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The Contribution of Cognitive and Noncognitive Skills to Intergenerational Social Mobility

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Abstract

We investigated intergenerational educational and occupational mobility in a sample of 2,594 adult offspring and 2,530 of their parents. Participants completed assessments of general cognitive ability and five noncognitive factors related to social achievement; 88% were also genotyped, allowing computation of educational-attainment polygenic scores. Most offspring were socially mobile. Offspring who scored at least 1 standard deviation higher than their parents on both cognitive and noncognitive measures rarely moved down and frequently moved up. Polygenic scores were also associated with social mobility. Inheritance of a favorable subset of parent alleles was associated with moving up, and inheritance of an unfavorable subset was associated with moving down. Parents' education did not moderate the association of offspring's skill with mobility, suggesting that low-skilled offspring from advantaged homes were not protected from downward mobility. These data suggest that cognitive and noncognitive skills as well as genetic factors contribute to the reordering of social standing that takes place across generations.

Keywords

social mobility, parent–offspring transmission, general cognitive ability, noncognitive skills, open data

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Increasing economic inequality has led to concern over erosion of the middle class, exacerbation of health and social problems, and heightened economic and political instability (Neckerman & Torche, 2007). Nonetheless, Americans broadly support an unequal distribution of income as long as it is seen as being fair (Starmans, Sheskin, & Bloom, 2017), the result of individual initiative and talent rather than a perquisite of an advantaged family background (Jencks & Tach, 2006). Americans by a large majority believe that getting ahead is a matter of meritocratic processes rather than inherited privilege, and the strength of this belief does not appear to have waned as income inequality has increased (Reynolds & Xian, 2014). Nonetheless, belief in system fairness may be misplaced, the result of not knowing true rates of economic inequality and being motivated by the false hope that individuals get what they deserve (Jost, Gaucher, & Stern, 2015).

A major challenge to a belief in meritocratic processes is that advantaged parents are much more likely to have advantaged children than are less advantaged parents (Cullen, 2003). Wealth, social capital, and involvement are all ways in which parents can create opportunities for their children that are not widely available to others (Breen & Goldthorpe, 2001). Yet unequal opportunity is not the only factor contributing to the intergenerational transmission of inequality. High-achieving parents also transmit to their children, genetically and environmentally, the skills that contributed to their own success (Swift, 2004). Whether the persistence of socioeconomic status across generations

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is due to the unique opportunities that high-achieving parents create for their children or to the contribution of inherited skills to meritocratic processes is hotly debated (Breen & Goldthorpe, 2001; Saunders, 2002). In a between-family design, the opportunities associated with growing up in a high-achieving home are confounded with the skills that children in those homes inherit from their parents. Alternatively, within-family comparisons, such as those used here, help isolate the contribution of individual skills from the correlated consequences of shared home advantages.

We focused on a particular form of within-family comparison, intergenerational social mobility. Identifying when individuals achieve more or less than their parents effectively controls for the main effects associated with parent status. Intergenerational mobility is multifaceted and can vary depending on whether it is assessed in terms of income, wealth, occupation, or education (Torche, 2015). For both methodological and substantive reasons, we focused on educational mobility. Educational attainment is reliably established at a relatively early age because most individuals have completed their formal education by early adulthood. Substantively, education drives other forms of social mobility and is consequently viewed as an appropriate target of policies aimed at addressing economic and other forms of inequality (Hout & Janus, 2011). We also investigated occupational mobility, even though many of the young-adult offspring in our study have likely not yet attained their highest lifetime occupational level. Nonetheless, analysis of occupation provides an opportunity to examine the robustness of the pattern of results that we observe with education.

Largely missing in debates concerning whether Americans' endorsement of meritocratic beliefs is misplaced is an analysis of whether hard work and ability are major drivers of social advancement (Reynolds & Xian, 2014). The most widely documented individual-level predictor of educational and occupational attainment is general cognitive ability (Johnson, Brett, & Deary, 2010). Noncognitive factors such as industry and commitment are also, if somewhat more weakly, predictive (Farkas, 2003). These associations are based, however, on between-family comparisons and so confound offspring skills with the advantages or disadvantages conveyed by their rearing homes. Few researchers have investigated the association of offspring–parent differences in social status with individual cognitive skills (Deary et al., 2005) and noncognitive skills (von Stumm, Gale, Batty, & Deary, 2009), although their results have likely led to underestimations of the degree to which these skills contribute to social mobility. This is because even though highly skilled individuals are expected as a group to achieve more than their parents, they would not necessarily be expected to do so when their parents had even greater skill levels than they do. An unbiased assessment of the association of skills to social mobility requires a determination of whether offspring move up or move down according to whether they are more or less skilled than their parents. Such comparisons are rarely seen because offspring and parent skills are usually not both assessed in a given study (for an important exception, see Waller, 1971).

Genetic factors are also predictive of intergenerational social mobility (Ayorech, Krapohl, Plomin, & von Stumm, 2017; Belsky et al., 2018), as expected given the abundant evidence of the heritability of general cognitive ability and the noncognitive skills thought to underlie social success (Bouchard & McGue, 2003). But genetic factors are confounded with the shared family environment (Scarr & McCartney, 1983), complicating interpretation of genetic correlations. Geneticists place a particular emphasis on within-family comparisons because they control for the confounding of genetic with environmental factors (as well as for population stratification). Consequently, if offspring–parent differences in skills contribute to social mobility, then offspring–parent differences in the genetic factors underlying those skills should also be predictive (Belsky et al., 2018).

In the current study, we tested the hypothesis that offspring–parent differences in cognitive and noncognitive skills as well as a polygenic score predictive of educational attainment are associated with intergenerational educational and occupational mobility. Our analysis was based on a sample of 2,594 young adult American twins from 1,321 families, 1,321 of their mothers, and 1,209 of their fathers. Offspring and parents were assessed for general cognitive ability and an array of noncognitive predictors of social achievement, allowing us to investigate the degree to which offspring–parent differences in these skills predicted offspring upward and downward mobility.

Method

A detailed description of the sample and measures is provided in the Supplemental Material available online. The sample included 2,594 twin offspring (52.6% female), 1,321 mothers, and 1,209 fathers from 1,321 nuclear families from the ongoing, longitudinal Minnesota Twin Family Study (MTFS; Iacono & McGue, 2002). For offspring, cognitive and noncognitive skills were assessed in adolescence (i.e., at about age 17 years or earlier, prior to completing their education or attaining adult occupational level), and social outcomes were assessed in their mid- to late 20s (i.e., at either their age-24 assessment, n = 105, or age-29 assessment, n = 2,489). For parents, measures were obtained at a single in-person assessment in midlife. For a small number of nonparticipating fathers, we used mothers' reports of fathers' education (n = 106) or occupation (n = 76). There was minimal attrition in the MTFS offspring sample. Of the 2,764 twins who completed an assessment in adolescence, social-outcome data in early adulthood could be determined for 2,594, or 93.8%.

Table S1 in the Supplemental Material provides a description of all measures. Social outcomes included educational level and occupational level; predictor variables included measures of cognitive and noncognitive skills implicated in earlier research as predictive of social achievement. Also included in our analysis was a polygenic score predictive of educational attainment derived using results from the most recent large-scale genome-wide association study (GWAS) of educational attainment (Lee et al., 2018). All variables were assessed in the same way in offspring and parents.

Education was coded as the highest degree completed using a 5-point scale: 1 = *less than high school*, 2 = *high school or GED*, 3 = *some college*, 4 = *4-year college*, and 5 = *graduate* (e.g., MA, PhD, MD). Occupation was coded using a 7-point scale according to the Hollingshead system (Hollingshead, 1957). To facilitate interpretation, we adapted the original Hollingshead scale so that higher scores corresponded to higher perceived occupational status. On this revised scale, scores ranged from 1 (*unskilled labor*) to 7 (*professional position*). Occupation was coded only for participants who had a full-time occupation at the time of their assessment and was consequently available for 1,078 (87.7%) of the sons, 1,142 (83.7%) of the daughters, 1,211 (91.7%) of the fathers, and 756 (57.2%) of the mothers. As expected, education and occupation were moderately correlated in both offspring (r = .55, 95% confidence interval, or CI = [.51, .59]) and parents (r = .61, 95% CI = [.57, .64]). Offspring were born between 1972 and 1984, although year of birth was not significantly associated with either educational level, $\chi^2(1, N = 2{,}594) = 2.35$, $p = .13$, or occupational level, $\chi^2(1, N = 2{,}220) = 0.23$, $p = .63$, and so will not be considered further here.

General cognitive ability was assessed using an abbreviated form of either the Weschler Adult Intelligence Scale-Revised (Wechsler, 1981) for participants age 16 years and older or the Weschler Intelligence Scale for Children-Revised (Wechsler, 1974) for those 15 years and younger. Noncognitive measures were selected from assessments completed by both parents and offspring and included four self-report, multi-item scales from the Multidimensional Personality Questionnaire (MPQ; Tellegen & Waller, 2008) and a fifth measure of behavioral disinhibition (Hicks, Schalet, Malone, Iacono, & McGue, 2011). The MPQ scales were Social Potency (being decisive), Achievement (ambitious and hard-working), Alienation (feeling exploited and unlucky), and Control (being careful and reflective). The behavioral-disinhibition measure consisted of aggregated symptoms of antisocial behavior and substance abuse obtained by clinical interview. The noncognitive composite was formed by taking the mean of the five (or four, in the case of those missing one of the components) standardized (M = 0, SD = 1) noncognitive components after reverse-scoring the Alienation and behavioral-disinhibition scores.

Single-nucleotide-polymorphism (SNP) genotypes from a GWAS platform were available for 2,463 (94.9%) of the 2,594 offspring and 2,205 (87.2%) of the 2,530 parent participants (Miller et al., 2012). Polygenic scores for educational attainment are weighted composites of individual SNP counts (i.e., the count of a reference allele at a specific locus). Weights were based on results from the Social Science Genetics Association Consortium's most recent GWAS of educational attainment, EA3 (Lee et al., 2018). Polygenic scores were computed using the LDpred software with a prior probability of 1.0 (Vilhjálmsson et al., 2015), which in effect allows information from all SNPs in the developmental sample to be weighted in the prediction. Because the MTFS parent sample was included in EA3, polygenic-score weights were estimated after it (as well as the 23andMe sample, which is nonoverlapping with the MTFS but proprietary) had been removed. Polygenic scores were used for genetic parents only and, because genetic prediction varies by ancestral background (Martin et al., 2017), only for individuals identified as being of European ancestry on the basis of previous genomic analysis of the MTFS sample (Miller et al., 2012). This reduced the sample for polygenic-score analysis to 2,394 offspring and 2,114 parents.

To facilitate interpretation, we standardized all predictor variables separately in the parent and offspring samples. Education and occupation were not standardized. Table S2 in the Supplemental Material provides descriptive statistics and available sample sizes for all study variables by gender and generation. In social-mobility analyses, the educational and occupational levels of parents in each family were combined by taking the maximum of the mother's and father's education and occupation levels, respectively. For families with only a single parent, parent education and occupation were set to the levels attained by that parent. For predictor variables, mothers' and fathers' scores were combined by taking their average after standardization. The rationale and empirical support for our approach to combining mother and father scores are provided in the Supplemental Material.

Analyses involved fitting alternative regression models and correlation estimation. Regression models included age at assessment and gender as covariates. Analyses that included the polygenic score as a predictor also included the first 10 principal components of the genetic covariance matrix as covariates to account for residual stratification not eliminated by restricting analyses to individuals of European ancestry (Miller et al., 2012). Generalized estimating equations were used to account for sample clustering by family (Hanley, Negassa, Edwardes, & Forrester, 2003); otherwise, the twin nature of the sample was not used in the analyses reported here. In cases in which a statistical null hypothesis was tested, the p-value threshold was set at .01 (two-tailed). Sample size was determined by taking all participants in the longitudinal MTFS who met the eligibility criteria described above. Power was conservatively estimated on a total of 1,321 families (rather than number of individuals) as greater than 85% to detect effects accounting for at least 1% of variance at an alpha level of .01 (two-tailed).

Results

Association of cognitive and noncognitive skills with social achievement

Each of the five noncognitive components (Social Potency, Achievement, Alienation, Control, and behavioral disinhibition) was significantly but modestly correlated with both education and occupation in both the offspring and parent samples (Table S3 in the Supplemental Material). In general, there was little evidence that gender moderated these correlations. The single possible exception was Achievement, which consistently predicted social outcomes more strongly for women than men, although significantly so only for education in the offspring sample. General cognitive ability and noncognitive-composite scores were moderately and similarly correlated with both education and occupation in the offspring sample. A different pattern was observed in the parent sample, in which both social outcomes were correlated more strongly with general cognitive ability than with the noncognitive-composite score (Table S3). Nonetheless, sample differences were modest; mean standardized general cognitive ability and noncognitive-composite score increased similarly across the four Gender × Generation groups for both education (Fig. 1) and occupation (Fig. S1 in the Supplemental Material). The cognitive and noncognitive contributions to social success appeared to be generally similar in men and women and for offspring and their parents.

Intergenerational social persistence

The persistence of social achievement across generations is typically assessed either by the regression of offspring achievement on parent achievement or by the correlation between offspring and parent achievement (Black & Devereux, 2011). Although the two indicators can differ, particularly when the variance in social achievement expands across generations, both approaches gave qualitatively similar results here.

The regression of offspring education on parent education yielded an estimated regression coefficient (β) of 0.63 (95% CI = [0.55, 0.71]) and a correlation (r) between parent and offspring education of .36 (95% CI = [0.31, 0.41]). The corresponding results for occupational attainment were as follows: β = 0.24 (95% CI = [0.18, 0.29]) and r = .21 (95% CI = [.16, .26]). The lower coefficients for occupation than education likely reflect at least in part that many offspring in this relatively young sample have yet to attain their highest occupational level. Gender did not significantly moderate offspring–parent similarity for either education, $\chi^2(1, N = 2,594) = 0.02$, $p = .90$, or occupation, $\chi^2(1, N = 2,147) = 3.9$, $p = .05$.

There was significant offspring–parent correlation (Table S4 in the Supplemental Material) for both general cognitive ability (r = .48, 95% CI = [.44, .52]) and the noncognitive-composite score (r = .23, 95% CI = [.18, .28]). Including parents' general cognitive ability and parents' noncognitive-composite score into the intergenerational regression reduced the estimated offspring–parent regression coefficient (β) to 0.45 (95% CI = [0.35, 0.54]) for education and 0.13 (95% CI = [0.07, 0.20]) for occupation, indicating that approximately 30% to 40% of the observed persistence in social achievement could be attributed statistically to the intergenerational transmission of general cognitive ability and the noncognitive-composite score.

Intergenerational social mobility

Intergenerational social mobility was indexed by offspring–parent differences in educational or occupational attainment. Nearly half (46.7%) of the 1,365 female offspring (95% CI = [43.4%, 50.0%]) and 40.4% (95% CI = [37.1%, 43.7%]) of the 1,229 male offspring achieved a higher educational level than their parents; only 16.9% (95% CI = [14.4%, 19.4%]) of women and 22.9% (95% CI = [20.0%, 25.8%]) of men were educationally downwardly mobile (Fig. 2). For occupation, 37.0% (95% CI = [33.7%, 40.3%]) of 1,105 women and 31.8% (95% CI = [28.5%, 35.1%]) of 1,042 men had a higher occupational level than their parents, whereas 43.0% (95% CI = [39.5%, 46.5%]) of women and 45.4% (95% CI = [41.9%, 48.9%]) of men had a lower level. It is notable that a similar percentage of the 1,426 offspring with parents in the lowest educational class moved up (61.2%, 95% CI = [58.3%, 64.1%]) as the 300 offspring of the most highly educated parents moved

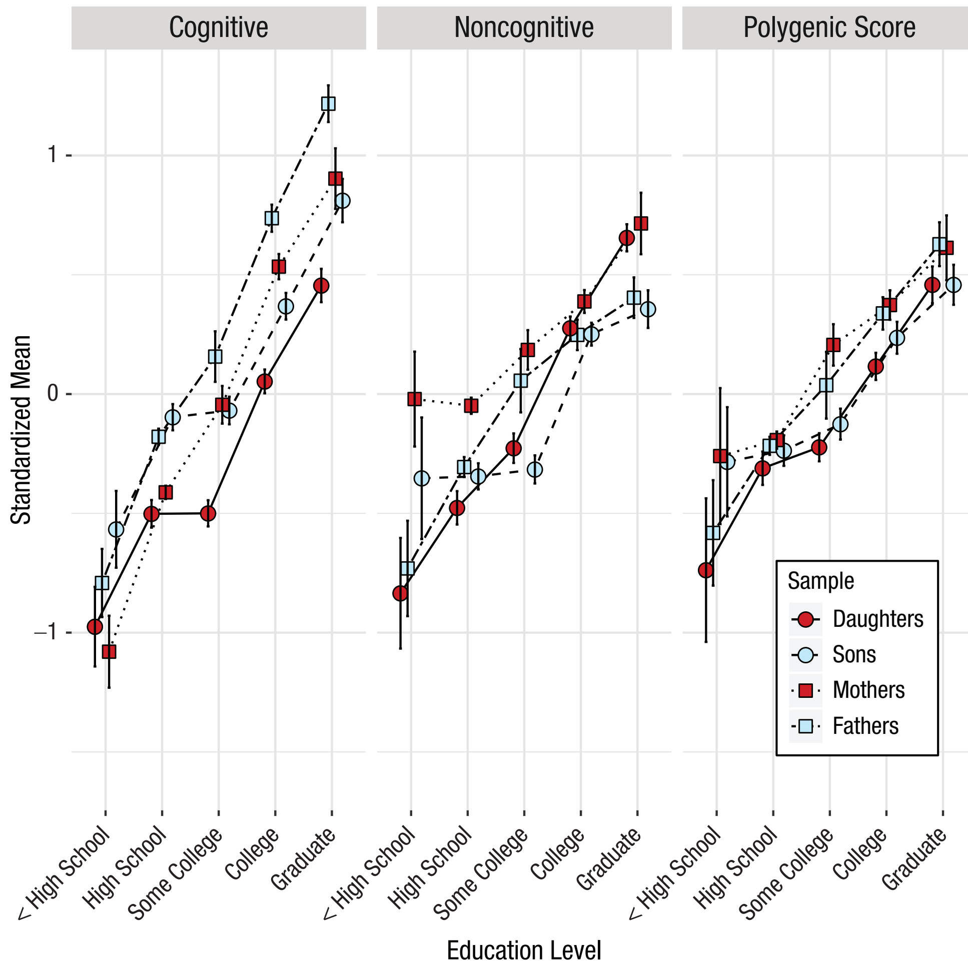

Fig. 1. Mean standardized general cognitive ability, noncognitive-composite score, and polygenic score for educational attainment as a function of attained education level in parent and offspring samples, separately by sex. Sample sizes and correlations are given in Tables S2 and S3, respectively, in the Supplemental Material available online. Error bars represent ±1 *SE*.

down (59.0%, 95% CI = [52.5%, 65.5%]; Fig. S2 in the Supplemental Material). The difference in mobility for education and occupation likely reflects the general expansion of educational opportunities between generations and the relative youth of offspring who have not all established their highest occupational level.

Results of regressing offspring–parent education and occupation differences on general cognitive ability, the noncognitive-composite score, and the polygenic score are summarized in Table 1; results for the individual noncognitive components are given in Table S5 in the Supplemental Material. The columns labeled "offspring univariate" give results when offspring–parent outcome differences were regressed separately onto offspring scores on each of the three predictors. This analysis, which does not make use of the parent scores, shows that only the noncognitive-composite score was consistently predictive of both educational and occupational mobility. A much different pattern emerged, however, when social mobility was predicted by differences in offspring–parent scores. Offspring–parent differences in general cognitive ability and the noncognitive-composite score were consistently and significantly associated with social mobility (columns labeled "offspring–parent difference univariate" in Table 1). The effect sizes were moderate in magnitude and stronger for general cognitive ability than the noncognitive-composite score, with increasing offspring–parent difference in social attainment being associated with increasing offspring–parent difference in underlying skills (Fig. 3).

General cognitive ability and the noncognitive-composite score were only weakly correlated in both the offspring (r = .18, 95% CI = [.13, .23]) and parent (r = .17, 95% CI = [.12, .22]) samples (Table S6 in the Supplemental Material). Consequently, together they should predict social mobility better than either alone. The combined associations of offspring–parent differences in general cognitive ability and the noncognitive

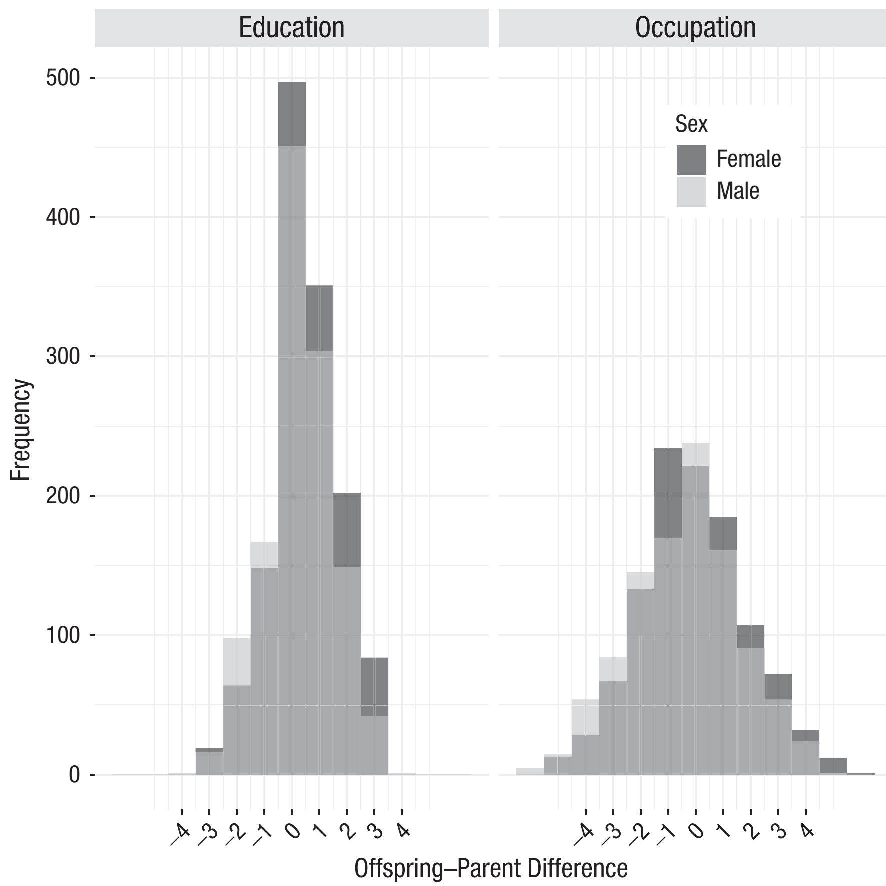

Fig. 2. Frequency of offspring–parent differences in educational and occupational attainment, separately by sex; positive scores indicate that offspring moved up relative to parents, and negative scores reflect the reverse.

composite with educational and occupational mobility are illustrated in Figure 4. Among offspring who scored at least 1 standard deviation higher than their parents on both general cognitive ability and the noncognitive composite, 58.8% (n = 97; 95% CI = [48.6%, 69.0%]) exceeded the highest educational level of their parents, and 63.7% (n = 82; 95% CI = [52.3%, 75.1%]) exceeded their parents' highest occupational level. At the other extreme, only 7.2% (n = 97; 95% CI = [0.6%, 13.8%]) and 23.8% (n = 82; 95% CI = [13.8%, 33.8%]) of these individuals failed to achieve as much as their parents did educationally and occupationally, respectively.

To test whether the association of each predictor with social mobility depended on social origin, we followed the method proposed by Nettle (2003) and regressed each predictor variable on offspring–parent difference in attainment, parent level of attainment, and their interaction, separately for education and occupation. Regression results are given in Table S7 in the Supplemental Material and illustrated for educational attainment in Figure S3 in the Supplemental Material. The coefficients associated with the interaction were uniformly small and none approached statistical significance, all χ^2s(1, Ns = 2,373–2,589) < 1.3; all ps > .25. As shown in Figure S3, the association of each predictor with upward and downward mobility showed no clear dependence on level of parent education.

The role of genetics in intergenerational mobility

As expected, the polygenic score based on weights from an independent GWAS of educational attainment was associated with both educational and occupational achievement in both the parent and offspring samples (Fig. 1). Correlations (rs) ranged from .26 to .32 for educational attainment and from .19 to .24 for occupational attainment (Table S3). There was no evidence of gender moderation in the regression of either education, χ^2(1, N = 2,394) = 0.20, p = .66, or occupation, χ^2(1, N = 2,075) = 0.15, p = .70, on the polygenic score.

Associations of the polygenic score with social outcomes may reflect genetic causation or environmental confounding due to passive gene–environment

Table 1. Results From the Ordinal Regression of Offspring–Parent Difference in Education and Occupation Levels (i.e., Mobility) as a Function of Both Offspring and Offspring–Parent Difference in General Cognitive Ability, Noncognitive-Composite Score, and Polygenic Score

	Offspring univariate		Offspring–parent difference univariate		Offspring–parent difference multivariate	
Outcome and predictor	*OR*	χ^2	*OR*	χ^2	*OR*	χ^2
Educational mobility						
General cognitive ability	1.03 [0.95, 1.12]	$\chi^2(1, N = 2{,}589) = 0.58$, $p = .45$	1.61 [1.48, 1.76]	$\chi^2(1, N = 2{,}585) = 120.0$, $p < .001$	1.56 [1.42, 1.72]	$\chi^2(1, N = 2{,}032) = 79.6$, $p < .001$
Noncognitive-composite score	1.36 [1.26, 1.48]	$\chi^2(1, N = 2{,}373) = 55.6$, $p < .001$	1.31 [1.21, 1.41]	$\chi^2(1, N = 2{,}308) = 50.5$, $p < .001$	1.25 [1.15, 1.35]	$\chi^2(1, N = 2{,}032) = 30.5$, $p < .001$
Polygenic score	1.06 [0.97, 1.15]	$\chi^2(1, N = 2{,}394) = 1.49$, $p = .22$	1.30 [1.16, 1.46]	$\chi^2(1, N = 2{,}252) = 19.5$, $p < .001$	1.19 [1.05, 1.34]	$\chi^2(1, N = 2{,}032) = 7.6$, $p = .006$
Occupational mobility						
General cognitive ability	1.13 [1.03, 1.23]	$\chi^2(1, N = 2{,}145) = 7.3$ $p = .007$	1.58 [1.45, 1.73]	$\chi^2(1, N = 2{,}141) = 108.1$, $p < .001$	1.48 [1.34, 1.64]	$\chi^2(1, N = 1{,}724) = 57.6$, $p < .001$
Noncognitive-composite score	1.40 [1.28, 1.52]	$\chi^2(1, N = 1{,}975) = 58.3$, $p < .001$	1.36 [1.27, 1.47]	$\chi^2(1, N = 1{,}928) = 67.8$, $p < .001$	1.33 [1.23, 1.43]	$\chi^2(1, N = 1{,}724) = 50.2$, $p < .001$
Polygenic score	1.06 [0.97, 1.17]	$\chi^2(1, N = 2{,}009) = 1.74$, $p = .19$	1.32 [1.17, 1.48]	$\chi^2(1, N = 1{,}903) = 20.8$, $p < .001$	1.24 [1.10, 1.41]	$\chi^2(1, N = 1{,}724) = 11.8$, $p = .001$

Note: In all regressions, the outcome was offspring–parent difference in either education or occupation level. The "offspring univariate" column gives results when the outcome was regressed on each of the three offspring scores separately; the "offspring–parent difference" columns give results when the outcome was regressed onto offspring–parent differences in predictors either separately (univariate) or simultaneously (multivariate). All regressions included sex and age as covariates, and regressions with the polygenic score also included 10 principal components to account for residual population stratification. All predictor variables were standardized to facilitate interpretation of odds ratios (*OR*s). Values in brackets are 95% confidence intervals.

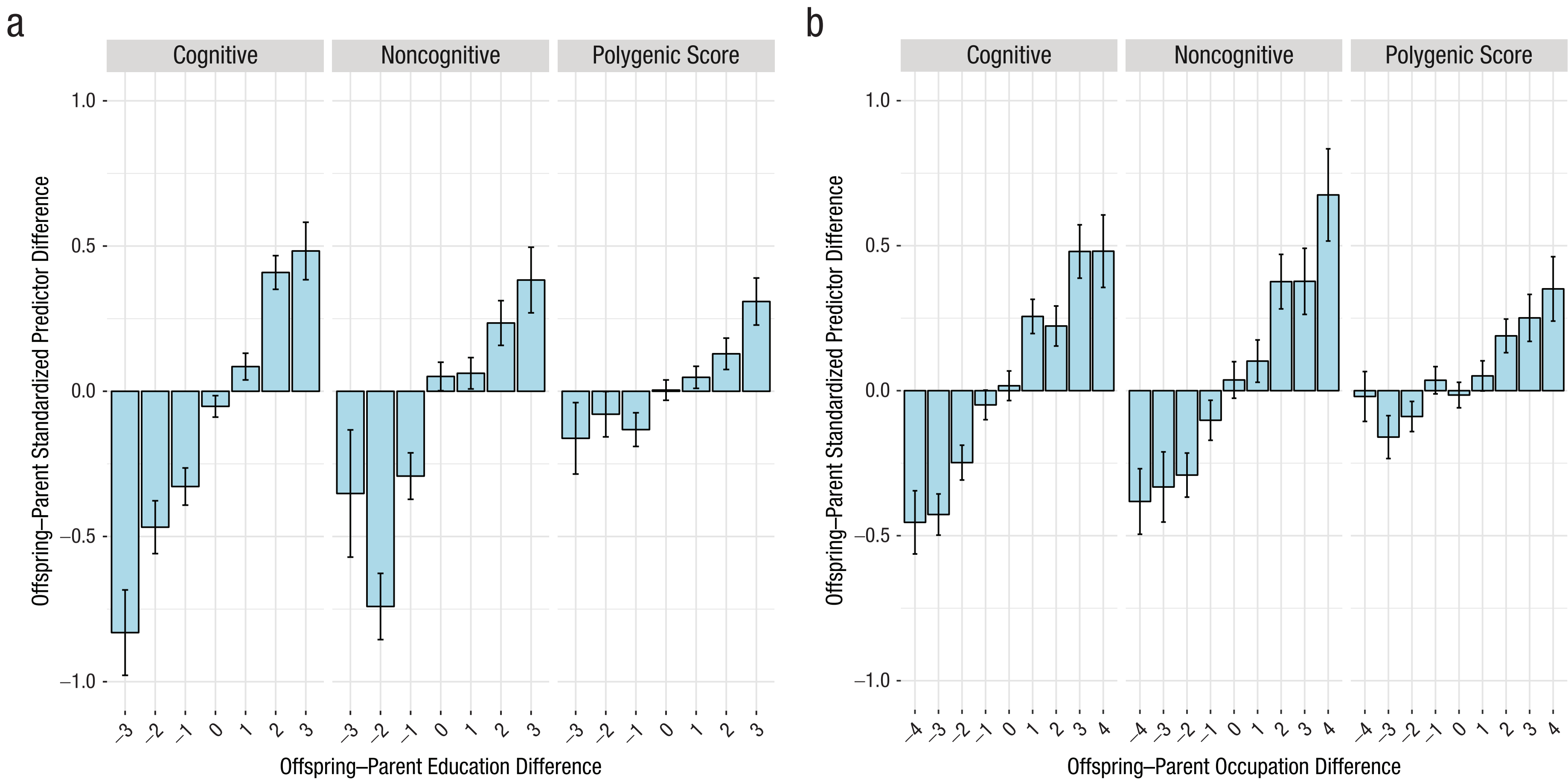

Fig. 3. Mean offspring–parent difference in general cognitive ability, noncognitive-composite score, and educational-attainment polygenic score by number of education levels (a) and occupation levels (b) that adult offspring had moved relative to their parents (positive scores indicate greater offspring achievement). Measures were all standardized separately in the offspring and parent samples before the offspring–parent difference was obtained. Error bars represent ±1 *SE*; difference scores were winsorized to ±3 for education and ±4 for occupation to provide adequate samples at the extremes (see the Supplemental Material available online).

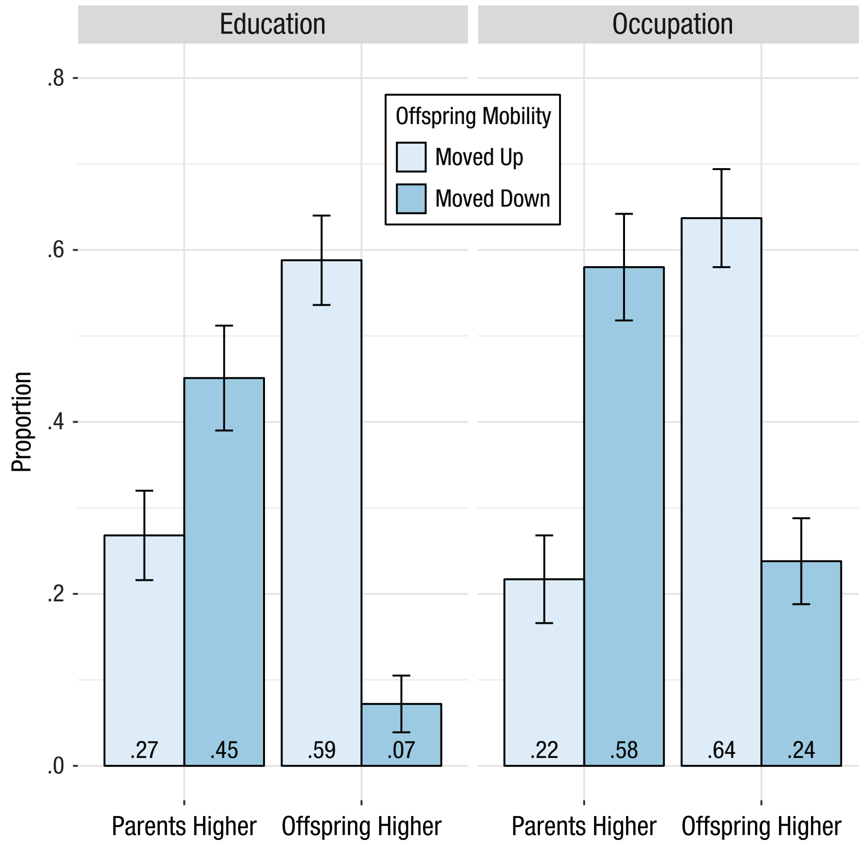

Fig. 4. Combined effect of offspring–parent differences in cognitive and noncognitive factors on intergenerational mobility. The graphs plot the proportion of offspring who either moved up or moved down relative to their parents according to whether they exceeded their parents' cognitive and noncognitive scores by at least 1 standard deviation each or fell below their parents' scores by at least 1 standard deviation on both. Error bars represent ±1 *SE*.

correlation. Although offspring inherit all of their genetic material from their parents, they inherit random subsets of their parents' genes because of meiotic segregation. Consequently, we can address the possibility of passive gene–environment correlation by determining whether inheriting a favorable combination of genes is associated with upward social mobility or a less favorable combination is associated with downward mobility. This is what occurred in the present sample (Fig. 3, Table 1). Specifically, offspring who achieved a higher educational or occupational level than their parents tended to have higher polygenic scores than their parents. Conversely, children who fell short of their parents' social achievements tended to have polygenic scores that were lower than their parents.

We expected that genetic variants contributing to educational attainment would also be associated with the cognitive and noncognitive skills necessary to attain higher levels of education. Consistent with this expectation, earlier research found that a polygenic score for educational attainment was correlated with both cognitive and noncognitive predictors of social success, with the magnitude of the former being generally greater than the latter (Krapohl et al., 2016). Consequently, genetic contributions to intergenerational mobility may overlap with genetic contributions to the cognitive and noncognitive factors underlying social success. Supporting this, the difference in offspring–parent polygenic score was significantly correlated with offspring–parent differences in general cognitive ability, although not with noncognitive-composite scores (Table S8 in the Supplemental Material). Regressing offspring–parent difference in educational or occupational level on differences in general cognitive ability, noncognitive-composite scores, and polygenic scores simultaneously, we observed that all three predictors remained significantly associated with both social outcomes (Table 1, columns labeled "offspring–parent difference multivariate"). The cognitive and noncognitive skills that we assessed did not fully account for the genetic contributions to within-family mobility that we observed.

Discussion

The inverse association of inequality with social mobility has raised the specter that individuals from disadvantaged backgrounds will have limited opportunity to rise above the circumstances of their births, especially in high-inequality countries such as the United States (Corak, 2013). The persistence of social standing across generations that we observed provides some support for this concern. Offspring of parents with the lowest educational credentials, for example, were 3.5 times more likely than offspring of the most highly educated parents to achieve no more than the lowest educational level. Nonetheless, our findings do not support the claim that educational and occupational success is a matter only of inherited privilege (McNamee, 2018). We found that a majority of individuals from the least advantaged homes achieved more educationally and occupationally than their parents, and conversely, a majority of individuals from the most advantaged homes achieved less. Our study implicated offspring–parent skill differentials as contributing to the considerable reordering of social standing that we observed across generations. Individuals rarely moved down and frequently moved up when they were more skilled than their parents.

Our finding that offspring–parent differences in skills and genetic endowment were consistently and robustly associated with intergenerational mobility does not unequivocally imply that the former causes the latter. Nonetheless, our prospective, within-family design provides a basis for stronger inference than a standard cross-sectional design. We believe that a reasonable explanation of our findings is that the degree to which individuals are more or less skilled than their parents contributes to their upward or downward mobility. Behavioral genetic and genomic research has established the heritability of social achievements (Conley, 2016) as well as the skills thought to underlie them (Bouchard & McGue, 2003). Nonetheless, these associations may be due to passive gene–environment correlation, whereby high-achieving parents both transmit genes and provide a rearing environment that promotes their children's social success (Scarr & McCartney, 1983). Our within-family design controlled for passive gene–environment correlation effects. Although offspring inherit all of their genes from their parents, they inherit a random subset of parental alleles because of meiotic segregation. Consequently, some offspring inherit a favorable subset of their parents' alleles, whereas others inherit a less favorable subset. We found, as did previous researchers (Belsky et al., 2018), that the inheritance of a favorable subset of alleles was associated with an increased likelihood of upward mobility, whereas inheriting a less favorable subset was associated with an increased likelihood of moving down. It is noteworthy that the offspring–parent difference in measured genetic endowment was significantly correlated with offspring–parent difference in general cognitive ability but not the noncognitive composite. Whereas our within-family analysis of measured genetic endowment provides additional support for a causal influence of general cognitive ability on social mobility, the polygenic score clearly accounted for a small portion of the mobility effects that we observed. Even in a GWAS of more than 1 million participants, the vast majority of heritable effects on education remains undetected (Lee et al., 2018), limiting the predictive utility of our polygenic score.

Throughout much of the 20th century, expanding opportunity ensured that a large majority of individuals in each generation achieved more than their parents, reinforcing belief in the American dream. Expansion has, however, slowed in the 21st century (Hout & Janus, 2011), so that upward movements are increasingly offset by downward movements. Several have posited the existence of a "glass floor," whereby individuals from the most advantaged backgrounds are preferentially protected from downward forces (Gugushvili, Bukodi, & Goldthorpe, 2017). A glass-floor effect should manifest as attenuated downward mobility among low-skilled individuals from advantaged backgrounds—that is, an interaction (Nettle, 2003). We found no evidence of a glass floor, however, as parents' education level did not moderate the association of offspring skill with social mobility. This is not to claim that social background was unimportant. We found consistent social-background effects on educational and occupational attainment even when accounting for the effects of the skills that we assessed. Yet in addition to being a consequence of exclusive opportunities that advantaged parents provide their children, a residual social-background effect could, in part, reflect skills unassessed in our study. Most notably, we know more about contributors in the cognitive domain than about the full range of noncognitive contributors, which likely span health and physical attributes through higher level personality factors. There is a need for research on the nature and structure of noncognitive contributors so that we might better understand how psychological, physical, and social factors combine to contribute to social advancement (Humphries & Kosse, 2017). In any case, the absence of interaction effects implies that there are constraints on the extent to which advantaged parents can protect their low-skilled offspring from downward mobility.

Americans' acceptance of income inequality is linked with their perception that the American socioeconomic system is meritocratic (Reynolds & Xian, 2014), which can have the salutary effect of motivating individual effort (Browman, Destin, Kearney, & Levine, 2019). For individuals who appear to be disadvantaged by the current socioeconomic system, belief in meritocratic processes may nonetheless appear paradoxical. In a series of studies, Jost and colleagues (2015) presented evidence suggesting that people are motivated to justify the existing social system because doing so reduces uncertainty and threat and increases their satisfaction with the world in which they live. Our results suggest that other factors may also contribute to a belief in system fairness. Specifically, many people are likely to directly observe social mobility within their own families. Seeing firsthand that family members who are more skilled tend to be the ones who also achieve more educationally and occupationally may be a powerful influence on belief in meritocratic processes.

It is important to consider several study limitations when interpreting our findings. First, as was typical for the Minnesota birth years considered, our sample was overwhelmingly of European ancestry, and applicability to other populations is uncertain. In particular, a sample of predominantly White individuals from Minnesota cannot tell us about the impact of factors such as discrimination on social mobility. Second, the assessment of skills occurred at different developmental stages for parents and offspring. What impact, if any, this has on our results is difficult to say, although the behavioral genetic literature does indicate that the importance of genetic factors increases with age for many behavioral traits. Finally, our focus has been on intergenerational educational mobility, which we believe is an appropriate focus for a psychological investigation. Nonetheless, other aspects of mobility, and in particular income mobility, may show much different patterns from the ones shown here.

In summary, our analysis of intergenerational social mobility in a sample of 2,594 offspring from 1,321 families found that (a) most individuals were educationally and occupationally mobile, (b) mobility was predicted by offspring–parent differences in skills and genetic endowment, and (c) the relationship of offspring skills with social mobility did not vary significantly by parent social background. In an era in which there is legitimate concern over social stagnation, our findings are noteworthy in identifying the circumstances when parents' educational and occupational success is not reproduced across generations.

Transparency

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Anonymized data have been made publicly available via the Open Science Framework and can be accessed at https://osf.io/xhnsy. The design and analysis plans were not preregistered. The complete Open Practices Disclosure for this article can be found at http://journals.sagepub.com/doi/suppl/10.1177/0956797620924677. This article has received the badge for Open Data. More information about the Open Practices badges can be found at http://www.psychologicalscience.org/publications/badges.

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