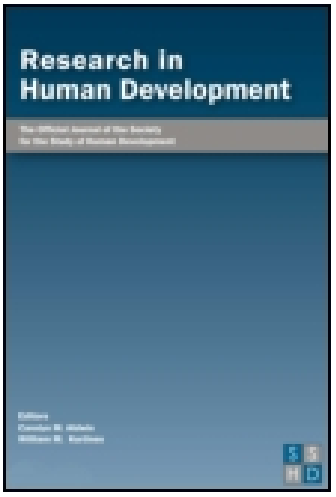

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High IQ in Early Adolescence and Career Success in Adulthood: Findings from a Swedish Longitudinal Study

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To what extent do intellectually talented adolescents pursue educational and vocational careers that match their intellectual resources? Career outcomes were compared between groups within different IQ ranges with a focus on comparing those with high IQ (top 10%, IQ > 119) to those with average IQ. Data were analyzed from the longitudinal Swedish IDA study ($N = 1{,}326$) with career outcomes measured in midlife (age 43–47). To obtain at least a master's degree was almost 10 times more common for those of high IQ than for those of average IQ. Still, the proportion of high-IQ adolescents who did this was not high (13% of females, 34% of males) and as much as 20% of them did not even graduate from 3-year high school. For men only, there was a graded raise in income by IQ group. Within the high-IQ group there was no significant relationship between parents' socioeconomic status and income. For men, high IQ predicted a strongly increased income/vocational level in midlife beyond what was predicted from a linear model of the IQ-outcome relationship.

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To what extent do intellectually talented youth pursue an educational and vocational career that matches their intellectual resources? There certainly are many different types and degrees of "intellectual talent." This article is limited to intelligence as measured by a sound global intelligence test developed within the standard psychometric tradition (henceforth denoted as IQ). Such a test loads heavily on the *g* factor, also called generalized intelligence (Gottfredson, 2004; Jensen, 1998). Of course, *IQ* is not synonymous with *intelligence* in its broadest sense, because different theories exist concerning the nature of intelligence (Carrol, 1993; Gardner, 1993; Sternberg, 1985). We are interested in youth that have a sufficiently high IQ to make them suitable for achieving a highly qualified education and/or to successfully manage an intellectually demanding job.

Numerous studies have reported a sizable relationship between IQ and vocational and educational success. As reviewed below, most studies have been cross-sectional, but there are also many longitudinal studies in which IQ in childhood has been related to adult career outcomes, and for both types of studies an IQ-outcome relationship has been found. Most commonly the relationship to adult outcomes has been studied across the whole IQ range based on a linear model of the IQ-outcome relationship (here labeled "standard IQ-outcome studies"). Exceptions are studies of career outcomes for highly intellectually gifted children, starting with the famous longitudinal study by Terman (1947) of children with IQ $>$ 135.

However, there is a knowledge gap, especially from a societal perspective. For any society, it is important to find out the extent to which its intellectually talented youth receive an education matched to their ability and have a vocational career that places them in positions in which their abilities are maximally useful. In this respect, neither standard IQ-outcome studies nor longitudinal studies of the outcomes of highly intellectually gifted children are sufficient. This study focuses on adolescents with an IQ that is sufficiently high for them to clearly meet the intellectual demands to successfully pursue highly qualified university training and/or manage a highly qualified job. The IQ level necessary to meet these demands is certainly lower than that of the participants included in the typical study of intellectually gifted children. In this study, we defined the high-IQ group as the top 10% in the IQ distribution, IQ $\geq$ 120 (the reasons for the cutoff point are indicated in the Method section). To what extent do such youth achieve successful career outcomes and to what extent are the outcomes dependent on gender and on the parents' socioeconomic status (SES)?

A study with the present aims should fulfill four requirements: (1) IQ should be measured before streaming has occurred in school to minimize reverse causality, because schooling may affect intelligence (see Gustafsson, 2001, for a review and for findings based on Swedish data). Of course, there is a dynamic interplay between IQ and school achievement that continues into adulthood (Clouston et al., 2012), but it falls outside our focus. (2) The study should be longitudinal, starting not later than in adolescence and ending not before midlife when the career patterns have been established. (3) From a theoretical standpoint (see Study aims section), it is doubtful if the importance of high IQ for career outcomes can be inferred from standard IQ-outcome studies because there may be threshold and/or nonlinear effects. It is more straightforward to compare outcomes between groups within different IQ ranges with the focal group being those with high IQ. (4) If IQ groups are analyzed, IQ must be measured with very high reliability to minimize miss classification due to errors of measurement. This study fulfills these four requirements. It is based on data from the Swedish longitudinal study Individual Development and Adaptation (IDA; Bergman, 2000; Magnusson, 1988).

IQ and Vocational and Educational Success

Strong arguments exist for expecting IQ to be important for many types of career success (Gottfredson, 1997). A high IQ usually implies a good capacity for processing information, for learning, and for handling novel and complex situations. All these competencies are of obvious importance for career success. Of course, IQ is far from the only determinant of career success. Examples of other important factors are the parents' and child's aspirations, personality, and the opportunities for success that exist within the young person's societal context (cf. Roberts, Kuncel, Shiner, Caspi, & Goldberg, 2007). However, in the literature review that follows we focus on the importance of IQ for educational and vocational career outcomes.

Extant research on associations between generalized intelligence in childhood or adolescence and educational and vocational outcomes in adulthood have been summarized by meta-analyses and literature reviews (e.g., Bowles, Gintis, & Osbourne, 2001; Jencks et al., 1979). This evidence base, in many cases, consists of participant samples that cover the entire intelligence range and for which the linear relationship between intelligence and outcomes are studied, with intelligence consistently being found to be an important predictor of several career outcomes.

Sorjonen, Hemmingsson, Lundin, Falkstedt, and Melin (2012) reported findings from a Swedish IQ-outcome study. For a large prospective cohort of men ($N = 48{,}013$) they studied intelligence, socioeconomic background, emotional capacity, and level of education as predictors of attained socioeconomic position. The men were born between 1949 and 1951. IQ was measured at military conscription when they were age 18 years, and the outcomes covered information about income and attained occupational status, from when they were about age 40 years. Using structural equation methodology, models of the relationship of intelligence and the other independent variables to the outcomes were fitted. Intelligence and level of education were found to have the strongest total "effect" on attained occupational status (beta coefficients of .46 and .49, respectively). The "effects" on income were weaker.

In the Hawaii Family Study of Cognition, IQ and outcomes, variables were studied separately by gender ($N = 1{,}816$; Nagoshi, Johnson, & Honbo, 1993). This study began in the early 1970s, and the majority of the families had either a European or Japanese family background. The sample was a general cohort, not selected on the basis of their IQ scores, and with a subset of the original cohort followed up in their early thirties. Hierarchical multiple regression analyses showed that IQ in adolescence or young adulthood was positively related to later educational attainment in the thirties, even after controlling for the contribution of other important predictors, such as father's educational attainment. Another set of regression analyses, with income in the thirties as the attainment outcome, showed that for males IQ was an important predictor, but for females their own educational attainment and not IQ predicted their income. Parents' education was controlled for in these analyses, but it was not related to income.

Strentze (2007) provided an overview of standard IQ-outcome studies in a meta-analysis of 85 longitudinal data sets, representing 135 samples from Western nations. However, gender differences were not examined. Studies included had measures of participants' generalized intelligence defined as "abstract ability that is not tied to any specific domain of knowledge" (Strenze, 2007, p. 407), and were indexed by IQ tests**,** such as the Raven Progressive Matrices or Stanford-Binet tests, as well as by multiple aptitude tests. Outcomes measured included level of educational attainment, job prestige/level, and individual salary or income. Some of the studies also contained information on important constructs such as parental ES. Significant correlations were

reported between childhood or adolescent intelligence (measured before age 19) and adult outcomes (measured after age 29), such as educational ($r = .56$) and vocational ($r = .45$) attainment as well as income ($r = .23$).

Strenze's (2007) meta-analysis addressed questions about the importance of childhood or adolescent intelligence compared to the importance of parent SES in relation to adult outcomes. He found that whenever intelligence and SES were found to be differentially important, intelligence was found to be significantly more important to educational and vocational attainment. The results were less clear when the outcome was income.

Studies that focus on the educational and vocational outcomes of intellectually gifted children and adolescents are of some interest in the present context (e.g., Gross, 2006). Such studies usually concern children/adolescents with very high IQ, far above 119, which is the cutoff point in this study. As mentioned, classic U.S. studies in this area include the work of Terman (1947), a study of 1,528 children with IQ > 135 that were followed to adulthood, as well as Hollingsworth's (1942) study of profoundly gifted children with IQs above 180. However, we focus on relatively contemporary longitudinal studies.

Study of Mathematically Precocious Youth (SMPY; Wai, Lubinski, & Benbow, 2005) is a large longitudinal study of highly intellectually gifted children founded by Stanley in the 1970s and presently conducted by Lubinski and Benbow (2006). In the study, several thousand U.S. children across five cohorts are being followed from approximate age 13 with study results reported so far into young adulthood. SMPY's sample is not a traditionally identified high-IQ sample, instead the children were identified as being intellectually talented based on their performance in math and/or verbal ability on the American College Board's Scholastic Aptitude Test (SAT; presently referred to as the Scholastic Assessment Test; Benhow, 2012). SMPY participants scored anywhere in the top 1% to top 5% in either math and/or verbal ability around or before age 13, depending on the cohort studied. SMPY is a large-scale study in which variations in ability within a high-ability group have also been investigated.

For the first and second SMPY cohorts ($N = 2{,}966$), participants with SAT math and/or verbal ability scores in the bottom and top quartiles of the whole participant sample were compared on a variety of adult outcomes at age 33, such as doctorates, primary income, patents, and tenure (Wai et al., 2005). SMPY participants in the top quartile of math and/or verbal ability were significantly better off on all adult outcomes relative to SMPY participants in the bottom quartile of ability (i.e., had significantly higher incomes, etc.). Based on their findings, SMPY researchers have argued against a general principle of diminishing returns in regards to the benefits of increased ability within the high IQ range. In their own words,

> Other factors are indeed important, and we agree that being strongly committed and highly motivated is critical for high achievement . . .. Yet, the data reported here on secured doctorates, math-science PhD., income, patents, and tenure track positions at top U.S. universities collectively falsify the idea that after a certain point more ability does not matter. (Wai et al., 2005, p. 489)

From a different historical and cultural viewpoint, the five wave, several decades long, Warsaw study (Firkowska-Mankiewicz, 2011) illustrates a study that bridges the standard IQ-outcome study and the gifted child study. The Warsaw study began in the early 1970s with an IQ test of a general cohort of 11-year-olds in Warsaw schools ($N = 14{,}000$). Subsequently, subsamples were identified, based on childhood IQ, and followed up into adulthood when the participants were in their thirties (Warsaw Study II). This study is situated in a particular point in history,

its participants experienced the transition in Poland from a communist to a democratic state; however, primary and secondary schools that this cohort attended were serving children coming from homes that spanned a range of different family socioeconomic backgrounds in Poland at the time. A subgroup was followed into adulthood that consisted of participants with a high-IQ score in childhood ($n = 170$ with an average IQ of 130). Of them 67% had attained a college education, 49% had high prestige jobs (e.g., top manager, employers, or professionals), and approximately 80% had a high household income by their thirties.

Ability Reserve Studies

Another research tradition, somewhat related to the types of studies reviewed so far, is the study of the so-called ability reserve. Such studies have usually been conducted within the field of education and often address questions at a societal level that concern the degree to which a country is making optimal use of its intellectually talented youth. Studies on the ability reserve (in Swedish, *begåvningsreserven*) were initiated in Sweden in the 1940s. The purpose was to estimate the number of children in lower social strata who were intellectually capable of successfully completing further schooling after mandatory school, which in those days only comprised 6 years. For instance, in an early study it was estimated that one out of five of all children were intellectually capable of successfully completing senior high school, which at that time only 7% of the children did (Husén, 2002). Further studies were conducted in the following decades in Sweden and in other countries, see Husén (1974) for an overview.

Characteristics of the Studied Cohort and the Surrounding Swedish Society

Almost all members of the studied school grade cohort were born in 1955 and grew up in the Swedish town of Örebro, a town of about 100,000 inhabitants. The majority of them continued to live there up to midlife. They completed 9-year mandatory school in 1971 (age 16), but 87% continued schooling by attending 2-year practical or 3-year theoretical senior high school. About 46% achieved an educational level corresponding to at least a 3-year senior high school education, and 13% obtained a university degree.

The cohort's educational and vocational careers were largely formed by choices and achievements during the 20-year period 1971 to 1991. Admission to attractive advanced trainings, like studying medicine, was determined on the basis of school grades, which had to be very high to be competitive. A school reform was implemented in the 1950s and 1960s, resulting in a mandatory 9 years of schooling with no streaming (except for a differentiation into advanced and basic courses in mathematics and English). All schooling, also at university level, was free of charge, and there was also financial support for students pursuing higher education (Björklund, Lindahl, & Sund, 2003). Efforts were made to encourage teenagers of both genders and from all SES backgrounds to continue their studies, and "back doors" for entering higher education were created for those who had not completed 3-year senior high school. Even so, the socioeconomic position of the family still played an important role for students' school results, and a recent Swedish study showed that this association has been fairly constant over the past 20 years (Böhlmark & Holmlund, 2012) even though the difference in school performance between low- and

high-performing individuals has been lower in Sweden than in most other countries (Swedish National Agency for Education, 2006).

In 2008, 32% of the Swedish population in the age range of 25 to 64 years had an academic degree of at least 3 years (120 credits) compared to an average for the Organisation for Economic Co-operation and Development countries of 28%. The proportion of individuals that proceed to higher education has also increased in the last 30 years. The previous predominance of men in higher education is now reversed, and of those who started higher education in Sweden in 2010, 58% were women and 42% were men. Among doctoral students the gender distribution is equal (Swedish National Agency for Higher Education, 2011). Despite these changes, the majority of the highest positions in the private and public sector are still held by men in the beginning of the 21st century (Statens Offentliga Utredningar [SOU], 2004).

In the 1970s and 1980s, the Swedish unemployment rate was low compared to the rest of Europe. It was usually between around 3%, but in the early 1990s it increased to almost 10% as a consequence of an economic crisis (Österholm, 2009). Thereafter, the economy started to recover, and the unemployment rates dropped, particularly for men (Fredriksson & Topel, 2010). In 1998, the unemployment rate increased for women in the Örebro area due to budget restrictions in the health care sector.

In the 1960s and 1970s, women with small children increasingly entered the labor force. This was made possible by day care service that was set up on large scale during these decades. By 1983, publicly provided day care covered 52% of preschool children, and by 2004, more than 80% of preschool children were in public day care (Kolm & Lazear, 2010). The incentives for both parents to work were also strong because no tax deductions were given to families where only the man or the woman worked. By the 1990s, female labor force participation had become fairly close to that of the men (SOU, 2004).

From an international perspective, Swedish income taxes were extremely high during the period of 1960 to 1990, and marginal tax rates were above 70% for blue-collar and white-collar workers in the 1970s. The 1991 tax reform reduced the marginal tax rates, but tax rates in Sweden remained high when compared to non-Nordic countries (Freeman, Swedenborg, & Topel, 2010). The income distribution in Sweden is also very compressed. All families with children younger than age 18 received child support and families with low incomes, which also included some families where both caretakers worked full time, often received social support in the form of housing rent subsidies. A strong social safety net ensured that also the unemployed and chronically ill received social benefits that often were only moderately lower than what they would have earned from a low-paying job.

This Study

The general aim of the study was described in the introduction. More specifically, the study had the following aims:

1. To describe career outcomes in midlife of adolescents with high IQ (top 10%) as compared to those belonging to other IQ groups. It is expected that the high-IQ group will have increased chances of a successful educational and vocational career. The extent of the increased chances of success is of interest, as well as the proportion of those with high

IQ who achieve a successful career. Conversely, the proportion of those with high IQ who experience a career failure is also of interest.

2. To describe the extent to which the SES of the family of origin (parents' SES) and gender-moderate career outcomes. It is expected that being a woman or growing up in a low SES home will lead to decreased chances of a successful career also for those with a high IQ.
3. To determine whether a high IQ has a stronger positive relationship to career outcomes than that indicated by linear models of the relationship between IQ and a career outcome. This is expected for men and especially, for vocational outcomes.

The starting point for this expectation is taken from Gottfredson's (1986, 1997) discussion of the important role of the *g* factor in everyday life and employment. For the studied cohort, whose careers were formed during the 1970s to 1990s, men were much more likely than women to pursue a career leading to a high occupational status and a high income. A high IQ, rather than an average or slightly above average IQ, enables one to intellectually master most obstacles when pursuing even an advanced career track. Seemingly, this is consistent with a model of a linear relationship of IQ to career outcomes but there are arguments that suggest a nonlinear relationship. Most high-status jobs and entry jobs leading to them are intellectually demanding, leaving a person of average IQ with little time for strategic planning and processing information of long-term importance after the necessary daily work is done. In contrast, the person with high IQ may manage the daily tasks more easily, leaving more time for such planning and information processing. This can affect the job career in a nonlinear way. For instance, there is a bias to think categorically (Macrae & Bodenhausen, 2000), and this also applies to managers who tend to divide subordinate workers into "promising" or "not promising." A person with high IQ is likely to stand out in this way from the coworkers and will often be regarded as "number one" in a work group. Hence, this person will more likely be promoted or at least be given more qualified tasks. This tends to make the high-IQ person even more capable and valuable to the organization, which can enhance the importance of even small IQ differences within the above average IQ level.

METHOD

Participants

Longitudinal data were used from the Swedish longitudinal research program Individual Development and Adaptation (IDA; Bergman, 2000; Magnusson, 1988). In IDA, a whole school grade cohort of children from the Swedish town of Örebro was studied. The cohort included all children who were in the normal school system but excluded those children who, mostly due to severe intellectual handicaps, were in special schools for the mentally challenged (about 2%–3% of all children). The participants have been followed from Grade 3 (age 10) in 1965 to age 43 in 1998 for women, and to age 47 in 2001 for men. Children who moved to Örebro after Grade 3 and belonged to the school grade cohort were added to the study, and in Grade 9 (age 16), the cohort had grown to 1,392 children. The follow-up in midlife was undertaken for all women in the extended cohort (i.e., all Örebro girls who were in one or more of Grade 3 1965 to Grade 9 1970, $n = 682$) and for men the follow-up was undertaken for all boys who were in the original Grade 3 cohort in 1965 ($n = 543$).

School age IQ data were available for 1,326 children (95% of the extended school grade cohort), and data from the follow-up in midlife were available for 962 participants (393 men and 569 women). The participation rates in midlife were for women 83% and for men 72%. Those who participated in the follow-up in midlife were compared to those who did not participate to examine how they differed with regard to four school age variables: IQ, school achievement, parents' education, and parents' income (see Variable section for descriptions). For two of these variables, significant differences were found between the two groups: The mean school achievement and IQ were slightly higher for those who participated in the follow-up in midlife than for those who did not (effect sizes of 0.23 and 0.29, respectively).

Örebro is a midsized Swedish town (about 100,000 inhabitants). It is fairly representative of Swedish urban communities, excluding the big cities. However, Bergman (1973) reported that for the IDA sample, the level of the parents' education and the children's standardized achievement test results were slightly higher than for "all Sweden" (effect size 0.1). The average IQ in Grade 6 was compared between the IDA sample and a normative sample of sixth-grade children studied by Härnquist (1969), who developed the differential ability analysis (DBA) test used in IDA. Expressed in IQ scores with a mean of 100 and a standard deviation of 15, the average IQ was 4.7 points higher in the IDA sample. However, in Härnquist's sample urban populations were underrepresented.

Measures at School Age

Gender

Information about gender was available for all children in the extended school grade cohort (710 boys and 682 girls; boys coded 1 and girls coded 0).

IQ

Information about intelligence was used from three sources: At age 15 it was used from scores on the Swedish WIT III intelligence test battery (four tests, each expressed in stanine scores), and at age 10 and 13 information was used from scores on the Swedish DBA intelligence test battery (six tests, raw scores). Both these tests are multifactor tests and only the global sum scores, measuring general intelligence, were used. Reported reliabilities for the global scores on these two composite tests are 0.95 and 0.93, respectively. The tests are described more in detail in Backteman and Magnusson (1981). To maximize reliability and minimize sample attrition, the following procedure was followed to construct a single measure of school-age intelligence based on the three available measures: (1) at each age separately the global test scores were standardized; (2) for children with complete data ($n = 809$), the mean of the three standardized test scores was computed; (3) for children with data missing from one age ($n = 246$), the mean was computed of the two available standardized scores; (4) for children with data from just one age ($n = 271$) their standardized scores were used; (5) finally, the standardized scores created by 1 through 4 above were standardized again to have a mean of 100 and a standard deviation of 15 for the whole sample and the final variable was labeled IQ. In this way highly reliable IQ data became available for 1,326 children. IQ correlated 0.94 with the age 10 global IQ score, 0.95 with the age 13 global IQ score, and 0.94 with the age 15 global IQ score. Furthermore,

IQ correlated 0.74 with school achievement (described below) and, for a biological subsample of IDA studied at age 26 ($n = 171$), IQ correlated 0.75 with the global intelligence score of the Swedish Synonyms, Reasoning, and Block Test (SRB) intelligence test.

IQ Group

Based on the IQ variable the following IQ groups were constructed: 1. $P_{90\text{-}100}$ (above the 90th percentile in IQ, n=134, 68 boys). This group is labeled the high-IQ group. 2. $P_{80\text{-}90}$ (between the 80th and 90th percentile in IQ, $n = 134$, 58 boys). 3. $P_{70\text{-}80}$ (between the 70th and 80th percentile in IQ, $n = 130$, 63 boys). 4. $P_{60\text{-}70}$ (between the 60th and70th percentile in IQ, $n = 129$, 55 boys). 5. $P_{40\text{-}60}$ (between the 40th and 60th percentile in IQ, $n = 275$, 133 boys). This group is labeled the average-IQ group. 6. $P_{0\text{-}40}$ (below the 40th percentile in IQ, $n = 524$, 292 boys). Based on IQ group, a binary variable was also constructed: high IQ, coded 1 if a child belonged to $P_{90\text{-}100}$, otherwise coded 0.

School Achievement

Information about school achievement was available in the form of average school grades in Grades 3, 6, and 9. In Grade 3 and 6 the grades in Swedish and mathematics were averaged and in Grade 9 the grades in Swedish, history, civic knowledge, biology, chemistry, and physics were averaged (mathematics could not be used due to the existence of two different courses in mathematics in Grade 9). The grade in a single subject was scored 1 through 5 with 5 being the highest grade and, consequently, the averaged grade at each age was in the range 1 to 5, in all cases close to 3. The instructions for the teachers' grading stressed that the grades were relative to all Swedish children in the same grade. These scores are easily interpretable so no standardization was carried out. Then the procedure described above for creating IQ was followed, except that no standardization was undertaken. The final variable was labeled school achievement for which data were available for 1,347 children ($M = 3.07$, $SD = .83$). School achievement correlated 0.91, 0.94, and 0.89 with the averaged school grades in Grade 3, 6, and 9, respectively, and school achievement correlated 0.90 with the averaged score on standardized achievement tests in Swedish and mathematics given in Grade 6 (standardized achievement tests were not given in Grade 9).

Parents' Education

The education of the parents was measured by the parent with the highest education, as reported in a parents' questionnaire. The reversed scale was from 1 (*only mandatory school*) to 7 (*academic degree*). Information about the education of the parents was available from Grades 3, 6, and 9 and from this the variable parents' education was constructed in the following way: (1) if data from Grade 6 were available, parents' education was defined by the education of the parents reported in that grade; (2) in case data were not available from Grade 6, Grade 9 data were used; (3) in cases where only data from Grade 3 were available, these data were used. Data for parents' education were available for 1,316 children. Parents' education correlated 0.90, 1.00, and 0.95 with the education of the parents reported in Grades 3, 6 and 9, respectively, and parents' education correlated 0.65 with parents' income (described below).

Parents' Income

Parents' income was measured by the average of self-reported family income before taxes in Grades 3 and 6 and, if data from only one age was available, these data were used. At each age the scales were 1 to 7, with 7 being the highest income category. Information about parents' income was available for 1,155 children. Parents' income correlated 0.96 with the income reported in Grade 3 and 0.96 with the income reported in Grade 6.

Parents' SES

An index of the parents' socioeconomic status was formed by summing the scores on parents' education and parents' income (the two variables had approximately the same standard deviations and correlated 0.65). The sum score was then *z*-transformed. Information about parents' SES was available for 1,151 children. Parents' SES correlated 0.93 with parents' education and 0.89 with parents' income.

Measures in Midlife

All variables measured in midlife were based on self-reports given in personal interviews with the women at age 43 and the men at age 47.

Married/Cohabiting

This variable was coded yes (79%) or no (19%) and information was available for 962 participants.

Number of Children

This variable measured the number of own children the participants had (including adopted children). Such information was available for 892 participants ($M = 2.14$, $SD = 1.10$).

Current Occupation

A number of questions were asked about the respondents' current occupation and four binary variables were formed: employed full-time (61%), runs business as a (part) owner (14%), free-lance (6%), study (7%), and unemployed (8%). It should be noted that in some cases a person had more than one occupation (e.g., is employed and study). Information was available for 898 to 931 participants.

Number of Work Hours

This variable was measured by the typical number of work hours per week for those who had a job. Information was available for 851 subjects ($M = 39.0$, $SD = 8.2$).

Highest Education

The coding of this variable was based on the answers to a large number of questions about the participants' education. In analyses where highest education was entered as a continuous variable, the original 13-step coding was used. Based on the original coding a simplified coding with six categories was used for cross-tabulations: (1) only mandatory school (13%), (2) some schooling above mandatory school (42%), (3) 3-year high school (7%), (4) some college study after high school (25%), (5) B.A. or equivalent (7%), and (6) A "prestige" education, at least at the master's degree level (7%), most commonly master's degrees were in advanced school of business, or civil engineering. Information was available for 962 participants.

Income

This variable was measured by the monthly personal income in Swedish Crowns (SEK) before tax deduction and it was available for 668 employed ($M = 20{,}300$, $SD = 13{,}100$). Information about income was not available for self-employed.

Occupational Level

The variable was coded using information from a variable measuring occupational level and that reflects the education usually demanded for the type of job the person holds. It is a 5-point scale with 1 (*almost no education is needed*), 2 (*high school competence is needed*), 3 (*some higher education is needed but not an academic degree*), 4 (*an academic degree is needed*). The code 5 was added in the IDA project and was reserved for person with a leading position (leader of a large organization). The variable is based on the Swedish Standard Classification of Occupations (SCB; Statistics Sweden, 1998) and is described in Andersson and Bergman (2011). High occupational level was coded 1 if the occupational level was 4 or 5 (29%), otherwise coded 0 (71%). Information was available for 910 participants.

Staff Manager and Advisor

Those who were employed were asked if they were a staff manager and about the size of their staff. Staff manager was coded *no* (71%), *yes, staff 1–9* (17%), *yes, staff 10–19* (6%), or *yes, staff 20 or more* (6%). Information was available for 745 employed. They were also asked if they had an advisory function and took part in strategic decision-making in the organization where they worked. Advisor was coded *yes* (61%) if they had an advisory function, otherwise *no* (39%). Information was available for 754 participants.

Own Business

Those who had their own business were asked about the number of employees they had. Own business was coded *no employees* (56%), *1–9 employees* (37%), *10–19 employees* (6%), and *20 or more employees* (2%). Information was available for 126 participants who had their own business.

Definition of a High-IQ Group

The definition of high IQ described in the Measures section is based on considerations of what IQ is typical of those who successfully complete advanced university training or achieve a highly qualified job position. We consider the median or mean IQ of such career groups as indicative of a suitable cutoff point. For this purpose, we used information from the present Swedish IDA study and from international studies of the IQ distribution within qualified educational and vocational groups. Based on IDA data, the mean/median IQ of those with a very qualified education (at least a master's degree) is 114.4/115.5 ($SD = 10.9$) and the corresponding figures for those belonging to the top 5% in income in midlife is 111.6/112.3 ($SD = 11.2$). Huang (2001) listed the mean and median IQ of those in high-IQ occupations with IQ measured by the Army Qualification Test (AFQT) for the National Longitudinal Survey of Youth sample and IQ measured by the Henmon-Nelson IQ for the Wisconsin Longitudinal study. The mean/median IQs for the five high-IQ professions with the highest average IQ were in the range of 117.5 to 124.8/117 to 122. Matarazzo (1972) reported mean WAIS IQ scores of 115 for college graduates, and 125 for PhDs/MDs.

The above research suggests that a reasonable cutoff point for high IQ is the top 10 percent of a normal population (IQ $\geq$ 120). For the IDA data with IQ standardized to a mean of 100 and a standard deviation of 15, the choice of an IQ $>$ 119 corresponds to the top 10% of the distribution. However, for the IDA data this cutoff point is 0.37 *SD* units above the average for the group with the highest education, and 0.63 *SD* units above the average for the top-income group. Partly for the reason of increasing international comparability of the findings, we decided to use the top 10% cutoff point. For the Swedish cohort, this probably leads to a slight underestimation of the group that is intellectually suitable for a highly qualified education or vocation.

The definition of high IQ as the top 10% of the adolescents corresponds roughly to what in the giftedness literature has been called the "mildly gifted group" (IQ 115–129; Gross, 2009). Of our high-IQ group, 84% falls in this range, the remaining 16% falls in the IQ range 130 to 147.

RESULTS

In Table 1, basic information is presented about the relationship between IQ and the variables measured at school age. As expected, IQ is highly correlated with school achievement and moderately correlated with parents' education, parents' income, and parents' SES. The means for all variables differ significantly between IQ groups, most strongly for IQ and School achievement. For school achievement (scaled 1–5), the mean for $P_{90\text{-}100}$, the high-IQ group, is 4.18 as compared to 3.01 for the average-IQ group, $P_{40\text{-}60}$, a difference of 1.4 *SD* units.

We tested mean differences between IQ groups on a number of background characteristics in midlife: marital status, number of children, employment status, and number of work hours per week. No significant differences were found between the high-IQ group and the average-IQ group. The findings reported in this paragraph are not given in a table.

In Table 2, the percentages with different levels of highest education are presented for the six IQ groups. There is a strong relationship between IQ group and highest education. Comparing the high-IQ group with the average-IQ group, achieving a master's degree is almost 10 times more common in the high-IQ group. Still, less than one fourth of this group achieved a master's degree

TABLE 1
IQ in Relation to School Achievement, Parents' Education, Parents' Income, and Parents' Socioeconomic Status (SES). Correlations Between Variables and Means for the Six IQ Groups

Variable	*1*	*2*	*3*	*4*	*5*
1. IQ	1				
2. School achievement	.74	1			
3. Parents' education	.33	.35	1		
4. Parents' income	.28	.29	.65	1	
5. Parents' SES	.34	.36	.93	.89	1
IQ group					
$P_{90–100}$	124.8	4.18	3.82	5.06	0.55
$P_{80–90}$	115.8	3.76	3.61	4.87	0.42
$P_{70–80}$	110.9	3.64	3.39	4.78	0.29
$P_{60–70}$	106.4	3.36	3.27	4.70	0.22
$P_{40–60}$	100.5	3.01	2.83	4.47	−0.02
$P_{0–40}$	85.1	2.42	2.34	3.95	−0.37
All	100.0	3.07	2.92	4.42	0.00

Note. All correlations are significant at $p < .01$ and testing with one-way ANOVA all variables are significantly related to IQ group at $p < .01$. The correlations were recomputed using Spearman's rho and were almost identical to the Pearson correlations.

TABLE 2
IQ and Educational Level Achieved in Midlife, Percentages and Means

	Highest Education						
IQ Group	*Mandatory School*	*Some High School*	*3-Year High School*	*Some College*	*BA Degree*	*Master's*	*All*
$P_{90–100}$	4.0	15.8	9.9	32.7	14.9	22.8	100.0
$P_{80–90}$	7.1	24.2	15.2	28.3	10.1	15.2	100.0
$P_{70–80}$	5.9	26.5	7.8	43.1	6.9	9.8	100.0
$P_{60–70}$	8.7	33.0	11.7	34.0	7.8	4.9	100.0
$P_{40–60}$	11.3	50.0	3.1	24.7	8.2	2.6	100.0
$P_{0–40}$	20.8	57.4	5.7	13.1	1.5	1.5	100.0
All groups	12.6	41.8	7.5	24.8	6.5	6.7	100.0
Mean IQ	92.6	96.1	105.8	106.8	110.6	114.4	101.2

Note. $\chi^2(25, N = 935) = 238.38, p < .001$, when testing the relationship between IQ group and educational group.

or a PhD degree. Thirty percent of the high-IQ group did not obtain any schooling above senior high school and as many as one fifth of them did not complete 3-year senior high school.

However, there were large gender differences. In Table 3, highest education was compared between the high-IQ group and the average-IQ group for the genders separately. The largest gender differences within the high-IQ group can be found for the two extremes of educational level. None of the males had only completed mandatory school, whereas 7% of the females had. Moreover, achieving the highest educational level was more than twice as common for men (34%) than for women (13%).

TABLE 3
IQ and Educational Level Achieved in Midlife: Comparison of Males and Females in the High-IQ Group and the Average-IQ Group (Percentages and Means)

	Highest Education						
IQ Group	*Mandatory School*	*Some High School*	*3-Year High School*	*Some College*	*BA Degree*	*Master's*	*All*
$P_{90–100}$							
Males	0.0	14.9	6.4	25.5	19.1	34.0	100.0
Females	7.4	16.7	13.0	38.9	11.1	13.0	100.0
$P_{40–60}$							
Males	4.2	54.9	4.2	18.3	12.7	5.6	100.0
Females	15.4	47.2	2.4	28.5	5.7	0.8	100.0
IQ means							
Males	89.4	94.9	101.5	106.0	111.0	114.6	100.4
Females	93.8	97.1	111.1	107.1	110.3	114.1	101.8

Note. The relationship between gender and educational group was tested using a chi-squared test of independence separately for those belonging to the high-IQ group and the average-IQ group. The results were, respectively, $\chi^2(5, N = 101) = 12.0, p < .05$ and $\chi^2(5, N = 194) = 14.6, p < .05$.

Table 4 shows large differences between genders in income, with men earning almost twice as much as women. Comparing income between genders and within IQ group, a large gender difference to the men's advantage is found in each IQ group. For the high-IQ group, the gender difference in income is extremely large (SEK 43,800 for men as compared to SEK 17,200 for women, the income for men is 2.5 times higher and a two-tailed t test for independent samples showed that $t(66) = 4.80$, $p < .001$. It is noteworthy that when the high-IQ group is compared to the average-IQ group, the difference in income is very large for men (SEK 43,800 compared to SEK 26,300) but it is quite small for women (SEK 17,200 compared to SEK 15,400). The findings for men will be analyzed more in detail in Table 5.

These differences are not explained by the fact that men worked longer hours, because the number of work hours per week is only moderately higher for men than for women (42.3h compared to 36.5h, data not shown). Recalculating the women's average income under the assumption that they had worked 42.3h per week for the same pay/h, the income can be estimated to have been about SEK 18000, an average income that the men exceed by 57%. The men were studied 3 years later than the women, and during that time salaries in Sweden had increased about 16% (Statistics Sweden, 1999, 2002). The men were also about 3.5 years older at the time of study, but according to Statistics Sweden (2002), the average salary was almost the same for both ages in 2001. If the men's income is recalculated to correspond to 1998 salary levels, it should be divided by 1.16. Applying this correction to men's income only marginally decreases the gender differences reported above. For instance, for the high-IQ group men's income divided by women's income changes from 2.5 to 2.2.

It is also seen in Table 4 that the linear relationship between IQ and Income, as expressed by the Pearson correlation, is significant for both genders and of moderate size, somewhat lower for women. However, when school achievement or highest education is controlled for, the relationship vanishes or is strongly decreased.

TABLE 4
IQ and Income in Midlife, Employed Only

IQ Group	*Men*	*Women*
$P_{90–100}$	43800**	17200*
$P_{80–90}$	27700	17500
$P_{70–80}$	33200	14800
$P_{60–70}$	28300	16300
$P_{40–60}$	26300	15400
$P_{0–40}$	23200	14200
All groups	28200	15500
Correlation with IQ[a]	.30***	.24***
Correlation with IQ[b]	.04	15**
Correlation with IQ[c]	.23***	.17***
Correlation with IQ[d]	.02	.10
Correlation with IQ[e]	.02	.10
Correlation with IQ[r]	−.03	.10

Note. Income in SEK before tax deduction.

[a]Simple correlation. [b]Correlation when school achievement is controlled for. [c]Correlation when parents' socioeconomic status (SES) is controlled for. [d]Correlation when both school achievement and parents' SES is controlled for. [e]Correlation when highest education is controlled for. [f]Correlation when all three variables are controlled for.

$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$ when testing either the significance of a correlation or, using a two-tailed t test for two independent samples to test difference between group $P_{90–100}$ and group $P_{40–60}$.

It was expected that a nonlinear positive relationship of IQ to career outcomes should exist, at least for men for vocational outcomes. In addition to the linear relationship of IQ, having a high IQ should further increase a positive career outcome. Regression analyses were computed with highest education, income, and high occupational level as the dependent variables and with IQ and high IQ (dummy variable, coded 1 if the person belonged to the high-IQ group) as the independent variables. For women, no evidence of a nonlinear relationship was found for any of the three career outcomes. For men, a nonlinear relationship was found when income or high occupational level was the dependent variable, and these results are reported in Table 5. Three regression models were run. When income was the dependent variable it can be seen that, according to Model 1, in addition to the linear relationship to IQ, belonging to the high-IQ group increases income with SEK 12,400, an amount that is 44% of the average monthly income for the total sample. Although reduced in size, this nonlinear increase remains significant also when school achievement, parents' SES, and highest education are controlled for (Models 2 and 3). In fact, in all three regression models high IQ outperforms IQ as a predictor of men's income and in Models 2 and 3, high IQ but not IQ is a significant predictor. Very similar results were found when high occupational level was the dependent variable. For instance, in Model 2 IQ is not a significant predictor, but high IQ is. According to the regression model, belonging to the high-IQ group multiplies the odds of having a high occupational level with 3.34 even after IQ is included in the model.

How important are gender and the parents' SES for the career outcomes of the high-IQ group? This issue is addressed in Table 6 by reporting results from regression analyses with highest

TABLE 5
Prediction of Income and High Occupational Level from IQ when High IQ Is Added to the Equation. Results from Multiple Regression Analyses (Income Is Dependent Variable) and Logistic Regression Analyses (High Occupational Level Is Dependent Variable), Males Only

	Dependent Variable: Income			*Dependent Variable: High Occupational Level*	
Independent Variables	*b*	*β*	R^2	*Odds coefficient*	*Nagelkerke* R^2
Model 1:			.12***		.21***
IQ	191*	.16*		1.68**	
High IQ	12400**	.23**		4.23**	
Model 2:			.14***		.28***
IQ	−54	−.05		0.91	
High IQ	9230*	.17*		3.34*	
School achievement	4330*	.24*		2.06***	
Parents' SES	2880*	.14*		1.52**	
Model 3:			.22***		.45***
IQ	−8	−.01		.94	
High IQ	9330*	.17*		5.06**	
Highest education	2520***	.39***		3.98***	

Note. Income is a highly positively skewed variable and the regression analyses were rerun with the natural logarithm of income as the dependent variable. Identical significances were obtained but the explained variances were higher. In the logistic regression analyses, all variables, except high IQ, were *z*-standardized to simplify the interpretation of the odds coefficients.

*$p < .05$. **$p < .01$. ***$p < .001$.

TABLE 6
Gender and Parents' Socioeconomic Status (SES) as Predictors of Highest Education, Income, and Occupational Level for the Whole Sample and for the High IQ Group ($P_{90–100}$)

	Dependent Variable							
	Highest Education			*Income*			*High Occupation Level*	
Independent Variables	*b*	*β*	R^2	*b*	*β*	R^2	*Odds Coefficient*	*Nagelkerke* R^2
Whole sample			.16***			.24***		.08***
Gender	.39*	.07*		12900***	.47***		1.59**	
Parents' SES	1.10***	.40***		2210***	.16***		1.67***	
High IQ group			.13***			.21***		.15***
Gender	1.20*	.23*		25900***	.49***		4.17**	
Parents' SES	.71**	.30**		1710[a]	.07[b]		1.15[c]	

Note. Income is a highly positively skewed variable and the regression analyses were rerun with instead the natural logarithm of personal income as the dependent variable. Identical significances were obtained but the explained variances were higher.

[a]$p = .57$. [b]$p = .57$. [c]$p = .52$.

*$p < .05$. **$p < .01$. ***$p < .001$.

education (original 13-step scale), income, or high occupational level as the dependent variable, and gender and parents' SES as the independent variables. It can be seen that both of these two variables are of moderate importance for highest education when the whole sample is analyzed, and that this importance remains when only the high-IQ group is analyzed. Within the high-IQ group, and controlling for parents' education, being a man increases highest education by 1.2 steps (corresponding to about one extra year of study). Furthermore, one standard deviation units increase in parents' SES increases highest education by 0.7 steps (corresponding to about half an extra year of study).

With regard to income, the strongest predictor is gender, which has a strong relationship to income, even stronger within the high-IQ group, in which the regression model estimates that a man earns SEK 25,900 more per month than a woman when parents' SES is controlled. Within the high-IQ group, there is no significant relationship between parents' SES and income after controlling for gender. High occupational level was also not related to parents' SES within the high-IQ group. These two non significant relationships were not even close to significance (p values of .57 and .52, respectively).

The relationship between IQ group and some additional indicators of career success was studied (being a staff manager, having a business with employees, and being an advisor). The only indicator that showed a relationship to IQ group was advisor. It was more common in the high-IQ group than in the average-IQ group that they functioned as an advisor at their work. However, the difference was not large (74% as compared to 59%). It is somewhat surprising that, within the high-IQ group ($n = 101$ with information from midlife), only two persons ran a business that had 10 or more employees. The findings reported in this paragraph are not given in a table.

DISCUSSION

As expected, having a high IQ (belonging to the top 10%) strongly increased the chances that a person achieved a high education (at least a master's degree). This was almost 10 times more common for those with high IQ than for those with average IQ. However, the proportion of those with high IQ who achieved that was nevertheless not high, especially among women (13% compared to 34% of the men). From a societal perspective, there are no grounds for claiming that almost everyone with a high IQ should achieve a high education, but the proportion in the sample that did this seems, nevertheless, undesirably low, especially for women. The gender difference is in line with previous research, and it is probably caused by old gender roles that remained, in spite of formal obstacles having been removed and that policy makers and media already in the 1970s were striving for gender equality. During the last decade, the gender difference that we found seems to have disappeared in Sweden, for instance among doctoral students the gender distribution is now about equal (Swedish National Agency for Higher Education, 2011).

It cannot be desirable in a modern society that youths with high IQs do not even graduate from a 3-year senior high school, because without a high school diploma most qualified career ways are closed. Yet this was the case for about one fifth of those with high IQ. This lack of basic education is not completely explained by gender or the parents' SES, because even for men coming from homes with above average parents' SES, 15% had not graduated from high school (data not shown). In the study by Ferrer-Wreder, Wänström, and Corovic (2014) in this issue,

adolescents of above average IQ were studied with regard to factors that discriminate between achievers and underachievers and outcomes in midlife of underachievers.

Within the high-IQ group, and with gender controlled for, the parents' SES was found to be of moderate importance for educational attainment within the whole sample and within the high-IQ group, and SES remains a predictive factor of educational attainment in the 21st century. However, it is probable that the importance of parents' SES for career success is smaller in Sweden than in most other countries, as suggested by Sorjonen et al. (2012), who compared Swedish findings to British findings.

Before discussing the findings concerning the relationship between high IQ and vocational outcomes, the reader must be reminded of that, from an international perspective, the Swedish income distribution was and is compressed, very strongly so for women. Our results showed large gender differences in mean income and for those of high IQ, the men earned more than twice as much. For men, but not for women, a graded raise in income by IQ group was found with a high raise when moving from the next highest IQ group to the high-IQ group. A weak or nonexistent relationship between IQ and income for women has also been found in other studies, see for instance, Nagoshi et al. (1993). It is also interesting to note that gender was much more important for income than the parents' SES. In fact, within the high-IQ group there was no significant relationship between parents' SES and income. This was also the case when the outcome was high occupational level. Broadly speaking, in line with Sorjonen et al.'s (2012) Swedish findings, our results suggest a more modest importance of the parents' SES for vocational success than reported in most studies from other countries. A tentative explanation is that the strong importance of intelligence for job performance (as pointed out by Gottfredson, 1997) combined with the Swedish egalitarian society has led to that those with high IQ being not much hindered by coming from a low-SES home in obtaining a job with career possibilities and in being promoted.

It is somewhat surprising that no significant relationships were found between IQ and a variety of background characteristics in midlife, considering that the studied high-IQ group is largely in the range of "socially optimal intelligence," IQ 125 to 155, as defined by Hollingsworth (1926). However, for most studied background characteristics, there was a tendency for the high-IQ group, as compared to the average- IQ group, to have a more "favorable" outcome; a tendency that was strongest with regard to the rate of unemployment (not reported in a table).

The findings suggest that those with high IQ were not more likely than others to go into business and create jobs by hiring employees. In fact, only two out of 101 participants in the high-IQ group were entrepreneurs and employed 10 or more persons. This finding might also apply to today's Swedish conditions, and to many other developed countries; especially those with high taxes on personal income, which might lower the incentive for taking risks as an entrepreneur.

It was expected that, at least for men and vocational outcomes, high IQ would have a stronger relationship to positive career outcomes greater than that indicated by a linear model. This was the case. When IQ and high IQ were used to predict income or occupational level for the whole sample of men, belonging to the high-IQ group was a stronger predictor than IQ of vocational success. For instance, controlling for the linear relationship of IQ to income, belonging to the high-IQ group increased income by 44%. In difference to IQ, belonging to the high-IQ group also predicted income and high occupational level after school achievement, parents' SES, or education had been controlled for in the analyses.

Strengths of the study include the longitudinal design, covering the time span from school age to midlife, that the sample is rather large and fairly representative of a general population,

and that IQ was measured with very high reliability. The primary limitations of the study are that it is based on a single Swedish cohort and that the participants belong to a particular, earlier generation (born in 1955).

In conclusion, our findings suggest that high IQ may be of special importance for men's vocational success in a way that is nonlinear and not captured by standard linear models for the relationship between IQ and vocational success. For women and for education, no such nonlinear relationship was found. We believe there are several reasons why we found a nonlinear relationship that, to our knowledge, has not been reported in other studies. Often nonlinearity is not looked for and, even if it is, monotonic nonlinear relationships tend to be difficult to detect. Measurement errors tend to obscure these relationships and often the specific nonlinear function form is unknown, which necessitates the use of nonstandard methodology (Dougherty & Thomas, 2012). In our case, IQ was measured with unusually high reliability. We believe that in many studies examining the importance of intelligence for outcomes, nonlinearity is a theoretically feasible assumption, and in some cases even an expectation. This should be taken more into consideration.

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