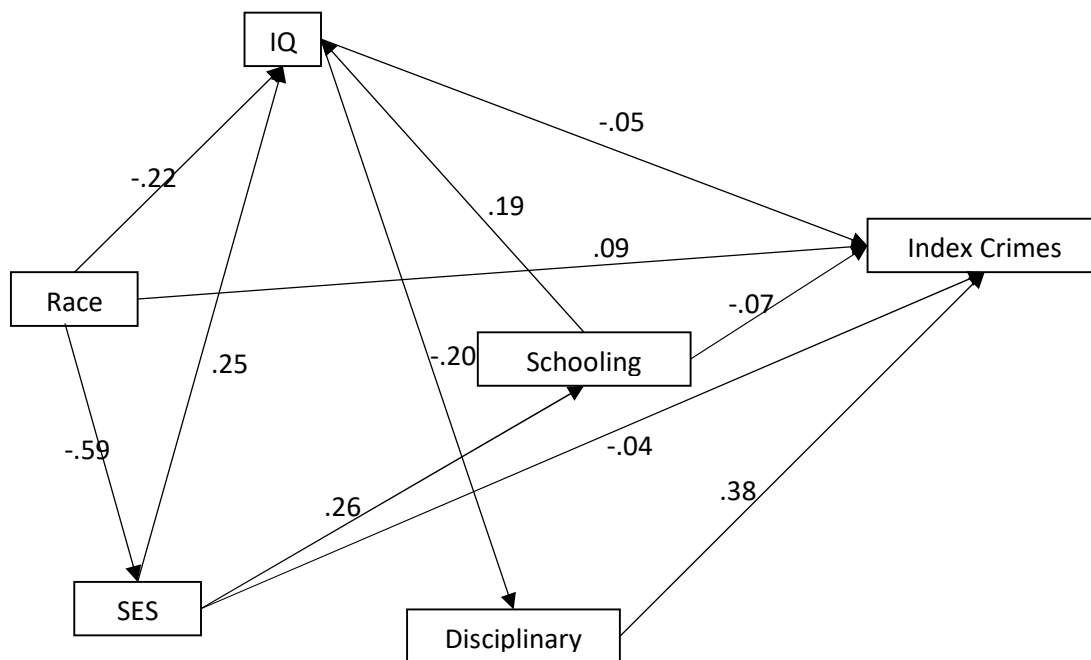
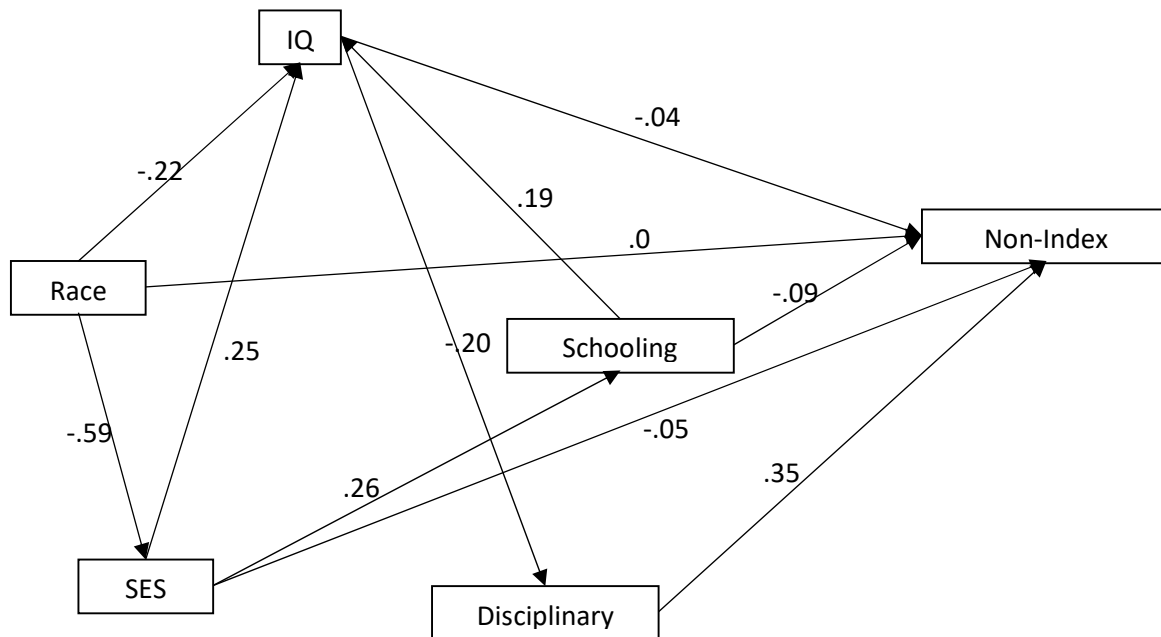


Figure 3. Path Analysis for Non-Index Crimes with Standardized Coefficients.



In short, as Figures 1, 2, and 3 show, the impact of environmental factors, IQ, and school performance is not dependent upon the type of crime which we measured in this study under three categories: combined, index, and non-index.

Conclusion

In this study, using structural equation modeling, we have investigated the explanatory power of IQ on delinquency, considering exogenous and endogenous variables. Overall, the path analyses suggest a weak link between IQ and delinquency. Environmental variables significantly affect the relationship between IQ and crime through the length of staying in school. In this way, this study provides strong support to Ceci's (1993) perspective. There is also both support and contradiction for Hirschi and Hindelang's (1977) study. Our study supports their first proposition that the length of staying in school increases IQ scores. However, it contradicts the second proposition that the length of staying school indirectly affects the crime through IQ (Schooling length \Rightarrow IQ \Rightarrow crime $\Rightarrow 0.19 \times -0.05 = 0.0095$).

A noteworthy finding of this study is the predictive strength of school disciplinary problems, and this strength is consistent regardless of the offense category (combined, index, and non-index). Therefore, we can hypothesize that students who display antisocial behavior early in life are more likely to continue deviant behaviors during their puberty and adulthoods (stability of aggressive behavior) independent of their IQ levels. These findings take us another direction, which is beyond the IQ argument, that delinquency may be the result of cumulative disadvantages (i.e., family, biological factors, peer groups, and neighborhood) coming from early childhood that mortgage the rest of their life (Campbell, Shaw, & Gilliam, 2000; Caspi and Moffitt, 1993; Eron, 1987; Fergusson et al.,

1995; Gagnon et al, 1995; Huesmann et al., 1984; LeBlanc and Girard, 1997; Olweus, 1979, Stattin & Magnusson, 1989, 1991).

The findings in this study are subject to at least two limitations. First, we measured the crime based on police records which have a limitation of including offenses known to or defined by the police (Maxfield & Babbie, 2016). Moreover, smart criminals are less likely to be detected by the police. For this reason, self-reported crime data would help to address the limitations of official data in exploring the relationship between IQ level and crime. Second, only juveniles are the subjects of this study that restricts us from observing how IQ level fluctuates as people age. For instance, greedy people might outsmart the system by committing white collar crimes. Therefore, the relationship between IQ and crime can be curvilinear as people age.

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