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Intelligence and criminal behavior in a total birth cohort: An examination of functional form, dimensions of intelligence, and the nature of offending

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ABSTRACT

Intelligence has been found to predict a wide range of criminal and antisocial behaviors, including violent and chronic offending. The results from this literature have shown that individuals with lower intelligence levels (typically measured as IQ) tend to be more likely to engage in criminal behavior. Despite the pervasiveness of this basic finding, many aspects of the IQ-offending relationship remain unclear, such as the functional form of the association. Some perspectives expect a discrete or curvilinear association, while others assume a more incremental or linear pattern. The current study contributes to this literature by examining the functional form of the IQ-offending association in a total birth cohort of Finnish males born in 1987. Criminal offending was measured with nine different indicators from official records and intelligence was measured using three subscales (verbal, mathematical, and spatial reasoning) as well as a composite measure. The results show consistent evidence of mostly linear patterns, with some indication of curvilinear associations at the very lowest and the very highest ranges of intellectual ability. We discuss the implications of these findings for future research.

1. Introduction

Along with sex and age, intelligence stands out as one of the most consistent predictors of criminal and antisocial behaviors. Decades of studies from multiple disciplines have shown that, on average, individuals with lower IQ scores are more likely to engage in antisocial behavior relative to individuals with higher IQ scores (Beaver et al., 2013; Herrnstein & Murray, 1994; Jolliffe & Farrington, 2004; Kratzer & Hodgins, 1999; Neisser et al., 1996). Lower overall levels of intelligence have also been found to be associated with a wide range of criminal offending including violent offenses such as sexual assault (Cantor, Blanchard, Robichaud, & Christensen, 2005), murder (Dwyer & Frierson, 2006), and other forms of interpersonal violence (Kearns & O'Connor, 1988). Additional studies have demonstrated a negative association between intelligence and offending versatility, wherein offenders with lower levels of intelligence are more likely to engage in a greater variety of criminal acts (Frisell, Pawitan, & Långström, 2012; Nevin, 2000; Walsh, 1987; Walsh & Beyer, 1986).

In addition to studies examining the association between intelligence and criminal behaviors, a related body of literature has documented negative associations between intelligence and contact with the criminal justice system (Beaver et al., 2013; Diamond, Morris, & Barnes, 2012; Fergusson, Horwood, & Ridder, 2005; Hirschi & Hindelang, 1977; Loeber et al., 2012; Yun & Lee, 2013). These patterns have also been replicated at higher levels of aggregation, such as neighborhoods (Beaver & Wright, 2011), states (Bartels, Ryan, Urban, & Glass, 2010; McDaniel, 2006), and even nations (Rushton & Templer, 2009). In perhaps the most comprehensive study examining the IQ-offending association at the macro-level, Rushton and Templer (2009) utilized previously estimated national IQ scores (Lynn & Vanhanen, 2006) and crime statistics from 116 countries. Even after controlling for a host of covariates, the results revealed a significant and negative association between intelligence and criminal offending, providing evidence of a robust pattern that persists across geographic regions and cultural contexts.

Despite the large number of studies identifying a significant negative association between intelligence and offending, important aspects of the association remain relatively unknown. One aspect that has received recent attention is the *functional form* of the association. On the one hand, several studies have found evidence of a linear association between intelligence and offending; showing highest rates of offending among individuals with the lowest intelligence scores, followed by gradual decreases in offending at increasing levels of intelligence (Denno, 1990; Moffitt, Gabrielli, Mednick, & Schulsinger, 1981; West & Farrington, 1973; Welte & Wieczorek, 1998). On the other hand, at least two important studies have found evidence of non-linear patterns. Hirschi and Hindelang (1977) found individuals in the *second to lowest* category of

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their IQ measure to have the greatest involvement in criminal offending. This finding documents a slightly nonlinear association, as a purely linear association would have shown the greatest proportion of offenders to reside within the lowest IQ category. A more recent analysis by Mears and Cochran (2013) revealed a clearly curvilinear association in which offending rates were the lowest among individuals within the highest and lowest IQ categories, and individuals in the 30th to 40th percentiles were the most likely to offend.

One potential explanation for this lack of consensus in the existing literature may have to do with data limitations. We wish to draw attention to four specific limitations. First, previous research has primarily relied upon data collected several decades ago, most notably the National Longitudinal Survey of Youth (NLSY), which was initially collected in 1979 (e.g., Herrnstein & Murray, 1994; Mears & Cochran, 2013). Second, most studies have examined criminal offending using vague or overly general measures of criminal behavior. For example, a substantial number of studies have relied on a single comprehensive measure of crime or delinquency without considering more specific types of offending (e.g., Diamond et al., 2012). This approach may limit the conclusions that can be drawn from the results. For example, it is possible that the IQ-crime association varies depending on the seriousness and the type of crime (e.g., property vs. violent crime).

Third, even in cases where a wider range of offending measures was examined (e.g., Mears & Cochran, 2013), such studies rely exclusively on self-reported data. While the limitations of both self-report and official records measures of offending have been documented, the strengths of each measurement strategy seem to complement the other's limitations (Thornberry & Krohn, 2000). In light of these observations, a further examination of the functional form of the IQ-offending association based on individual-level data from official records would address a significant gap in the literature.

Finally, the vast majority of previous studies examining the IQ-offending association rely either on a single, comprehensive measure of intelligence (Herrnstein & Murray, 1994; Mears & Cochran, 2013) or a single subscale (Beaver et al., 2013). While previous studies have indicated that virtually all standardized measures of intelligence tend to tap the same underlying construct (typically referred to as general intelligence or g; Nisbett et al., 2012), the results of a recent meta-analysis suggest that *verbal* intelligence may be a better predictor of offending and delinquency relative to other subscales (e.g., performance intelligence; Isen, 2010). Based on these findings, a more nuanced approach that involves examining separate subscales along with a composite intelligence measure would constitute an important contribution to the literature.

The current study explores the IQ-offending association with specific attention devoted to functional form, while also addressing additional limitations present in the literature. A *total birth cohort* of Finnish males born in 1987 will be used to examine the IQ-offending association in a contemporary sample. In addition, a wide range of criminal offenses – nine different measures in total – will be examined in an effort to gain a more detailed picture of the association. The measures of criminal offending employed in the current study were collected from official records (the Central Register for Criminal Records) rather than a survey of self-reported offending. Finally, in an effort to examine whether different subscales of intelligence alter the IQ-offending association, this research employs three subscales – verbal reasoning, mathematical reasoning, and spatial reasoning – along with a composite intelligence measure.

2. Methods

2.1. Data

This study analyzes data from the 1987 Finnish Birth Cohort (FBC), which consists of 60,069 children born in Finland in 1987 (Paananen & Gissler, 2012). Individuals were selected using the 1987 Medical Birth Registry. All children weighing greater than 500 g or a gestation age of greater than or equal to 22 weeks were included. Additional information was gathered for children born abroad during the study period ($n = 185$) from the Central Population Register. A total of 73 (0.1%) children born during the study period were unable to be traced due to incomplete, missing, or incorrect information from the Central Population Register.

Through the use of additional Finnish population registries, information on a wide range of topics including social welfare, physical and mental health, and military service has been included in the FBC (for more information regarding the specific information collected and the registers used see Paananen & Gissler, 2012). Follow-up information was collected through 2008 for all cohort members who survived the first week after birth ($n = 59{,}476$). During the follow-up period, 497 (0.8%) children died and 557 (0.9%) had permanently relocated out of Finland, resulting in a final cohort size of 58,430 or approximately 97% of all children born in Finland in 1987. *The analytic sample used in the current study was limited to males* since the measure of intelligence was based on assessments offered by the military ($n = 21{,}513$). In Finland, military training is mandatory for males, with nearly 90% participating. Those who do not participate in the military service typically choose a civilian alternative for religious or ethical reasons or are unable to serve due to a chronic health condition (Tiihonen et al., 2005). The study obtained approval from the Ethical Committee of the National Institute for Health and Welfare (§28/2009) and appropriate permission to use the confidential register data in scientific research from all register keeping organizations.

2.2. Measures

2.2.1. Intelligence

Intelligence was assessed using the Finnish Defense Forces Basic Ability Test developed by the Finnish Defense Forces Education Development Center. Taking the test is mandatory for all new recruits during the first two weeks of military service (Tiihonen et al., 2005). This instrument was aimed at assessing general cognitive ability as well as logical reasoning and contains three subscales tapping mathematical, verbal, and spatial reasoning. The mathematical reasoning subscale contained items that required respondents to perform a number of quantitative tasks including identifying patterns in a numerical set and simple arithmetic operations. The verbal reasoning subscale consisted of a number of word-related tasks including selecting the correct synonyms or antonyms for a given word and selecting a word from a given list that does not belong. Finally, the spatial reasoning subscale was similar to the more widely used Raven's Progressive Matrices (Raven, 2000), wherein respondents were presented with a series of patterns with one piece removed. Respondents are then asked to choose the missing piece from a provided set of possible answers. Each subscale consisted of 40 multiple-choice questions that increase in difficulty as the questions progress. All three subscales were normed and coded on a nine-point scale with scores ranging between 1 and 9 and higher values indicating higher levels of intelligence. Importantly, this coding strategy provides a distinct advantage for the purposes of the current study, in that it eliminates the need to categorize a continuously measured IQ measure, which is common in previous studies (e.g., Hirschi & Hindelang, 1977; Mears & Cochran, 2013; Herrnstein & Murray, 1994). Correlations between each subscale ranged between .61 and .68 for the full sample and between .59 and .65 for cohort members who engaged in any criminal offense during the follow-up period.

In addition to the three subscales, and in line with previous studies (Pesonen et al., 2013; Räikkönen et al., 2009; Savolainen, Paananen, Merikukka, Aaltonen, & Gissler, 2013; Tiihonen et al., 2005), the current study employs a composite intelligence measure that reflects the total score from all three subscales. Correlations between the composite intelligence measure and each of the examined subscales ranged between .82 and .85 in both the full sample and the subsample of cohort members with a criminal record during the follow-up period. The means, standard deviations, minimum, and maximum values for each intelligence measure, and all other study measures, are included in Table 1.

2.2.2. Criminal behavior

In an effort to capture the widest possible range of criminal offending, a total of nine measures were included. Each measure is based on information from the Central Register for Criminal Records and covers crimes committed between the ages of 15[1] and 21. The first offending measure is a raw count of the total number of criminal sanctions accumulated by each cohort member during the study period. This includes all criminal convictions and other official sanctions (e.g., general fines), but does not include information on minor infractions such as fines issued for minor traffic offenses (e.g., parking violations). Due to the relatively low levels of criminal offending within the sample, the second measure of criminal behavior is a dummy variable that indicates whether individuals received any criminal sanctions during the study period (0 = none; 1 = at least one sanctioned offense). In an effort to focus on more serious offending, the third measure taps felony convictions and was coded dichotomously such that 0 = no felony convictions and 1 = one or more felony convictions.

The fourth measure of criminal behavior identified *high frequency* offenders. It was also coded dichotomously such that 0 = fewer than five convictions and 1 = five or more convictions. The fifth measure of criminal behavior was aimed at assessing the variety (or "versatility") of officially sanctioned offending among six major types of crime: violent, property, drunk or intoxicated driving (DUI), other traffic offense, sexual assault, and drug offense. The variety score was coded categorically where 0 = none, 1 = one type of crime, 2 = two types, and 3 = three or more crime types. The sixth measure of criminal behavior focused on violent offending and was coded such that 0 = no violent crime convictions and 1 = one or more violent crime convictions. A similar measurement strategy was used to identify members of the cohort who were convicted of a property crime, a traffic offense, and those who had been convicted of driving under the influence of an intoxicating substance (DUI).

Table 1
Mean, standard deviation, percentages, and sample sizes for study measures.

	Mean/%	SD/freq.	Min–Max
Intelligence			
Verbal	4.64	2.15	1–9
Math	4.72	2.17	1–9
Spatial	5.05	4.00	1–9
Total	4.76	2.18	1–9
Criminal behavior			
Number of crimes committed	0.99	2.67	0–104
Any criminal behavior			0–1
Yes	38.65%	11,763	
No	61.35%	18,672	
Felony conviction			0–1
Yes	14.14%	4302	
No	85.86%	26,133	
High frequency offending (>5)			0–1
Yes	3.09%	941	
No	96.91%	29,494	
Variety of offending			0–3
0	85.89%	26,141	
1	7.69%	2341	
2	3.69%	1123	
3 or more	3.72%	830	
Violent crime			0–1
Yes	4.29%	1350	
No	95.71%	29,130	
Property crime			0–1
Yes	2.34%	711	
No	97.66%	29,724	
Traffic offense			0–1
Yes	7.40%	2253	
No	92.60%	28,182	
DUI			0–1
Yes	6.39%	1944	
No	93.61%	28,491	

3. Results

3.1. Descriptive statistics

Due to its comprehensiveness, the FBC offers the rare opportunity to more closely examine average intelligence scores and the prevalence of criminal behavior within a male birth cohort. The first set of descriptive calculations focused on the intelligence measures. The mean scores for the verbal reasoning, mathematical reasoning, spatial reasoning, and the composite reasoning measures are presented in Table 1 and were 4.62 (SD = 2.15), 4.72 (SD = 2.17), 5.05 (SD = 4.00), and 4.76 (SD = 2.18), respectively. In an effort to more closely explore the distributions of each intelligence measure across the entire cohort, distributions for each intelligence score were plotted and are presented in Fig. 1. The resulting distributions appear to approximate a normal distribution, which closely aligns with other commonly used and standardized intelligence measures (Gottfredson, 1994).

Table 1 also displays descriptive information for each of the nine criminal behavior measures. The calculations revealed the mean number of criminal convictions for the analytic sample to be .99 (SD = 2.67), with a maximum of 104 sanctions. Consistent with this observation, nearly 39% of the analytic sample (n = 11,763) received at least one criminal sanction and over 14% (n = 4302) were convicted of at least one felony during the study period. Approximately 3% (n = 941) committed five or more criminal offenses and were thus identified as high frequency offenders.

When examining the variety of offending, the overwhelming majority of the sample (85.89%, n = 26,141) did not have any convictions during the study period, while 7.69% (n = 2341) were convicted of one crime, 3.69% (n = 1123) were convicted of two crimes, and 3.72% (n = 830) were convicted of three or more crimes. Approximately, 4% (n = 1350) were convicted of one or more violent offenses during the examination period. Finally, 2.34% (n = 711) committed a property crime, 7.40% (n = 2253) committed a traffic offense, and 6.39% (n = 1944) were convicted of a DUI.

3.2. Visual plots

The next stage of the analysis involved plotting the prevalence of each criminal behavior measure across each intelligence measure. The purpose was to investigate the functional form of each indicator of criminal offending across varying levels of intelligence. Since the analysis was focused on visualizing functional form, the results are presented as figures as opposed to tables. Appendix A presents the cross-tabulations used to generate the figures.[2]

The first panel from the left of Fig. 2 presents the mean number of crimes plotted across all four intelligence scores. The resulting trend lines show a negative association between intelligence and offending. In addition, and perhaps more importantly, the patterns appear to be mostly linear, with the lowest intelligence scores corresponding with the most criminal behavior and the highest intelligence scores corresponding with the least number of offenses. The only exception to this pattern is the *slight* increase in the mean number of offenses when comparing males with the score of 1 (i.e., the lowest score) on the spatial and total intelligence scores (spatial score = 1.10; total score = 1.19) to those with the score of 2 on the same measures (spatial score =

[1] Finland does not have a juvenile justice system and juveniles under the age of 15 cannot be held legally responsible for criminal behavior (Lappi-Seppälä, 2006). For this reason, there is no official data on criminal offending among those under the age of 15 in Finland.

[2] The accompanying cross-tabulations are included in the appendix, with the verbal reasoning scores presented in Table A1, the mathematical reasoning scores presented in Table A2, the spatial reasoning scores presented in Table A3, and the total reasoning scores presented in Table A4.

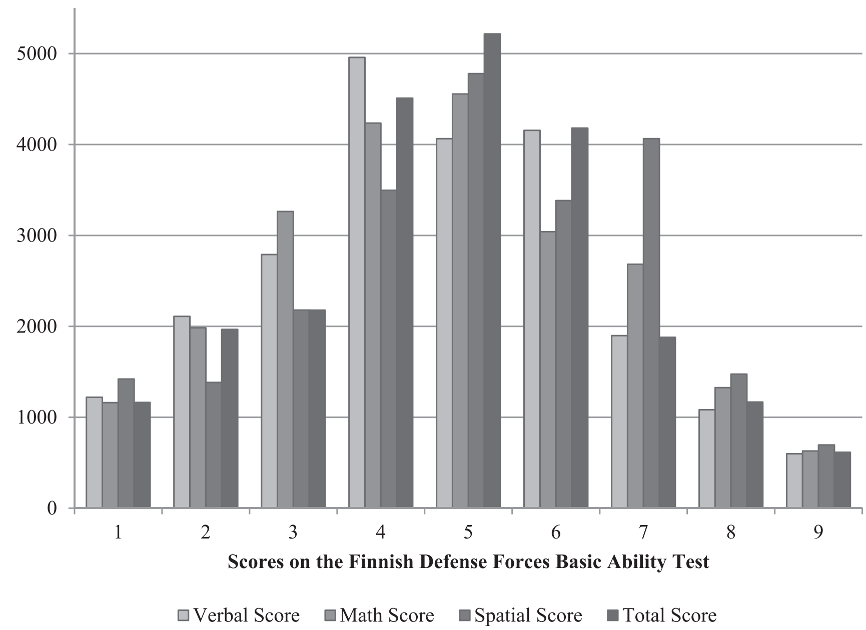

Fig. 1. Distributions of the verbal, mathematical, and total intelligence scores.

1.18; total score = 1.30). After this slight uptick in the trend lines, the mean number of offenses drops precipitously at increasing levels of intelligence. The second panel of Fig. 2 displays the prevalence of any criminal sanctions plotted across each of the intelligence scores. This figure documents a pattern very similar to the one observed in the previous panel: a slight uptick between the two lowest categories followed by a linear decline thereafter.

Fig. 3 presents the prevalence of felony convictions (presented in the first panel) and high frequency offending (five or more offenses; presented in the second panel) across all four intelligence measures. Once again, the trend is mostly linear with two minor exceptions. First, a greater proportion of individuals scoring 2 on the spatial (18.70%) and total (20.89%) intelligence measures were convicted of a felony relative to the proportion of individuals scoring 1 on the same measures (spatial score = 17.30%; total score = 18.49%). Second, felony convictions were slightly more prevalent among individuals who earned the highest score (9) on the math (6.36%), spatial (7.50%), and total (5.69%) intelligence scores as compared to those who received a score of 8 (math score = 5.88%; spatial score = 6.60%; total score = 4.71%). The association between high frequency offending and each of the intelligence measures, as presented in the second panel of Fig. 3, also displays a mostly linear trend. While there are a number of instances in which the proportion of the sample increases as intelligence scores increase, such increases are relatively small in magnitude (less than 1 percentage point) and likely a function of the low proportion of the overall sample identified as high frequency offenders (3.09%).

Fig. 4 presents the association between the variety score of criminal offending and each intelligence score. The first panel presents the group mean for each intelligence score plotted across the four categories of the offending variety measure. The mean intelligence score across all four measures decreases as the variety of offending increases, which shows that offenders who committed three or more types of criminal behavior have the lowest verbal (mean = 3.69), math (mean = 3.69), spatial (mean = 4.08), and total (mean = 3.63) intelligence scores. In addition,

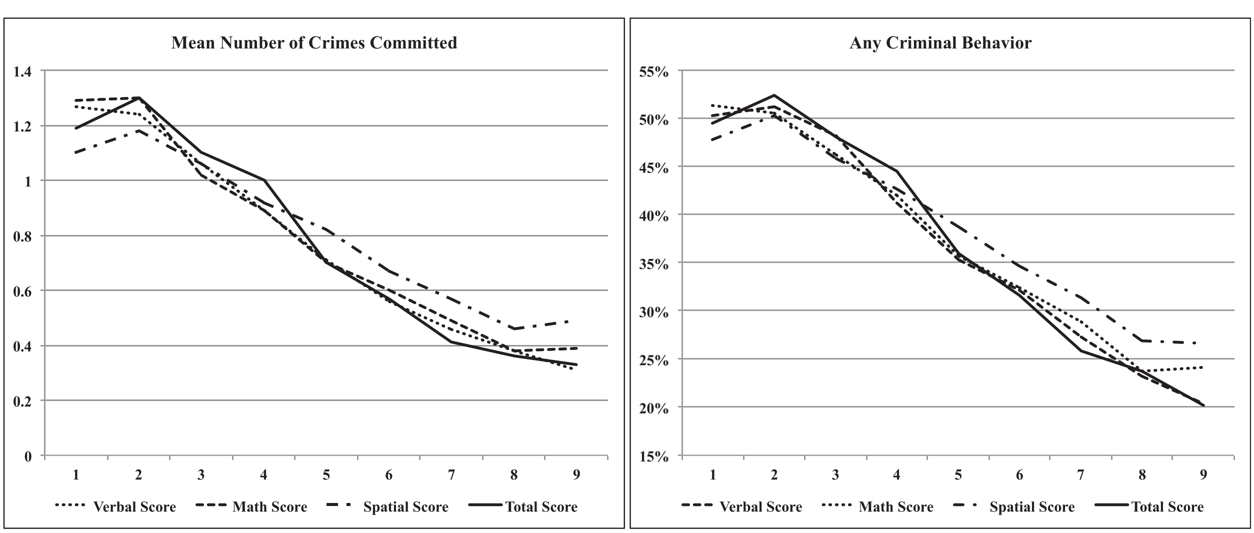

Fig. 2. Mean number of crimes committed and any criminal behavior plotted across intelligence scores.

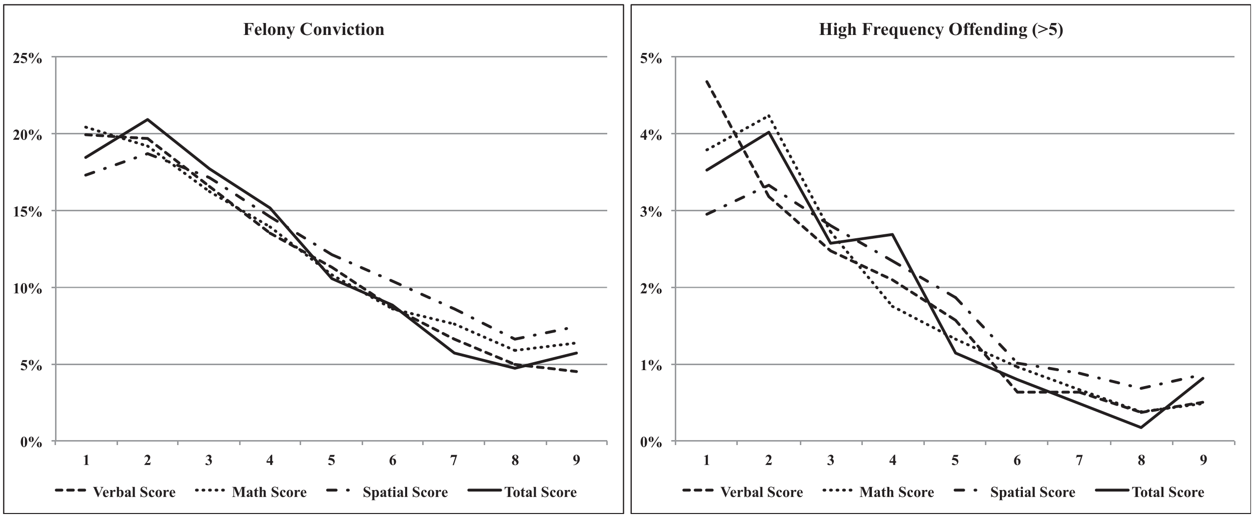

Fig. 3. Felony conviction and high frequency offending plotted across intelligence scores.

analysis of variance (ANOVA) estimates revealed significant between group differences across the four categories of the offending variety measure for each intelligence measure (verbal: $F = 146.80$; mathematical: $F = 138.00$; spatial: $F = 93.80$; total: $F = 163.40$).

The second panel of Fig. 4 presents the difference between the group mean and the grand mean for each intelligence measure. Positive values indicate a group mean that is greater than the grand mean, and negative values indicate a group mean lower than the grand mean. The results indicate that individuals who committed zero offenses had a positive difference score across all intelligence measures (verbal score = .10; math score = .09; spatial score = .07; total score = .10), while offenders who committed three or more different offenses had the greatest negative difference score for all three intelligence measures (verbal score = −.95; math score = −1.09; spatial score = −.97; total score = −1.07).

The prevalence of violent and property crime plotted across each of the intelligence scores are presented in the first and second panels (respectively) of Fig. 5. The results replicate previously observed patterns: a mostly linear declining trend with occasional evidence of an uptick between the two lowest IQ categories. For example, violent offending was slightly more prevalent (7.02%) among males scoring 2 on the total intelligence measure compared to those scoring 1 (5.16%). In addition, there was a slight increase in the proportion of violent offenders who scored a 9 on the total intelligence measure (0.65%) relative to the proportion who scored an 8 on the same measure (0.51%). Similar deviations from pure linearity were detected in the prevalence of property offending.

Fig. 6 displays the prevalence of traffic and DUI offenses across the four intelligence measures. The trend lines follow a linear declining pattern. The greatest proportion of individuals who committed traffic (11.59%) or DUI (9.61%) offenses scored a 2 on the total intelligence measure. This pattern was not detected in the verbal and math subscales where the greatest proportion of traffic and DUI offenders scored a 1 on each subscale. Finally, the association between spatial intelligence measure and the traffic offense measure displayed yet another pattern: cohort members who scored a 3 on the spatial reasoning measure had slightly more traffic offenses (10.14%) compared to cohort members who scored a 2 (9.69%) or 1 (9.57%) on the same measure.

4. Discussion

Few psychological concepts have received more empirical attention than intelligence. The number of individual outcomes that have been linked to intelligence is quite extensive, covering such subjects as

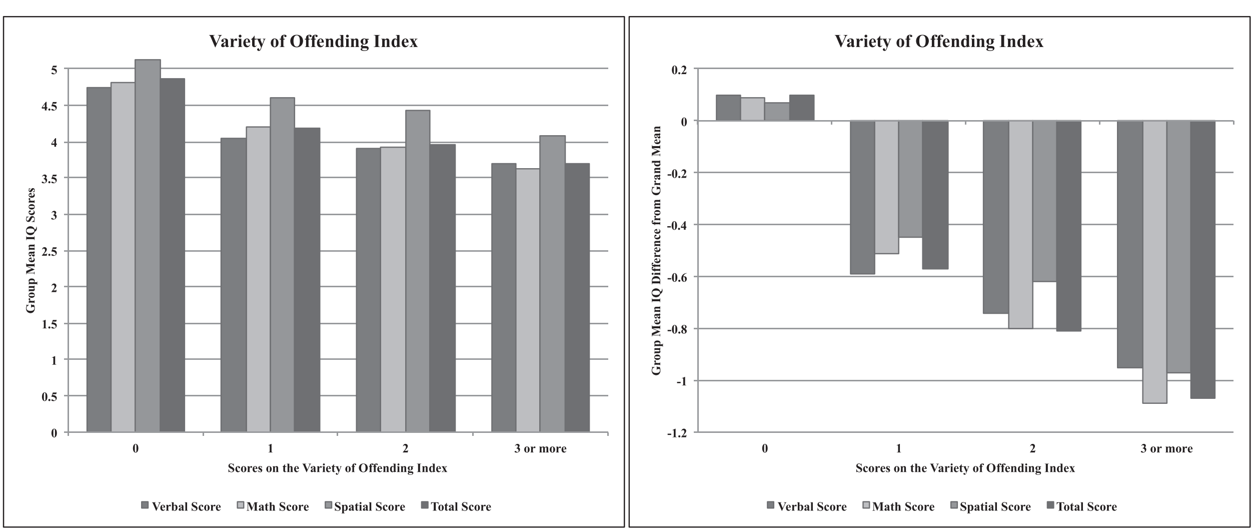

Fig. 4. Mean intelligence scores plotted across variety offending scores.

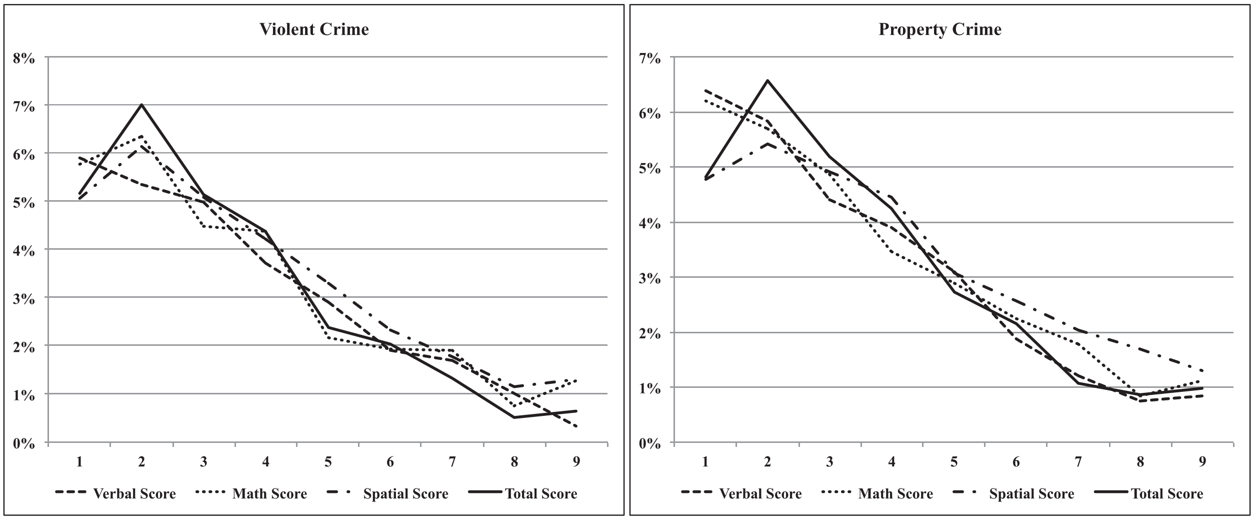

Fig. 5. Violent and property offenses plotted across intelligence scores.

academic achievement (Caspi, Wright, Moffitt, & Silva, 1998; Colom & Flores-Mendoza, 2007; Deary, Strand, Smith, & Fernandes, 2007), health and mortality (Deary & Batty, 2006), job performance (Gottfredson, 1997), and political affiliation (Deary, Batty, & Gale, 2008a; Deary, Batty, Pattie, & Gale, 2008b). Intelligence has maintained a somewhat controversial status within the field of criminology, but overwhelming evidence has indicated that individuals with lower IQ scores are more likely to engage in a wide range of criminal behaviors (Beaver et al., 2013; Herrnstein & Murray, 1994; Jolliffe & Farrington, 2004; Kratzer & Hodgins, 1999; Neisser et al., 1996). Despite the number of studies reporting a significant IQ-offending association, several details underlying the association remain unknown. For example, a significant number of studies have utilized analytic methods that assume a linear association between IQ and offending (Denno, 1990; Moffitt et al., 1981; West & Farrington, 1973; Welte & Wieczorek, 1998) despite a growing literature suggesting a nonlinear pattern (Freeman, 2012; Hirschi & Hindelang, 1977; Levine, 2008; Mears & Cochran, 2013).

The current study adds to this literature by examining the functional form of the IQ-offending association using data from a total birth cohort of Finnish males born in 1987. Importantly, the data utilized in the current study addresses some of the limitations of previous studies by making use of a wide variety of official measures of crime and multiple subscales (as well as a composite measure) of intelligence. The results yielded three primary findings with important theoretical and empirical implications.

First, the results were remarkably consistent across the multiple measures of criminal offending and intelligence, suggesting that the IQ-offending association may be largely driven by general intelligence (*g*). Future research would benefit from an investigation of the ways in which highly *g*-loaded factors such as deficits in executive functions, including inhibition, processing speed, and attention are potentially linked to both criminal behavior and overall levels of intelligence (Herpertz et al., 2001; Kane & Engle, 2002; Morgan & Lilienfeld, 2000). Future research would also benefit from investigations of potential additional mechanisms responsible for the effect of IQ on crime. To this end, we encourage criminologists to draw on advances made in other fields of inquiry, such as health sciences. For example, a series of studies focusing on all-cause mortality (Batty, Deary, & Gottfredson, 2007; Batty et al., 2009; Deary, 2009; Deary & Batty, 2006) has shown that individuals with higher levels of intelligence are more dependable (Deary et al., 2008b) and conscientious (Luciano, Wainwright, Wright, & Martin, 2006), suggesting that they are more likely to think about the moral consequences of their actions compared to individuals with lower levels of intelligence. Consistent with this observation, individuals with lower intelligence have also been found to act more

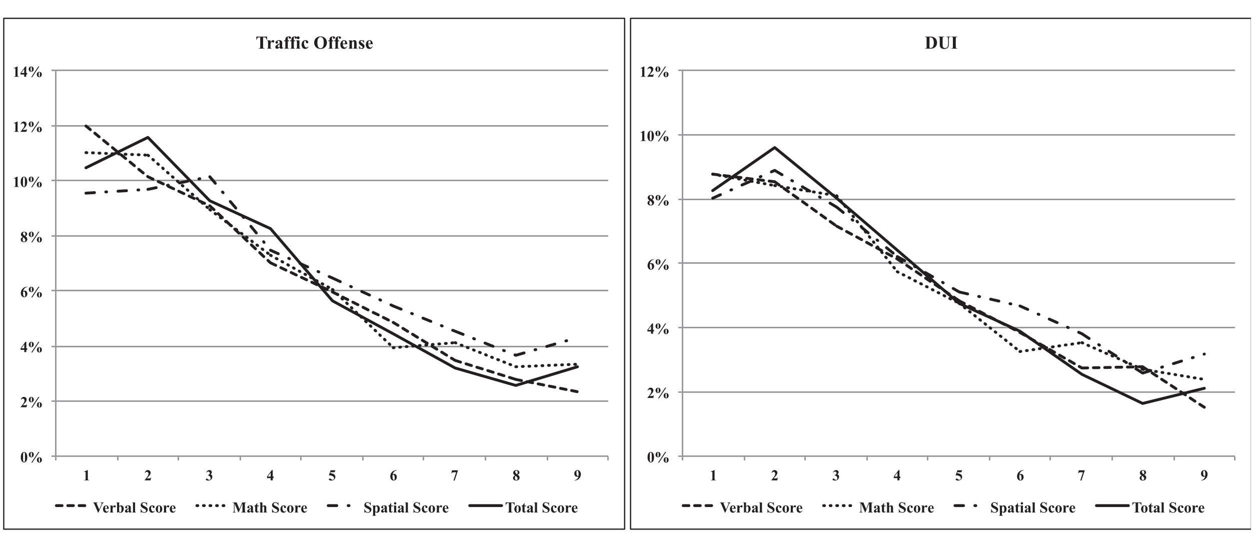

Fig. 6. Traffic and DUI offenses plotted across intelligence scores.

impulsively (de Wit, Flory, Acheson, McCloskey, & Manuck, 2007; Funder & Block, 1989). In turn, individuals with lower levels of impulse control and related constructs, such as low self-control, have also been found to be significantly more likely to engage in various forms of criminal and antisocial behavior (Gottfredson & Hirschi, 1990; Moffitt et al., 2011; Pratt & Cullen, 2000). While only preliminary, current research suggests that lower levels of intelligence reduces the ability to weigh the costs and benefits of individual action, resulting in a greater propensity to make impulsive decisions, which in some cases involve illegal behavior.

Our findings contradict evidence from prior studies reporting substantial variation in the IQ-offending association across subscales of intelligence (Herrero, Escorial, & Colom, 2010; Isen, 2010). Importantly, previous results were adjusted for the influence of additional covariates, such as educational attainment (e.g., Herrero et al., 2010), while the present study focused on bivariate associations. This analytic strategy allows for the possibility that some measures of intelligence are more sensitive to potential confounders of the IQ-crime association than others. Future research would benefit from thorough investigations of the mechanisms that underlie the observed associations. The purpose of the present investigation was more modest, namely to provide a comprehensive assessment of the association between intelligence and crime.

Second, across many of the examined criminal behavior measures, the largest proportions of offenders (or the largest mean number of offenses) emerged in the second lowest category (those receiving a score of 2) on the total intelligence measure. For example, 52.36% of individuals who received a score of 2 on total intelligence committed at least one offense during the observation period compared to 49.53% of individuals in the lowest category. A similar pattern was observed for total intelligence and all other measures of criminal offending. The spatial intelligence measure also exhibited a similar pattern across each measure of crime. However, this pattern was less consistent in analyses based on verbal and math subscales of cognitive ability. Only one measure of crime (any sanctioned offense) exhibited this pattern within the verbal subscale, and two offending measures (high frequency and violent) produced a similar pattern within the math subscale. Despite the overall prominence of this pattern (particularly when examining the spatial and total intelligence measures), it is worth noting that the proportional differences between the groups scoring in the lowest and second to lowest category were small. For example, the observed differences exceeded two percentage points in only two instances ("any crime" when examining both the spatial and total intelligence measures). However, given how consistent this pattern was in our data, it may capture something essential about the nature of the association between IQ and criminal behavior.

It is worth noting that a similar pattern was also reported in at least one highly influential prior study of intelligence and criminal offending (Hirschi & Hindelang, 1977). This convergence suggests that, although individuals with low IQ scores tend to engage in higher levels of criminal behavior, those with the very lowest scores may not be the most crime-prone. This finding coheres with studies that have examined criminal offending and contact with the criminal justice system among individuals with severe intellectual disabilities (for an overview, see Holland, Clare, & Mukhopadhyay, 2002). While only speculation, the pattern observed in our data may be related to individual differences in behavioral independence and opportunities to engage in criminal behavior. For example, individuals with severe intellectual deficits may require more supervision and assistance, thereby decreasing independence and, by extension, opportunities for criminal behavior. A large body of previous research has suggested that criminal offending is a group activity that occurs in the context of peer associations and other social interaction (Warr, 2002). It is possible that relative social isolation prevents individuals with intellectual disabilities from participating in crime as much as they would in the absence of the environmental constraints related to their disability. This topic also merits attention in future research.

Third, we found *some* evidence suggesting that criminality is slightly more prevalent in the very highest total intelligence category (a score of 9) compared to the second highest category (a score of 8). For example, the proportion of high frequency offenders who fell into the highest intelligence category (verbal = 0.50%; math = 0.48%; spatial = 0.90%; total = 0.81%) exceeded the proportion of high frequency offenders in the second highest category (verbal = 0.37%; math = 0.38%; spatial = 0.70%; total = 0.17%) across all four intelligence measures. Importantly, this pattern persisted for the vast majority of the offending measures across the verbal, spatial, and total intelligence measures, but only two measures (property offending and high frequency offending) exhibited this same pattern across the math intelligence measure. Despite the pervasiveness of the pattern, the proportional differences between the highest and second highest intelligence categories does not appear to be substantive, with none of the resulting differences exceeding 1 percentage point. While only speculation, this finding is likely the result of small cell sizes, particularly when examining relatively rare forms of offending, such as high frequency offending (3.09% of the overall sample) and violent offending (4.29% of the overall sample). Pairing these rare offenses with intelligence scores falling in the outermost tails of the distribution is likely driving these somewhat unintuitive findings.

Although this study addressed some important shortcomings in the extant literature, it is not free from its own limitations. First, this research used official data to assess criminal behavior. While the use of official records addresses some well-known limitations of self-report measures (most notably deceptive disclosure), official measures are not perfect. For example, previous studies have argued that the use of official records results in biased measures of criminal behavior due to differential detection, wherein individuals with lower levels of intelligence are more likely to be apprehended by law enforcement (Cullen, Gendreau, Jarjoura, & Wright, 1997). While this remains a concern, previous studies have empirically assessed the differential detection hypothesis and found it to be invalid, providing strong justification for the use of official crime data (Moffitt & Silva, 1988). Second, while the current study examined a contemporary total birth cohort of males, the sample was limited to respondents from one nation. Whether this same pattern holds across geographic and cultural boundaries remains unanswered. Future research would benefit from investigating these associations across more diverse sets of samples.

The clearest takeaway from this research is that *low intelligence is a strong and consistent correlate of criminal offending*. For example, the risk of acquiring a felony conviction by age 21 is nearly four times (3.6) higher among those in the three lowest categories (1–3) of total intelligence as compared to those scoring in the top three categories (7–9). We observed differences of similar magnitude across each indicator of criminal offending and regardless of the measure of intelligence. We found no evidence for the hypothesis that deficits in verbal intelligence are more salient to criminal offending than deficits in other dimensions of cognitive ability.

Regarding the functional form of the IQ-offending association, we observed some evidence of non-linearity at the extremely high and extremely low ends of the intelligence continuum. Although the magnitude of these deviations was relatively minor, these patterns are consistent with previous studies examining the functional form of the IQ-crime association (e.g., Hirschi & Hindelang, 1977; Mears & Cochran, 2013). However, it would be misleading to characterize any of the 36 unique associations examined in our research as curvilinear or anything another than *approximately linear*. Because the context of a single study is never sufficient for drawing firm conclusions, we avoid making definitive claims about the functional form.

Our main conclusions are two-fold. First, cognitive ability is an important correlate of individual differences in criminal offending, a finding that criminological theories ignore at their own peril. Second, studies modeling the association between IQ and crime should recognize the possibility of non-linearity, especially at the extreme ends of the intelligence scores. However, it seems clear that the association is predominantly incremental, as opposed to discrete, so that rates of criminal offending tend to decrease with increasing levels of intelligence.

Appendix A

Table A1
The prevalence (%) of criminal offending by verbal intelligence score.

	1	2	3	4	5	6	7	8	9
Number of crimes (mean)	1.27	1.24	1.06	0.89	0.71	0.56	0.46	0.38	0.31
Any crime (%)	50.25	51.23	48.14	41.23	35.31	32.10	27.29	23.27	20.37
Felony (%)	19.92	19.67	16.52	13.55	11.27	8.64	6.59	4.99	4.51
High freq. (%)	4.67	3.18	2.47	2.10	1.57	0.63	0.63	0.37	0.50
Variety index (%)									
0	80.00	80.38	83.26	86.43	88.68	91.31	93.15	95.01	95.99
1	10.41	11.33	10.14	8.07	6.99	5.53	4.85	2.86	2.67
2	5.82	5.97	3.84	3.61	2.85	2.26	1.42	1.57	1.34
3 or more	5.90	5.36	4.98	3.73	2.90	1.90	1.69	1.02	0.33
Violent crime (%)	5.90	5.36	4.98	3.73	2.90	1.90	1.69	1.02	0.33
Property crime (%)	6.39	5.83	4.41	3.89	3.10	1.88	1.21	0.74	0.83
Traffic crime (%)	11.97	10.14	9.07	7.02	5.95	4.84	3.48	2.77	2.34
DUI (%)	8.77	8.53	7.17	6.15	4.82	3.85	2.74	2.77	1.50

Note: Scores on the verbal reasoning measure listed across top row.

Table A2
The prevalence (%) of criminal behaviors by mathematical intelligence score.

	1	2	3	4	5	6	7	8	9
Number of crimes (mean)	1.29	1.30	1.02	0.89	0.70	0.60	0.49	0.38	0.39
Any crime (%)	51.42	50.60	46.25	42.03	35.69	32.46	28.81	23.68	24.17
Felony (%)	20.41	19.15	16.21	13.93	10.84	8.62	7.60	5.88	6.36
High freq. (%)	3.79	4.23	2.73	1.75	1.32	0.95	0.67	0.38	0.48
Variety index (%)									
0	79.41	80.85	83.39	86.30	89.09	91.52	92.06	94.04	93.80
1	11.54	10.13	9.29	8.24	6.83	5.95	5.07	4.37	4.61
2	5.77	5.39	4.78	3.64	2.74	1.84	2.16	1.06	1.27
3 or more	3.27	3.63	2.54	1.82	1.34	0.69	0.71	0.53	0.32
Violent crime (%)	5.77	6.35	4.47	4.37	2.17	1.94	1.90	0.75	1.27
Property crime (%)	6.20	5.70	4.87	3.47	2.90	2.24	1.79	0.83	1.11
Traffic crime (%)	11.02	10.94	8.95	7.30	6.04	3.91	4.10	3.24	3.34
DUI (%)	8.79	8.42	8.12	5.74	4.76	3.26	3.54	2.71	2.38

Note: Scores on the mathematical reasoning measure listed across top row.

Table A3
The prevalence (%) of criminal behaviors by spatial intelligence score.

	1	2	3	4	5	6	7	8	9
Number of crimes (mean)	1.10	1.18	1.06	0.92	0.82	0.67	0.57	0.46	0.49
Any crime (%)	47.80	50.30	45.80	42.60	38.70	34.70	31.40	26.90	26.60
Felony (%)	17.30	18.70	17.10	14.60	12.10	10.40	8.60	6.60	7.50
High freq. (%)	3.00	3.30	2.80	2.30	1.90	1.00	0.90	0.70	0.90
Variety index (%)									
0	82.62	81.06	82.61	85.67	87.87	89.66	91.24	93.29	92.39
1	9.64	10.85	9.64	8.32	7.51	6.44	5.73	4.68	5.03
2	4.86	4.92	4.82	3.83	3.16	2.84	2.07	1.56	2.16
3 or more	2.89	3.18	2.94	2.17	1.46	1.06	0.96	0.47	0.43
Violent crime (%)	5.07	6.15	5.09	4.23	3.31	2.33	1.77	1.15	1.29
Property crime (%)	4.79	5.42	4.91	4.46	3.08	2.57	2.04	1.69	1.29
Traffic crime (%)	9.57	9.69	10.14	7.47	6.46	5.47	4.53	3.66	4.31
DUI (%)	8.02	8.89	7.76	6.21	5.10	4.67	3.79	2.58	3.16

Note: Scores on the spatial reasoning measure listed across top row.

Table A4
The prevalence (%) of criminal behaviors by total intelligence score.

	1	2	3	4	5	6	7	8	9
Number of crimes (mean)	1.19	1.30	1.10	1.00	0.70	0.57	0.41	0.36	0.33
Any crime (%)	49.53	52.36	48.07	44.50	35.92	31.60	25.86	23.72	20.16
Felony (%)	18.49	20.89	17.72	15.19	10.58	8.80	5.69	4.71	5.69
High freq. (%)	3.53	4.02	2.57	2.68	1.15	0.79	0.48	0.17	0.81
Variety index (%)									
0	81.43	78.95	82.00	85.01	89.34	91.15	93.88	95.46	94.31
1	10.40	11.18	10.74	8.69	6.71	5.67	4.31	3.68	3.90
2	5.59	5.69	4.78	4.08	2.78	2.22	1.33	0.68	1.46
3 or more	2.58	4.17	2.48	2.22	1.17	0.96	0.48	0.17	0.33
Violent crime (%)	5.16	7.02	5.14	4.37	2.38	2.03	1.33	0.51	0.65
Property crime (%)	4.82	6.56	5.19	4.24	2.72	2.15	1.06	0.86	0.98
Traffic crime (%)	10.49	11.59	9.27	8.27	5.62	4.45	3.19	2.57	3.25
DUI (%)	8.25	9.61	8.03	6.41	4.73	3.90	2.55	1.63	2.11

Note: Scores on the total reasoning measure listed across top row.

References

Bartels, J.M., Ryan, J.J., Urban, L.S., & Glass, L.A. (2010). Correlations between estimates of state IQ and FBI crime statistics. *Personality and Individual Differences*, *48*, 579–583.

Batty, G.D., Deary, I.J., & Gottfredson, L.S. (2007). Premorbid (early life) IQ and later mortality risk: Systematic review. *Annals of Epidemiology*, *17*, 278–288.

Batty, G.D., Wennerstad, K.M., Smith, G.D., Gunnell, D., Deary, I.J., Tynelius, P., & Rasmussen, F. (2009). IQ in early adulthood and mortality by middle age. Cohort study of 1 million Swedish men. *Epidemiology*, *20*, 100–109.

Beaver, K.M., Schwartz, J.A., Nedelec, J.L., Connolly, E.J., Boutwell, B.B., & Barnes, J.C. (2013). Intelligence is associated with criminal justice processing: Arrest through incarceration. *Intelligence*, *41*, 277–288.

Beaver, K.M., & Wright, J.P. (2011). The association between county-level IQ and county-level crime rates. *Intelligence*, *39*, 22–26.

Cantor, J.M., Blanchard, R., Robichaud, L.K., & Christensen, B.K. (2005). Quantitative reanalysis of aggregate data on IQ in sexual offenders. *Psychological Bulletin*, *131*, 555–568.

Caspi, A., Wright, B.R.E., Moffitt, T.E., & Silva, P.A. (1998). Early failure in the labor market: Childhood and adolescent predictors of unemployment in the transition to adulthood. *American Sociological Review*, *63*, 424–451.

Colom, R., & Flores-Mendoza, C.E. (2007). Intelligence predicts scholastic achievement irrespective of SES factors: Evidence from Brazil. *Intelligence*, *35*, 243–251.

Cullen, F.T., Gendreau, P., Jarjoura, G.R., & Wright, J.P. (1997). Crime and the bell curve: Lessons from intelligent criminology. *Crime & Delinquency*, *43*, 387–411.

de Wit, H., Flory, J.D., Acheson, A., McCloskey, M., & Manuck, S.B. (2007). IQ and nonplanning impulsivity are independently associated with delay discounting in middle-aged adults. *Personality and Individual Differences*, *42*, 111–121.

Deary, I.J. (2009). Introduction to the special issue on cognitive epidemiology. *Intelligence*, *37*, 517–519.

Deary, I.J., & Batty, G.D. (2006). Commentary: Pre-morbid IQ and later health—The rapidly evolving field of cognitive epidemiology. *International Journal of Epidemiology*, *35*, 670–672.

Deary, I.J., Batty, G.D., & Gale, C.R. (2008a). Childhood intelligence predicts voter turnout, voting preferences, and political involvement in adulthood: The 1970 British Cohort Study. *Intelligence*, *36*, 548–555.

Deary, I.J., Batty, G.D., Pattie, A., & Gale, C.R. (2008b). More intelligent, more dependable children live longer a 55-year longitudinal study of a representative sample of the Scottish nation. *Psychological Science*, *19*, 874–880.

Deary, I.J., Strand, S., Smith, P., & Fernandes, C. (2007). Intelligence and educational achievement. *Intelligence*, *35*, 13–21.

Denno, D.W. (1990). *Biology and violence: From birth to adulthood*. Cambridge, England: Cambridge University Press.

Diamond, B., Morris, R.G., & Barnes, J.C. (2012). Individual and group IQ predict inmate violence. *Intelligence*, *40*, 115–122.

Dwyer, R.G., & Frierson, R.L. (2006). The presence of low IQ and mental retardation among murder defendants referred for pretrial evaluation. *Journal of Forensic Sciences*, *51*, 678–682.

Fergusson, D.M., Horwood, L. John, & Ridder, E.M. (2005). Show me the child at seven II: Childhood intelligence and later outcomes in adolescence and young adulthood. *Journal of Child Psychology and Psychiatry*, *46*, 850–858.

Freeman, J. (2012). The relationship between lower intelligence, crime and custodial outcomes: A brief literary review of a vulnerable group. *Vulnerable Groups & Inclusion*, *3*, 1–15.

Frisell, T., Pawitan, Y., & Långström, N. (2012). Is the association between general cognitive ability and violent crime caused by family-level confounders? *PLoS ONE*, *7*, e41783.

Funder, D.C., & Block, J. (1989). The role of ego-control, ego-resiliency, and IQ in delay of gratification in adolescence. *Journal of Personality and Social Psychology*, *57*, 1041.

Gottfredson, L.S. (1994). Mainstream science on intelligence. *Wall Street Journal*, *A18*.

Gottfredson, L.S. (1997). Why g matters: The complexity of everyday life. *Intelligence*, *24*, 79–132.

Gottfredson, M.R., & Hirschi, T. (1990). *A general theory of crime*. California: Stanford University Press.

Herpertz, S.C., Wenning, B., Mueller, B., Qunaibi, M., Sass, H., & Herpertz-Dahlmann, B. (2001). Psychophysiological responses in ADHD boys with and without conduct disorder: Implications for adult antisocial behavior. *Journal of the American Academy of Child and Adolescent Psychiatry*, *40*, 1222–1230.

Herrero, O., Escorial, S., & Colom, R. (2010). Basic executive processes in incarcerated offenders. *Personality and Individual Differences*, *48*, 133–137.

Herrnstein, R.J., & Murray, C. (1994). *The bell curve: Intelligence and class structure in American life*. New York: Free Press.

Hirschi, T., & Hindelang, M.J. (1977). Intelligence and delinquency: A revisionist review. *American Sociological Review*, *42*, 571–587.

Holland, T., Clare, I.C.H., & Mukhopadhyay, T. (2002). Prevalence of 'criminal offending' by men and women with intellectual disability and the characteristics of 'offenders': Implications for research and service development. *Journal of Intellectual Disability Research*, *46*, 6–20.

Isen, J. (2010). A meta-analytic assessment of Wechsler's P > V sign in antisocial populations. *Clinical Psychology Review*, *30*, 423–435.

Jolliffe, D., & Farrington, D.P. (2004). Empathy and offending: A systematic review and meta-analysis. *Aggression and Violent Behavior*, *9*, 441–476.

Kane, M.J., & Engle, R.W. (2002). The role of prefrontal cortex in working-memory capacity, executive attention, and general fluid intelligence: An individual-differences perspective. *Psychonomic Bulletin & Review*, *9*, 637–671.

Kearns, A., & O'Connor, A. (1988). The mentally handicapped criminal offender: A 10-year study of two hospitals. *The British Journal of Psychiatry*, *152*, 848–851.

Kratzer, L., & Hodgins, S. (1999). A typology of offenders: A test of Moffitt's theory among males and females from childhood to age 30. *Criminal Behaviour and Mental Health*, *9*, 57–73.

Lappi-Seppälä, T. (2006). Finland: a model of tolerance. In J. Muncie, & B. Goldson (Eds.), *Comparative youth justice. Critical issues* (pp. 177–195). London: Sage.

Levine, S.Z. (2008). Using intelligence to predict subsequent contacts with the criminal justice system for sex offences. *Personality and Individual Differences*, *44*, 453–463.

Loeber, R., Menting, B., Lynam, D.R., Moffitt, T.E., Stouthamer-Loeber, M., Stallings, R., & Pardini, D. (2012). Findings from the Pittsburgh Youth Study: Cognitive impulsivity and intelligence as predictors of the age–crime curve. *Journal of the American Academy of Child and Adolescent Psychiatry*, *51*, 1136–1149.

Luciano, M., Wainwright, M.A., Wright, M.J., & Martin, N.G. (2006). The heritability of conscientiousness facets and their relationship to IQ and academic achievement. *Personality and Individual Differences*, *40*, 1189–1199.

Lynn, R., & Vanhanen, T. (2006). *IQ & global inequality*. Augusta, GA: Washington Summit Publishers.

McDaniel, M.A. (2006). Estimating state IQ: Measurement challenges and preliminary correlates. *Intelligence*, *34*, 607–619.

Mears, D. P., & Cochran, J. C. (2013). What is the effect of IQ on offending? *Criminal Justice and Behavior*, *44*, 1280–1300.

Moffitt, T.E., Arseneault, L., Belsky, D., Dickson, N., Hancox, R.J., Harrington, H., Houts, R., Poulton, R., Roberts, B.W., Ross, S., Sears, M.R., Thomson, W.M., & Caspi, A. (2011). A gradient of childhood self-control predicts health, wealth, and public safety. *Proceedings of the National Academy of Sciences*, *108*, 2693–2698.

Moffitt, T.E., Gabrielli, W.F., Mednick, S.A., & Schulsinger, F. (1981). Socioeconomic status, IQ, and delinquency. *Journal of Abnormal Psychology*, *90*, 152–156.

Moffitt, T.E., & Silva, P.A. (1988). IQ and delinquency: A direct test of the differential detection hypothesis. *Journal of Abnormal Psychology*, *97*, 330–333.

Morgan, A.B., & Lilienfeld, S.O. (2000). A meta-analytic review of the relation between antisocial behavior and neuropsychological measures of executive function. *Clinical Psychology Review*, *20*, 113–136.

Neisser, U., Boodoo, G., Bouchard, T.J., Jr., Boykin, A.W., Brody, N., Ceci, S.J., & Urbina, S. (1996). Intelligence: Knowns and unknowns. *American Psychologist*, *51*, 77–101.

Nevin, R. (2000). How lead exposure relates to temporal changes in IQ, violent crime, and unwed pregnancy. *Environmental Research*, *83*, 1–22.

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

Paananen, R., & Gissler, M. (2012). Cohort profile: The 1987 Finnish birth cohort. *International Journal of Epidemiology*, *41*, 941–945.

Pesonen, A.K., Eriksson, J.G., Heinonen, K., Kajantie, E., Tuovinen, S., Alastalo, H., & Räikkönen, K. (2013). Cognitive ability and decline after early life stress exposure. *Neurobiology of Aging*, *34*, 1674–1679.

Pratt, T.C., & Cullen, F.T. (2000). The empirical status of Gottfredson and Hirschi's general theory of crime: A meta-analysis. *Criminology*, *38*, 931–964.
Räikkönen, K., Forsén, T., Henriksson, M., Kajantie, E., Heinonen, K., Pesonen, A.K., & Eriksson, J.G. (2009). Growth trajectories and intellectual abilities in young adulthood: The Helsinki Birth Cohort Study. *American Journal of Epidemiology*, *170*, 447–455.
Raven, J. (2000). The Raven's progressive matrices: Change and stability over culture and time. *Cognitive Psychology*, *41*, 1–48.
Rushton, J.P., & Templer, D.I. (2009). National differences in intelligence, crime, income, and skin color. *Intelligence*, *37*, 341–346.
Savolainen, J., Paananen, R., Merikukka, M., Aaltonen, M., & Gissler, M. (2013). Material deprivation or minimal education? Social class and crime in an egalitarian welfare state. *Advances in Life Course Research*, *18*, 175–184.
Thornberry, T.P., & Krohn, M.D. (2000). The self-report method for measuring delinquency and crime. *Criminal Justice*, *4*, 33–83.
Tiihonen, J., Haukka, J., Henriksson, M., Cannon, M., Kieseppä, T., Laaksonen, I., & Lönnqvist, J. (2005). Premorbid intellectual functioning in bipolar disorder and schizophrenia: Results from a cohort study of male conscripts. *American Journal of Psychiatry*, *162*, 1904–1910.
Walsh, A. (1987). Cognitive functioning and delinquency: Property versus violent offenses. *International Journal of Offender Therapy and Comparative Criminology*, *31*, 285–289.
Walsh, A., & Beyer, J.A. (1986). Wechsler performance-verbal discrepancy and antisocial behavior. *The Journal of Social Psychology*, *126*, 419–420.
Warr, M. (2002). *Companions in crime: The social aspects of criminal conduct.* Cambridge University Press.
Welte, J.W., & Wieczorek, W.F. (1998). Alcohol, intelligence, and violent crime in young males. *Journal of Substance Abuse*, *10*, 309–319.
West, D. J., & Farrington, D. P. (1973). *Who becomes delinquent* London: Heinemann.
Yun, I., & Lee, J. (2013). IQ and delinquency: The differential detection hypothesis revisited. *Youth Violence and Juvenile Justice*, *11*, 196–211.