The Intergenerational Transmission of Cognitive and Non-Cognitive Skills During Adolescence and Young Adulthood

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Abstract

This study examines cognitive and non-cognitive skills and their transmission from parents to children as one potential candidate to explain the intergenerational link of socio-economic status. Using representative data from the German Socio-Economic Panel Study, we contrast the impact of parental cognitive abilities (fluid intelligence, crystallized intelligence) and personality traits (Big Five, locus of control) on their adolescent and young adult children's traits with the effects of parental background and childhood environment.

While for both age groups intelligence and personal traits were found to be transmitted from parents to their children, there are large discrepancies with respect to the age group and the type of skill. The intergenerational transmission effect was found to be relatively small for adolescent children, with correlations between 0.12 and 0.24, whereas the parent-child correlation in the sample of adult children was between 0.19 and 0.27 for non-cognitive skills, and up to 0.56 for cognitive skills. Thus, the skill gradient increases with the age of the child. Furthermore, the skill transmission effects are virtually unchanged by controlling for childhood environment or parental education, suggesting that the socio-economic status of the family does not play a mediating role in the intergenerational transmission of intelligence and personality traits. The finding that non-cognitive skills are not as strongly transmitted as cognitive skills, suggests that there is more room for external (non-parental) influences in the formation of personal traits. Hence, it is more promising for policy makers to focus on shaping children's non-cognitive skills to promote intergenerational mobility.

Intergenerational correlations of cognitive skills in Germany are roughly the same or slightly stronger than those found by previous studies for other countries with different institutional settings. Intergenerational correlations of non-cognitive skills revealed for Germany seem to be considerably higher than the ones found for the U.S.. Hence, skill transmission does not seem to be able to explain cross-country differences in socio-economic mobility.

JEL: J10, J24, I20

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Introduction

For the last few decades societies in most developed countries have been characterized by rising economic inequality. Social science research has generated cross-national evidence that this rising inequality is closely related to less social mobility across generations. Literature has mainly focused on intergenerational income mobility and education mobility as the two benchmarks against which differences between the socio-economic status of parents and their children are measured. However, while the intergenerational correlation of economic status is a well-known fact, it is much less clear what drives these correlation patterns. In order to develop policy measures which aim to enhance intergenerational mobility and reduce inequality in the long term, it is crucial that we understand how economic disadvantage is transmitted from parents to children. One potential factor that may help to explain how socio-economic status is linked across generations is skills and their transmission from parents to children. Both cognitive and non-cognitive skills have been found to be important predictors of economic and social success. Cognitive skills refer to various dimensions of intelligence, such as an individual's verbal fluency or their ability to solve new problems, whereas non-cognitive skills comprise personality traits, such as openness to experience or emotional stability.[1] Cognitive and non-cognitive skills have been shown to play a substantial role in educational achievement (for example, Heckman and Vytlacil 2001) and income (for example, Hanushek and Woessmann, 2008). Thus, a significant transmission of intelligence or personal traits from parents to their children could play a major role in determining the intergenerational correlation of socio-economic status. A small body of economic literature has investigated whether the intergenerational correlation of economic status is driven by cognitive and non-cognitive skills (for example, Blanden, Gregg, and Macmillan, 2007, and Mood, Bihagen, and Jonsson, 2011), but very few datasets provide information on the abilities and economic outcomes of both parents and their children..

This paper discusses the transmission of cognitive and non-cognitive skills from parents to their children during adolescence and young adulthood. Using representative data from the German Socio-Economic Panel Study (SOEP), the study compares the impact of parental skills on children's skill outcomes with the effects of parental background and childhood environment, which can account, to

some extent, for early life conditions that are critical to individuals' cognitive and non-cognitive development (Ermisch, 2008). The focus of this study is on the determinants of children's intelligence and personal traits as potential mediating variables in intergenerational education and earnings transmission.[2] The intergenerational correlations of skills will be analyzed for children of two different age groups: adolescents aged around 17 and young adult children aged 18 to 29.[3] The German school system means that some adolescents may already have finished secondary school at aged 17 with the most basic school leaving certificate (*Hauptschule*) or with no leaving certificate at all. However, the majority of young people are still enrolled in either an intermediate secondary school *(Realschule)* or an academic one (*Gymnasium*) or in a vocational school (*Berufsschule*). In contrast, young adults between the ages of 18 and 29 have mostly finished secondary school with some kind of leaving certificate and eventually pursue or have completed tertiary education, or have dropped out with no qualification. Hence, in this age group children are mainly in the labor market or enrolled at a university, although some may have started a family and, thus, are not part of the labor force.

The SOEP enables us to distinguish between fathers and mothers, and sons and daughters. This means that we can account for possible gender differences in IQ and personality transmission and compute overall transmission effects from both parents.[4] Furthermore, we can analyze whether intergenerational skill transmission occurs differently according to the type of skill. With respect to cognitive skills, the data allows us to distinguish between fluid intelligence (coding speed, abstract reasoning) and crystallized intelligence (verbal and numerical skills). Non-cognitive skills are measures of the Five Factor Model (Big Five: openness, conscientiousness, extraversion, agreeableness, neuroticism) and locus of control.

Finally, the intergenerational correlation patterns in Germany will be compared to previous findings for other countries with different institutional frameworks. With respect to IQ transmission, this analysis can be compared to two recent Scandinavian studies by Black, Devereux, and Salvanes (2009) for Norway, and by Björklund, Hederos Eriksson, and Jäntti (2010) for Sweden. These studies use a largely comparable framework for analyzing the various channels between parental resources and the attainment of cognitive skills. Although their datasets are based on matched administrative

registers, census data, and military records, and thus only available for fathers and their sons, a subsample of males from the SOEP can be used to match the samples of these studies. With respect to the transmission of personal traits, the results will be compared with findings from Mayer et al. (2002) and Duncan et al. (2005) who examine the relationship between maternal personality traits and the skills of their sons and daughters using the National Longitudinal Survey of Youth (NLSY). Furthermore, the reviews of existing studies on intergenerational correlations of non-cognitive skills provided by Osborne Groves (2005) and Loehlin (2005) will be drawn upon for comparison.

Existing literature considers two main channels for the transmission of cognitive and non-cognitive skills between generations. On the one hand, skills may be transmitted from parents to their biological children by the inheritance of genes ("nature"). On the other hand, the transmission may work through a productivity effect of parental skills ("nurture"). For example, more able parents are more likely to be able to afford high quality childcare, housing in areas with access to high quality schools, bear the costs of private lessons and tertiary education. They may also enhance the skills of their children by employing favorable parenting styles and by promoting good health conditions for their offspring. Unfortunately, the SOEP data do not allow us to clearly distinguish nature and nurture effects. Findings from recent research on income and educational mobility suggest the importance of both nature and nurture (Björklund et al., 2007). Moreover, Cunha and Heckman (2007) point out that the assumed separability of nature and nurture is obsolete as the mechanisms interact in more complex ways.

Previous Research on Intergenerational Skill Transmission

Existing economic literature on intergenerational mobility concentrates predominantly on education (for example, Hertz et al., 2007) and income mobility (for example, Solon, 1999). In modern societies, years of schooling completed by parents and their children's schooling have been found to be correlated between 0.14 and 0.45 (Mulligan, 1999). Couch and Dunn (1997) report a father-son correlation of 0.25 for Germany, but, most likely, underestimate the true correlation

because their estimates are based on a sample of relatively young children. Intergenerational correlations of earnings have an even wider range, from about 0.10 to 0.55 (Solon, 1999). Vogel (2007) estimates an intergenerational earnings elasticity of 0.25 in Germany and of 0.43 for a comparable sample in the U.S..

There is far less research on the underlying causes of these intergenerational correlations, but ongoing research aims at disentangling the causal mechanisms (Black and Devereux, 2010). Skills could serve as an intergenerational transmission mechanism as both cognitive skills and non-cognitive skills have been found to be important predictors for economic and social success (for example, Cameron and Heckman, 1993; Heckman et al., 2006; Anger and Heineck, 2010b, Heineck and Anger, 2010). The crucial question as to whether the intergenerational transmission of cognitive abilities or personality may explain the persistence of socioeconomic status across generations is examined by Mood, Bihagen, and Jonsson (2011). They use register data from Sweden to decompose father-son education and income correlations into different mediating characteristics of the children. They find that the intergenerational income effect can be explained to 20 percent out of 63 percent by the son's cognitive skills and to a somewhat lesser extent by non-cognitive traits. However, cognitive abilities are much more important for education and account for 37 percent out of 46 percent of the transmission between fathers and sons. Additional evidence that cognitive and non-cognitive skills serve as one of the causal channels of intergenerational transmission of economic status has been provided by Bowles and Gintis (2002), Osborne Groves (2005), and Blanden et al. (2007).

While economic research on skill formation is rather scarce, the determinants of cognitive and non-cognitive skills and intergenerational correlations have been analyzed by psychologists for decades. IQ correlations between parents and their children were found to be in the range between 0.42 and 0.72 (Bouchard and McGue, 1981; Devlin et al., 1997; Plomin et al., 2000). However, the datasets used by most psychological studies are based on a small number of observations and/or lack representativeness. One of the first economic studies by Agee and Crocker (2002) reports a positive association between mean parental IQ and their child's cognitive outcome using U.S. data. Using the British National Child Development Study (NCDS), Brown, McIntosh, and Taylor (2009) find a positive link between the literacy and numeracy abilities possessed by parents in their childhoods and

their children's performance in reading and mathematics. Their results support the importance of parenting style for the transmission of literacy skills, while genetic effects seem to be the driving force behind the transmission of numeracy skills. Measures of reading performance and numerical skills during adolescence can also be found in the National Longitudinal Survey of Youth (NLSY) which is used by Duncan et al. (2005) to show positive mother-child correlations for both reading and mathematics skills.

Two recent Scandinavian studies investigate the relationship between the cognitive skills of fathers and sons using IQ test scores from large-scale nationally representative datasets: Black et al. (2009) employ composite IQ test scores conducted at age 18, and find a strong intergenerational transmission of IQ scores for fathers and their sons in Norway. Björklund et al. (2009) find similar intergenerational IQ correlations for Sweden. Finding sibling correlations to be close to one half, they conclude that 50 percent of the variation in IQ can be attributed to family and community background factors. Finally, in a previous study, Anger and Heineck (2010a) report intergenerational correlations for sons and daughters in Germany which were stronger than the ones revealed for Scandinavia. Their estimates are based, however, on a sample of older children aged up to 64 at the time of skill measurement. In contrast, this study focuses on the intergenerational correlation of skills between parents and their children during adolescence and young adulthood to obtain results that are suitable for cross-national comparisons. In addition, adolescents observed in this study conduct an IQ test which is more elaborate than the IQ tests used in Anger and Heineck (2010a).

Another strand of research (predominantly psychological) provides evidence of the intergenerational correlation of non-cognitive skills which has been found to be substantially lower than the correlation of cognitive skills. In his review of psychological studies on parent-offspring correlations of personality traits and attitudes, Loehlin (2005) concludes that parents and their children do not resemble each other very much. He reports intergenerational correlations of personality measures, including the Big Five, of about 0.10 to 0.15 for young adult children. Somewhat stronger intergenerational correlations of personality traits are reported by Osborne Groves (2005) in her overview of previous research estimates. Only weak mother-daughter correlations were found by Mayer et al. (2005) for personal traits and behaviors measured during adolescence based on

the NLSY. They find that these correlations are barely affected by family socio-economic status. Using the same data set and a supplementary study conducted in Maryland, Duncan et al. (2005) report that parents mainly pass on their specific rather than their general skills. Furthermore, they confirm that "neither socioeconomic status nor parenting behaviors appear very important to the intergenerational transmission process" (Duncan et al. 2005, p. 26). Instead, their results are consistent with an important genetic component in the intergenerational correlation of personality attributes.

Data and Methodology

The analysis presented in this paper is based on data from the German Socio-Economic Panel Study (SOEP) which is a representative household panel survey (Wagner et al., 2007) and described in greater detail in the Appendix. The intergenerational transmission of skills will be analyzed for the years 2005-2008 and separately for adolescent children aged around 17 and for young adult children aged 18 to 29 as the available skill measures differ for both groups. The family background and childhood environment variables that are used in this study comprise potential determinants of cognitive and non-cognitive skills other than parental IQ or parental personality. In particular, the analysis considers parental education which is based on the ISCED classification (low education: 0-2, medium education: 3-4, higher education: 5-6). Further controls include family size (number of brothers and sisters), a dummy for being the first born child, a dummy for having been raised by a single parent, a dummy for good self-rated health status, and a set of childhood area dummies: childhood in a rural area, town, city, where childhood in an urban area serves as a reference category. The individual's childhood environment may partially capture socioeconomic conditions (for example, health care infrastructure, educational provision) that may be critical to cognitive and non-cognitive development. To complement the aforementioned, this study uses the individual's body height as an indicator of health and nutritional conditions in early childhood development. The key

variables in this project are personality measures and measures of cognitive skills both of which are available for adult respondents and for adolescents.

Skill Measures for Parents and Adult Children

Information on cognitive skills was collected from adult respondents in 2006 and comprises test scores from a word fluency test and a symbol correspondence test. Both tests correspond to different modules of the Wechsler Adult Intelligence Scale (WAIS) and produce outcomes which are relatively well correlated with test scores from more comprehensive and well-established intelligence tests (Lang et al., 2007).[5] The symbol correspondence test is conceptually related to the mechanics of cognition or fluid intelligence and comprises general abilities. The word fluency test is conceptually related to the pragmatics of cognition or crystallized intelligence. It consists of the fulfillment of specific tasks that improve with knowledge and skills acquired in the past. While verbal fluency is based on learning, speed of cognition is related to an individual's innate abilities (Cattell, 1987). In addition, a measure of general intelligence is generated by averaging the two types of ability test scores.[6] The overall sample of young adult offspring with IQ measures, for whom at least one parent with valid information on IQ test scores can be identified, consists of 446 sons and daughters of age 18 to 29.[7]

Measures of personality are available for 2005 (Dehne and Schupp, 2007). They include self-rated measures that were related to the Five Factor Model (McCrae and Costa, 1999) and comprise the five basic psychological dimensions – openness to experience, conscientiousness, extraversion, agreeableness, neuroticism (Big Five) – as well as measures of locus of control. The sample consists of 2,228 adult children with non-cognitive skill measures who can be linked to their parents with valid information on personality traits.

Skill Measures for Adolescent Children

Cognitive skills were measured for adolescents at age 17 in the years 2006, 2007, and 2008. The somewhat more complex intelligence tests are modified versions of the I-S-T 2000-Test (Solga et al.,

2005) and cover the following domains: verbal skills, numerical skills, and abstract reasoning. An integrated index of verbal and numerical skills provides an adequate assessment of the adolescent's crystallized intelligence i.e., skills that improve with knowledge acquired in the past, whereas abstract reasoning is related to fluid intelligence and, thus, comprises largely innate abilities.

Adolescents' personality measures are also available in the years 2006, 2007, and 2008. These measures relate to the Five Factor Model containing the same dimensions as for adults, and measures of locus of control. To analyze intergenerational skill transmission, intelligence test scores and personality indicators of adolescent respondents from 2006 to 2008 are linked to the parental skill measures that were available in 2005 and 2006. This selection leaves us with 280 adolescents for whom information on their own cognitive skills and their parents' IQ is available. In addition, 1,184 parent-child pairs with personality measures for both generations can be identified.

Methodology

In order to avoid spurious effects of age on test outcomes age-standardized scores for all cognitive ability tests are used. These are generated by calculating the scores' standardized values for every year along the age distribution. The study also uses age-standardized scores from the dimension-specific questions on the Five Factor Model and locus of control to net out age effects in self-rated personality.[8] Summary statistics of all variables are provided in Table A1 in the Appendix.

In the following section, children's test scores will be regressed on parental test scores, family background, childhood environment variables, and a gender dummy using ordinary least squares (OLS) regressions. Intergenerational skill transmissions are estimated using different subsamples for both age groups. First, the regressions will be based on all children for whom either maternal or paternal test scores are available in order to maximize the number of observations. Whenever the test scores of both parents are available, the averages of the mother's and father's test scores are used. Second, in additional regressions only father-son relationships will be considered to compare the results to findings from the recent Scandinavian studies (Black et al., 2009, Björklund et al., 2010) which are based on males only. Although the interdependence of cognitive abilities and personal traits

could play a role in the process of skill transmission, this analysis only investigates the intergenerational transmission of the same skill. This approach is supported by the findings of studies by Case and Katz (1991) and Duncan et al. (2005) which suggest that parents' specific skills primarily determine the same but not other skills of their children. Whether interdependencies between different types of skills indeed do only play a minor role in intergenerational skill transmission in the German data is left for future research.

Results

The following tables present intergenerational associations in cognitive and non-cognitive skills for children of two different age groups: adolescents and young adults. Table 1 summarizes the results of the most basic specification: children's test scores are regressed on the main independent variable of interest, the test scores of the parents, without including further control variables. The first column of each table displays parent-child correlations for all children of an age group for whom either maternal or paternal test scores are available, while the samples in the second column are restricted to sons for whom separate effects of paternal skills will be measured for comparison with previous studies.

Adolescents

The results reported in Table 1 demonstrate that there is an intergenerational transmission of both cognitive and non-cognitive skills for the whole sample of adolescents (column 1). The positive correlations between parental and children's test scores range between 0.13 and 0.24 for cognitive skills and between 0.12 and 0.22 for non-cognitive skills, and all estimated coefficients, except for fluid intelligence, are statistically significant at the one percent level. The strongest link between parental and children's skills is shown for external locus of control and for general intelligence: a one-point increase in the age-standardized test score of parents is associated with a 0.22-point increase in their children's external locus of control and with a 0.24-point increase in their children's general

intelligence test scores. This corresponds to two and a half right answers (out of 60) in the IQ test. However, the variation is very small with an adjusted R-squared of at most 7.5 percent. Compared to earlier findings based on similar data, these coefficients are not even half the size of the ones found in Anger and Heineck (2010a) for children in middle and late adulthood who participated in different IQ tests.

To compare the results to previous studies on father-son-correlations, this study examines the role of fathers for their sons using the relatively small sample of male adolescents (column 2). The exclusion of daughters and mothers leads to an insignificant transmission effect for fluid intelligence, but slightly increases the intergenerational correlation of crystallized intelligence to 0.21. Non-cognitive skills of sons seem to be largely correlated with their fathers' personality traits. In particular, fathers play an important role in the intergenerational transmission of external locus of control. However, the correlations tend to be slightly stronger when taking into account both mothers' and fathers' skills for the sample of all children.

In sum, the intergenerational transmission effects for adolescent children are not found to be overwhelmingly large. However, the estimates of non-cognitive skill transmissions are somewhat bigger than the ones reported by Loehlin (2005) in his review of psychological studies. For instance, the reviewed studies revealed parent-offspring correlations of the Big Five measures of between 0.09 and 0.17.

[Table 1 About Here]

Young Adults

Table 1 also presents the estimates for intergenerational correlations of skills between parents and their young adult children (columns 3 and 4). It is striking that the transmission of skills, and in particular of cognitive skills, is much stronger for this older age group of children. Similarly, the explained variance is much higher than in the estimates for the younger age group, with an adjusted R-squared of up to 0.28 in the regression of general cognitive skills for all children (column 3). The

parent-child correlation is as high as 0.56 for general intelligence, and between 0.19 and 0.27 for personality traits with highly significant coefficients. The transmission effects of non-cognitive skills, therefore, correspond to the intergenerational correlation of personality traits of between 0.14 and 0.29, which are reported by Osborne Groves (2005) in her overview of previous studies. The parent-child correlations of cognitive skills in this study are even higher than the ones found in Anger and Heineck (2010a) based on the same dataset for a sample which includes children at older ages. However, they are in line with the correlations summarized in studies by Bouchard and McGue (1981) from a sample of familial studies of IQ where an average correlation of 0.5 between parents and their offspring is reported.

Even in the clearly smaller sample, where effects from fathers on the cognitive and non-cognitive skills of their sons are calculated for cross-national comparison of the results with father-son-correlations of previous studies, almost all of the paternal test scores are large in both size and statistical significance (column 4). For coding speed, the transmission effect is clearly less when compared to the full sample, but both the crystallized and general intelligence of fathers and sons are still correlated with a coefficient of 0.42. In contrast to cognitive skills, the exclusion of daughters and maternal skills significantly increases the coefficients of the parental test scores for some of the personality traits. In particular, fathers' openness, conscientiousness and external locus of control seem to play an important role for the non-cognitive skills of their sons.

The question arises as to why the intergenerational correlations of skills are so much stronger for young adult children than for adolescent children. In the case of cognitive skills, this discrepancy may be partially explained by the different IQ tests conducted with adults and adolescents. While young adult children and their parents participate in exactly the same ultra-short IQ tests, the intelligence tests for adolescent children are more complex and may measure slightly different facets of cognition. Although both intelligence tests produce measures of fluid and crystallized intelligence, the fit between the two measures is unlikely to be perfect and the discrepancy may be partially traced back to measurement error.[9]

However, this argument does not apply to the measures of non-cognitive skills which have also been shown to be transmitted more strongly from parents to adult children than to adolescent children.

Both adult and adolescent respondents have rated their personality traits based on an identical set of questions using exactly the same scales. One possible explanation is that the personality of children is not fully developed during adolescence and may still be quite malleable. This argument is supported by Costa and McCrae (1994) who suggest that personality traits are stable from middle adulthood. It could, therefore, be the case that adolescents' personal traits do not bear a strong resemblance to their parents' non-cognitive traits but change during young adulthood in such a way that the intergenerational correlation for young adults increases in size. However, it could be the case that the convergence between children's and parental skills during young adulthood is due to parents being affected by their children.[10] Both explanations could also account for the stronger correlation between parental cognitive performance and their children's IQ at older ages.

The intergenerational correlations of cognitive skills (0.52-0.56) and non-cognitive skills (0.19-0.27) revealed for young adults compare to the father-son correlation in schooling of 0.25 for Germany reported by Couch and Dunn (1997) based on a sample of young adult children. Thus, while the transmission of personality traits seems to be comparable in size to the education transmission, the transmission effect is clearly stronger for cognitive skills than for schooling. Similarly, the estimated skill transmission effects for personality traits are of similar size and the transmission effects for intelligence twice as large when compared to the intergenerational earnings elasticity of 0.25 in Germany reported by Vogel (2007).

Family Background and Childhood Environment

The intergenerational correlation between parents' and their children's skills in the basic specifications could be driven by third variables since family characteristics during childhood or other factors could affect skill formation. The rich dataset available allows the inclusion of additional variables in the regression to control for family background, childhood environment, and child's health status. In unreported regressions, the study uses richer specifications controlling for gender, physical strength (height, health status), family background (single parent, first-born child, number of brothers, number of sisters), and childhood environment (childhood area dummies).[11] Interestingly,

the aforementioned variation increases only slightly and the coefficients of parents' test scores are barely affected by the inclusion of the control variables.[12] This is in line with the results from the UK study by Brown et al. (2009), which finds a robust transmission effect for reading and mathematics test scores, independently of additional controls.

However, factors other than parental skills seem to play an important role. For adolescents, for whom the parent-child correlation of cognitive skills is not found to be very high, good health condition plays a major role in determining intelligence test scores. Being healthy is also an important determinant of locus of control, agreeableness, and emotional stability. Furthermore, being raised by a single parent considerably lowers crystallized intelligence, general intelligence, and internal locus of control. For young adults, for whom parental cognitive skills were a much better predictor of IQ test scores, the number of brothers was the only other determinant of measured intelligence. While affecting cognitive skills negatively, the number of brothers had a positive influence on personality measures. In contrast, personality traits were adversely affected by the single parent variable. Again, health status emerged as an important factor of all non-cognitive skills except openness. Test scores on the internal locus of control and emotional stability of a young adult significantly benefit from the child's good health.

Parental Education and Skill Formation

So far, this analysis has not taken into account parental socio-economic status which is widely considered to be the most important family background variable. Socio-economic resources could be one of the channels through which skills are transmitted from parents to their children (for example, Duncan et al., 2005). As skills are rewarded on the labor market, more able parents have more resources to afford high-quality childcare, housing in areas with access to high-quality schools, and bear the costs of private lessons and tertiary education, which, combined together, may benefit children's skills. Moreover, educated parents may provide a favorable home environment and also enhance the skills of their children by employing favorable parenting styles and by promoting good health conditions for their offspring. The socio-economic status of the family may, therefore, act as an

important mediator in the intergenerational transmission of intelligence and personality traits. The role of parental socio-economic status in children's skill formation will be examined by linking children's skill outcomes to their parents' education, which is available for fathers and mothers in the sample. A first impression on the relationship between parental schooling and children's skills is presented in Figure 1 which displays adolescents and young adults' average intelligence test scores by parental highest education. In both domains of the IQ test there is a clear SES gradient in the cognitive skills of adolescents, as children of higher educated parents perform better in the cognitive tests. This finding holds regardless of the type of school, i.e., when the current school type of a child is taken into account (not displayed). The association is clearly weaker for the younger cohort, but young adult children with highly educated parents also perform better, particularly in the verbal fluency test.[13]

Non-cognitive skills show a less clear SES gradient, even for adolescents. Average scores on the personality scales by parental highest education are displayed in Figure A1 in the Appendix. If there is any difference at all, adolescent children's conscientiousness and agreeableness, but also their neuroticism increase with higher parental education, and extraversion and external locus of control decrease. In contrast, young adult children's openness and extraversion slightly increase with parental education, and also their agreeableness and neuroticism. A weaker link between parental socio-economic status (as measured by education and income) and personality, as compared to IQ, is also shown for Sweden by Mood, Bihagen, and Jonsson (2011).

[Figure 1 About Here]

Next, the link between parental education and skill outcomes will be analyzed in a regression-adjusted framework. First, children's intelligence and personality test scores will be regressed on dummies for the highest parental educational degrees (medium and high education, with low education being the reference group). Second, parental test scores will be included in these regressions to measure the relative importance of these characteristics. Table 2 reports results for the relationship between the parental education and cognitive skills of adolescent children (Panel A) and of young adult children (Panel B). As the results of the first three columns (without IQ transmission

effects) show, there is a strong association between parents' education and the intelligence of their adolescent children. This is in line with the Swedish study by Mood, Bihagen, and Jonsson (2011) which reports a correlation between fathers' schooling and their sons' IQ of 0.32. Table 2 shows that parents' higher education is most strongly correlated with general cognitive skills and more important for crystallized than for fluid intelligence. However, even for fluid intelligence, having a highly educated parent is associated with a one-point increase in the child's intelligence, which corresponds to more than three answers (out of 20) in the corresponding IQ test. The association between parental education and children's cognitive skills is, however, much weaker for older children (Panel B). Only coding speed (fluid intelligence) is significantly affected by parents' higher education.

[Table 2 About Here]

As displayed in the last three columns in Panel A, the inclusion of parental test scores only slightly changes the effect of parental education on adolescents' cognitive skills. Parents' higher education still has a significant impact on all three skill outcomes. However, despite the inclusion of the obviously important parental education, parental test scores still matter for the cognitive skills of their children. Compared to the raw regressions in Table 1, the coefficients of crystallized and general intelligence were reduced in size and significance, whereas there is only a small change in the transmission of fluid intelligence. Thus, both parents' education and their skills seem to matter independently for the intelligence of their adolescent children. In contrast, the last three columns in Panel B show that there parental education has no effect on the test scores of their young adult children, and the IQ transmission effect is virtually unchanged for this age group when compared to the raw regressions in Table 1. This is in line with previous findings of Anger and Heineck (2010a) for older children. Overall, although parents' educational background affects the skills of adolescent children, it seems to play only a minor role as mediator in the intergenerational transmission of intelligence. This supports findings of Brown et al. (2009) for a sample of somewhat younger children in the UK. They rule out the possibility that the intergenerational effect of parents' test scores occurs via their impact on parents' income or educational attainment.

[Table 3 About Here]

Estimates of the link between parental schooling and children's non-cognitive outcomes are displayed in Table 3 (adolescent children) and Table 4 (young adult children). As shown in Panel A (without parental personality traits) in both tables, parents' higher education reduces both adolescent and adult children's external locus of control. For adolescent children, having parents with medium education does not seem to matter for skill formation as compared to having low educated parents, whereas young adult children with medium educated parents score higher on openness. Young adult children with highly educated parents are more extroverted, but rate themselves, like children with medium educated parents, as less internalizing than young adults from low socio-economic background.

[Table 4 About Here]

The lower panels in Tables 3 and 4 (Panel B) include parental personality traits, and show that parental education is still significantly related to some of the child's non-cognitive skills. Children with educated parents have a lower internal locus of control, independent of their age group, whereas the stage of the life course seems to matter for extraversion. Adolescents with a medium socio-economic background are less extroverted than adolescents with a higher or lower educational background (Table 3), while older children are more extroverted if they have highly educated parents (Table 4). Despite the inclusion of parental personality traits, young adults from highly educated families are still significantly more open. The most remarkable finding is, however, that, compared to the raw regressions in Table 1, the effects that parental non-cognitive skills exert on the traits of their children is virtually identical when controlling for parental education. With the exception of external locus of control of young adults, the transmission effects are of the same size, or even slightly higher, when educational background is included. This is in line with findings of Duncan et al. (2005) who point out that the intergenerational correlations of non-cognitive skills are robust to the inclusion of

family income. Thus, for both adolescents and young adults, parental schooling plays no role as mediator in the intergenerational transmission of personal traits.

Overall, the socio-economic status of the family, as measured by parental education, does not seem to play a mediating role in the intergenerational transmission of intelligence and personality traits.

Cross-National Comparisons

The intergenerational transmission effects of cognitive and non-cognitive skills revealed above can be contrasted with findings from previous studies on countries with different institutional frameworks (Table 5). First, this paper will look at comparisons of intergenerational IQ transmissions. In order to do this, the results for the father-son pairs are used to compare the findings directly to the recent studies on Norway (Black et al., 2009) and Sweden (Björklund et al., 2010) which both use general intelligence measures of cognitive skills. In both Scandinavian studies a one-point increase in the father's ability is associated with an increase in the son's ability of about one third.[14] The IQ transmission from fathers to adolescent sons revealed for Germany is only 0.20 for general intelligence and, therefore, considerably smaller than for Norway and Sweden. However, adolescents are of a slightly younger age than the sons in the Scandinavian samples. In addition, as explained above, the intergenerational correlations of cognitive skills may be understated for the sample of adolescents as children and their parents do not participate in the same intelligence test. Thus, the IQ correlations between parents and their young adult children who participate in exactly the same ultra-short IQ tests are preferable. The estimates for the group of young adults show a coefficient of 0.42 for general intelligence, and, therefore, the transmission effect for Germany is comparable with the Nordic countries.[15] This may be somewhat surprising as the intergenerational income elasticity in Germany is higher than in Norway and Sweden (Björklund and Jäntti, 2009). Thus, it does not seem to be the case that intergenerational correlations in cognitive skills account for the discrepancy in social mobility between Germany and Scandinavian countries.

[Table 5 About Here]

Intergenerational correlations of cognitive skills revealed for adolescent children seem to be of a similar size to the U.S.. The transmission effects reported by Mayer et al. (2002) and Duncan et al. (2005) based on reading and mathematical skills are slightly below one quarter for pairs of mothers and daughters, and somewhat lower for mother-son pairs. Estimates from, so far, unreported regressions for the German sample of adolescent children, which disregard effects of the father, show similar findings for crystallized intelligence. In contrast, Agee and Crocker (2002) use full-scale intelligence tests and find a one-point increase in general parental IQ to be associated with an increase in their child's IQ of almost one third. This transmission effect is higher than the parent-child correlation for adolescent children in Germany. However, direct comparisons are difficult, since the U.S. study is based on a sample of young children of about 6 years-old.

Similarly, Brown et al. (2009) use a sample of younger children with an average age of 9 years to analyze the intergenerational transmission of reading and mathematical skills in the UK. They report transmission effects of 0.25 for reading performance and 0.08 for numeracy skills, both of which correspond to crystallized intelligence in the current study. Thus, the corresponding transmission effect for the German sample of adolescent children (0.24) is presumably higher than the average of the two skill types found for the UK. However, their measures of cognitive skills clearly differ from the ones used in the current study for Germany.

With respect to non-cognitive skills, the results for the sample of adolescent children are slightly higher than those found in psychological studies (Loehlin, 2005) and roughly compare to the studies reviewed by Osborne Groves (2005). Intergenerational correlations of non-cognitive skills revealed for the U.S. seem to be considerably smaller than the ones found for Germany. Duncan et al. (2005) report coefficients of the maternal transmission effect of between 0.07 and 0.10 for daughters' personality traits and mostly statistically insignificant coefficients for sons. In contrast, additional regressions for the German adolescent sample, where father's non-cognitive skills are excluded, reveal effects of between 0.14 and 0.32 for daughters and 0.13 and 0.22 for sons. All mother-child correlations are, therefore, stronger than those found for the U.S.A. However, Duncan et al. (2005)

use different measures of personality traits: self-esteem, depression, shyness, and the Pearlin mastery scale. Only the latter can be used for direct comparison with the German data, as the mastery scale roughly corresponds to the locus of control measure. While mastery is transmitted at a rate of only 0.07 from mothers to daughters in the U.S. (and is insignificant for sons), the mother-daughter correlation of internal locus of control is 0.14 (sons: 0.14), and even 0.32 (sons: 0.22) for external locus of control in Germany, and, despite the relatively small sample sizes, always highly statistically significant.

Conclusion and Policy Implications

This paper provided estimates of intergenerational transmissions of cognitive and non-cognitive skills from parents to their children during adolescence and young adulthood using representative data from the German SOEP. While for both age groups intelligence and personal traits were found to be transmitted from parents to their children, there are large discrepancies with respect to the age group and the type of skill. The intergenerational transmission effect was found to be relatively small for adolescent children, with correlations between 0.12 and 0.24, whereas the parent-child correlation in the sample of adult children was between 0.19 and 0.27 for non-cognitive skills, and up to 0.56 for cognitive skills.

Thus, it seems that the skill gradient increases with the age of the child. One potential explanation may be that adolescent children who are largely still in school are strongly influenced by their teachers and peers but less by their parents. Another explanation could be that institutions in Germany enhance skill inequalities by placing students with a lower skill level on lower academic tracks.[16] However, in the absence of cross-national comparisons for both age groups, it is difficult to judge whether the German education system or labor market institutions play any role in determining this increase in the gradient.

Cognitive skills were shown to increase with parental education and these differences hold regardless of the school type. However, when parents' educational degrees are included in the

regressions the skill transmission effects are virtually unchanged. This suggests that the socio-economic status of the family does not play a mediating role in the intergenerational transmission of intelligence and personality traits. Similarly, the effect of parental IQ and personality on children's skills barely changes when other control variables for family background and childhood environment are included. However, some of the individual and family characteristics do seem to play a role in children's skill formation. In particular, good health seems to be important for skill formation, whereas skills seem to suffer if a child is raised by a single parent.

In a cross-country comparison, intergenerational correlations of cognitive skills in Germany are roughly the same or slightly stronger than those found by previous studies for other countries with different institutional settings. Thus, characteristics of the German education system, such as early school tracking, do not seem to affect the strength of the intergenerational link of intelligence. It is also quite unlikely that intergenerational correlations of cognitive skills can account for the greater inequality persistence in Germany relative to the Scandinavian countries. This conclusion is supported by the finding that Germany has similar, or even higher, transmission effects than in the U.S. and the U.K., which both have a lower education and income mobility than Germany.

Moreover, non-cognitive skills seem to be transmitted across generations more strongly in Germany than in the U.S. One tentative explanation may be a lower prevalence of childcare for children under the age of three and lower childhood education in Germany, which may strengthen the link between parental personality traits and children's skills as these are known to be largely shaped in early childhood. Furthermore, the intergenerational correlation of non-cognitive skills may be stronger in countries with early school tracking, such as Germany, as initial skill differences between students with different family backgrounds may be reinforced. However, family background does not play a different role in the intergenerational skill transmission in Germany and the comparison countries analyzed by previous studies. On the whole, neither cognitive nor non-cognitive skill transmission seems to be able to explain cross-country differences in socio-economic mobility.

This study points to intergenerational persistence in cognitive and non-cognitive disadvantage in Germany which is of similar size to the countries with higher social mobility, and similar or even stronger to the countries with lower social mobility. One explanation that may reconcile these findings

could be that the transmission of skills feeds differently into the process of intergenerational education or income transmission in the different countries. This underlines the necessity to examine the link between skill transmission, educational mobility and earnings persistence in Germany. This will, however, only be possible when future waves of the SOEP data become available allowing us to measure children's earnings at reasonable points in time of their life cycle. Thus, the full answer to the question as to how socio-economic status is transmitted across generations in Germany is left for future research.

Overall, this study suggests that non-cognitive skills are not as strongly transmitted as cognitive skills, but are at least as important for economic success, as past empirical evidence has shown. Thus, there seems to be more room for external (non-parental) influences in the formation of personal traits. Therefore, it should be more promising for policy makers to focus on shaping children's non-cognitive skills to promote intergenerational mobility. This could be achieved by focusing on the provision of high-quality childcare to children from disadvantaged families, by teaching and developing non-cognitive skills in class, and by providing educational support through nurseries and teachers for families with low socio-economic background.

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Figures and Tables

Table 1: Transmission of Cognitive and Non-Cognitive Skills

	Adolescent Children		Young Adult Children	
	All	Sons	All	Sons
Fluid Intelligence				
Test score parents	0.134*	-	0.522***	-
	(0.0703)	-	(0.0439)	-
Test score Father	-	0.0279	-	0.388***
	-	(0.129)	-	(0.0766)
Adjusted R-squared	0.009	-0.011	0.240	0.150
Crystallized Intelligence				
Test score parents	0.180***	-	0.531***	-
	(0.0652)	-	(0.0439)	-
Test score Father	-	0.214**	-	0.421***
	-	(0.0994)	-	(0.0719)
Adjusted R-squared	0.023	0.038	0.246	0.192
General Intelligence				
Test score parents	0.237***	-	0.556***	-
	(0.0697)	-	(0.0427)	-
Test score Father	-	0.203*	-	0.424***
	-	(0.111)	-	(0.0757)
Adjusted R-squared	0.036	0.026	0.281	0.185
Openness				
Test score parents	0.173***	-	0.245***	-
	(0.0249)	-	(0.0171)	-
Test score Father	-	0.166***	-	0.310***
	-	(0.0430)	-	(0.0319)
Adjusted R-squared	0.038	0.026	0.083	0.093
Conscientiousness				
Test score parents	0.146***	-	0.226***	-
	(0.0238)	-	(0.0174)	-
Test score Father	-	0.159***	-	0.245***
	-	(0.0424)	-	(0.0314)
Adjusted R-squared	0.030	0.024	0.068	0.061
Extraversion				
Test score parents	0.168***	-	0.193***	-
	(0.0255)	-	(0.0189)	-
Test score Father	-	0.140***	-	0.201***
	-	(0.0430)	-	(0.0331)
Adjusted R-squared	0.034	0.018	0.043	0.037
Agreeableness				
Test score parents	0.163***	-	0.224***	-
	(0.0247)	-	(0.0170)	-
Test score Father	-	0.146***	-	0.206***
	-	(0.0411)	-	(0.0309)
Adjusted R-squared	0.034	0.021	0.070	0.045
Neuroticism				

Test score parents	0.147***	-	0.206***	-
	(0.0247)	-	(0.0179)	-
Test score Father	-	0.162***	-	0.209***
	-	(0.0448)	-	(0.0336)
Adjusted R-squared	0.028	0.022	0.055	0.039
LOC: internal				
Test score parents	0.116***	-	0.214***	-
	(0.0225)	-	(0.0170)	-
Test score Father	-	0.0849**	-	0.191***
	-	(0.0421)	-	(0.0321)
Adjusted R-squared	0.021	0.006	0.065	0.036
LOC: external				
Test score parents	0.220***	-	0.265***	-
	(0.0224)	-	(0.0162)	-
Test score Father	-	0.215***	-	0.282***
	-	(0.0404)	-	(0.0307)
Adjusted R-squared	0.075	0.050	0.107	0.085
Number of Observations (cognitive skills)	280	90	446	141
Number of Observations (non-cognitive skills)	1184	518	2228	892

Source: SOEP 2005-2008.

Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.
Dependent variable: age-standardized scores of the child's skill measure.
"Test score parents" refers to the average of parents' age-standardized test scores when test scores for both parents are available.
Fluid intelligence refers to the coding speed of young adult children and parents (symbol correspondence test) and to the abstract reasoning of adolescent children (matrix test). Crystallized intelligence refers to the word fluency of young adult children and parents (animal naming task) and to the verbal and numerical skills of adolescent children (word analogies, arithmetic operations). General intelligence combines fluid and crystallized intelligence measures.

Table 2: Parental Education and Cognitive Skills of Adolescents and Young Adults

	Fluid Intelligence	Crystallized Intelligence	General intelligence	Fluid Intelligence	Crystallized Intelligence	General intelligence
Panel A: Adolescents						
Medium educated parents	0.444*	0.628***	0.643***	0.404*	0.563**	0.568**
	(0.227)	(0.223)	(0.227)	(0.227)	(0.222)	(0.226)
Highly educated parents	1.013***	1.198***	1.289***	0.956***	1.069***	1.127***
	(0.233)	(0.229)	(0.233)	(0.234)	(0.232)	(0.235)
Test score parents	-	-	-	0.127**	0.145**	0.191***
	-	-	-	(0.0621)	(0.0598)	(0.0626)
Constant	-0.691***	-0.839***	-0.928***	-0.633***	-0.744***	-0.795***
	(0.216)	(0.212)	(0.216)	(0.216)	(0.212)	(0.216)
Adjusted R-squared	0.091	0.109	0.127	0.098	0.122	0.146
Observations	280	280	280	280	280	280
Panel A: Young Adults						
Medium educated parents	0.137	-0.0708	-0.0161	-0.0938	-0.122	-0.184
	(0.210)	(0.212)	(0.212)	(0.186)	(0.184)	(0.182)
Highly educated parents	0.361*	0.0927	0.233	0.00334	-0.157	-0.130
	(0.214)	(0.216)	(0.216)	(0.191)	(0.188)	(0.187)
Test score parents	-	-	-	0.517***	0.536***	0.555***
	-	-	-	(0.0448)	(0.0448)	(0.0438)
Constant	-0.175	0.00469	-0.0588	0.103	0.110	0.171
	(0.200)	(0.203)	(0.203)	(0.178)	(0.176)	(0.174)
Adjusted R-squared	0.010	0.002	0.010	0.238	0.243	0.280
Observations	446	446	446	446	446	446

Source: SOEP 2005-2008.
Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.
Dependent variable: age-standardized scores of the child's skill measure.
"Test score parents" refers to the average of parents' age-standardized test scores when test scores for both parents are available.
Reference group: low educated parents
Fluid intelligence refers to the coding speed of parents and young adult children (symbol correspondence test) and to the abstract reasoning of adolescents (matrix test). Crystallized intelligence refers to the word fluency of parents and young adults (animal naming task) and to the verbal and numerical skills of adolescents (word analogies, arithmetic operations). General intelligence combines fluid and crystallized intelligence measures.

Table 3: Parental Education and Non-Cognitive Skills of Adolescent Children

	Internal LOC	External LOC	Openness	Conscientious.	Extraversion	Agreeablen.	Neurotic.
Panel A							
Medium educated parents	-0.185	-0.0733	-0.0488	0.0142	-0.203	0.0839	0.145
	(0.126)	(0.127)	(0.128)	(0.128)	(0.127)	(0.128)	(0.128)
Highly educated parents	0.00679	-0.420***	0.158	-0.0476	-0.130	0.0822	0.0178
	(0.128)	(0.130)	(0.130)	(0.130)	(0.129)	(0.131)	(0.130)
Constant	0.115	0.217*	-0.0124	0.0234	0.181	-0.0776	-0.0928
	(0.120)	(0.122)	(0.122)	(0.122)	(0.121)	(0.123)	(0.122)
Adjusted R-squared	0.008	0.028	0.008	-0.001	0.001	-0.001	0.003
Panel B							
Medium educated parents	-0.226*	0.0602	-0.121	-0.0208	-0.238*	0.0565	0.151
	(0.124)	(0.123)	(0.126)	(0.126)	(0.125)	(0.126)	(0.126)
Highly educated parents	-0.0476	-0.157	0.0364	-0.0564	-0.164	0.0570	0.0662
	(0.127)	(0.127)	(0.129)	(0.128)	(0.127)	(0.128)	(0.129)
Test score parents	0.131***	0.217***	0.173***	0.157***	0.168***	0.185***	0.144***
	(0.0210)	(0.0210)	(0.0232)	(0.0233)	(0.0244)	(0.0234)	(0.0239)
Constant	0.156	0.0246	0.0741	0.0403	0.207*	-0.0750	-0.113
	(0.119)	(0.119)	(0.120)	(0.120)	(0.119)	(0.120)	(0.121)
Adjusted R-squared	0.036	0.101	0.048	0.032	0.035	0.044	0.029
Observations	1184	1184	1184	1184	1184	1184	1184

Source: SOEP 2005-2008.

Dependent variable: age-standardized scores of the child's skill measure.
"Test score parents" refers to the average of parents' age-standardized test scores when test scores for both parents are available.
Reference group: low educated parents

Table 4: Parental Education and Non-Cognitive Skills of Young Adult Children

	Internal LOC	External LOC	Openness	Conscientious.	Extraversion	Agreeablen.	Neurotic.
Panel A							
Medium educated parents	-0.267**	-0.0724	0.281**	0.200	0.171	-0.0167	-0.0358
	(0.129)	(0.128)	(0.132)	(0.132)	(0.134)	(0.133)	(0.132)
Highly educated parents	-0.274**	-0.238*	0.422***	0.0839	0.231*	-0.0620	-0.0479
	(0.130)	(0.129)	(0.133)	(0.133)	(0.134)	(0.133)	(0.133)
Constant	0.263**	0.105	-0.317**	-0.166	-0.189	0.0326	0.0259
	(0.126)	(0.125)	(0.129)	(0.129)	(0.130)	(0.129)	(0.129)
Adjusted R-squared	0.001	0.007	0.007	0.003	0.001	0.001	0.001
Panel B							
Medium educated parents	-0.262**	0.0510	0.197	0.196	0.180	-0.0121	-0.0830
	(0.124)	(0.125)	(0.127)	(0.127)	(0.131)	(0.128)	(0.129)
Highly educated parents	-0.279**	-0.0495	0.254**	0.122	0.236*	-0.0558	-0.0539
	(0.124)	(0.126)	(0.128)	(0.128)	(0.132)	(0.129)	(0.129)
Test score parents	0.236***	0.208***	0.233***	0.224***	0.188***	0.220***	0.204***
	(0.0165)	(0.0169)	(0.0176)	(0.0177)	(0.0194)	(0.0173)	(0.0182)
Constant	0.257**	-0.0432	-0.196	-0.187	-0.209	0.0116	0.0578
	(0.121)	(0.122)	(0.124)	(0.124)	(0.128)	(0.125)	(0.125)
Adjusted R-squared	0.085	0.070	0.080	0.070	0.041	0.067	0.053
Observations	2228	2228	2228	2228	2228	2228	2228

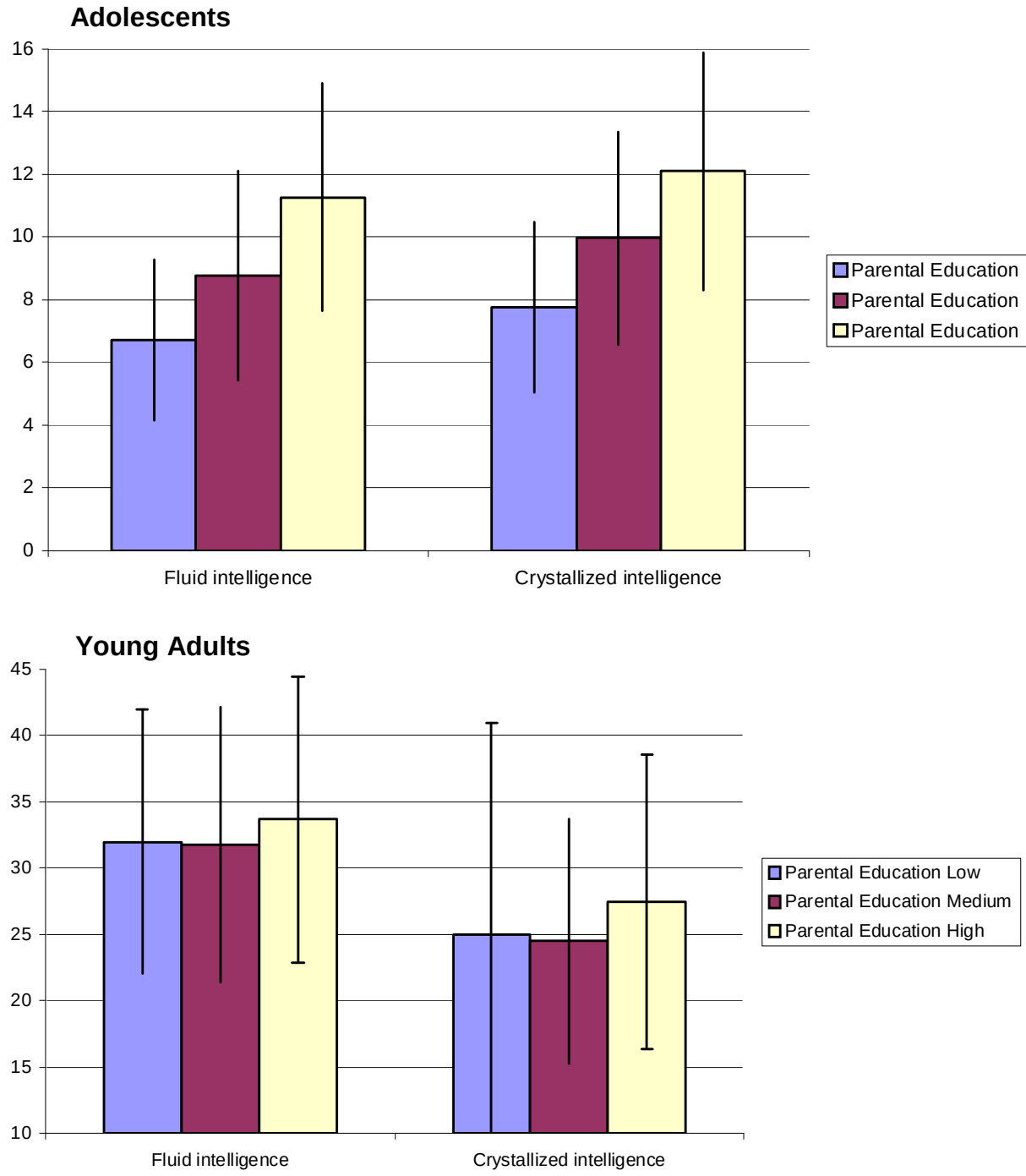
Source: SOEP 2005-2006.
Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.
Dependent variable: age-standardized scores of the child's skill measure.
"Test score parents" refers to the average of parents' age-standardized test scores when test scores for both parents are available.
Reference group: low educated parents

Table 5: Cross-National Comparison of Intergenerational Skill Transmission, Correlation Coefficients

	Germany		Norway	Sweden	United States	United Kingdom
	Adolescent Children	Young Adult Children	Young Adult Children	Young Adult Children	Young/ Adolescent Children	Young/ Adolescent Children
General Intelligence						
Father-son	0.20	0.42	0.38	0.35	-	-
Parent-child	0.24	-	-	-	0.31	-
Crystallized Intelligence						
Mother-daughter	0.19 (0.09)	-	-	-	0.22-0.24	-
Mother-son	0.19 (0.09)	-	-	-	0.15-0.20	-
Parent-child	0.24	-	-	-	-	0.08-0.25
Personality Traits						
Mother-daughter	0.14-0.32	-	-	-	0.07-0.10	-
Mother-son	0.13-0.22	-	-	-	insign.	-
Locus of Control						
Mother-daughter	0.14 (internal) 0.32 (external)	-	-	-	0.07 (mastery)	-
Mother-son	0.14 (internal) 0.22 (external)	-	-	-	insign.	-

Sources: Germany: SOEP 2005-2008 (own calculations)
Norway: Black et al. (2009)
Sweden: Björklund et al. (2010)
United States: Agee and Crocker (2002), Mayer et al. (2002), Duncan et al. (2005)
United Kingdom: Brown et al. (2009)

Figure 1: Children's IQ Test Scores According to Parental Education



Source: SOEP 2006-2008.

Appendix

Data

This paper's analysis is based on the German Socio-Economic Panel Study (SOEP), which is a representative household panel survey that started in 1984 (Wagner et al., 2007). The SOEP conducts annual personal interviews with all household members aged 18 and above, and provides rich information on socio-demographic characteristics, family background, and childhood environment. In more recent years, a Youth Questionnaire was implemented for adolescents at age 17. The SOEP data used in this project come from the samples of adult respondents, where parents and their adult children can be identified. In addition, data from the Youth Questionnaire is used to match adolescent children to their parents from the adult samples. Thus, the intergenerational transmission of skills will be analyzed separately for adolescent children aged around 17 and for young adult children aged 18 to 29. Parents and children who were not of German nationality were excluded from the study, since individuals with a migration background may be disadvantaged as compared to native speakers due to inadequate language skills when taking the tests or when rating their personality.

Measures of Cognitive and Non-Cognitive Skills of Adult Respondents

Since information on cognitive skills was only collected in 2006 and on non-cognitive skills only in 2005 from adult respondents , this study uses these two cross-sections for young adult children and all parents. In 2006, about one third of all respondents (only those with a CAPI interview) participated in two ultra-short IQ tests lasting 90 seconds each (Lang et al., 2007): a word fluency test and a symbol correspondence test. Both tests correspond to different modules of the Wechsler Adult Intelligence Scale (WAIS). The symbol correspondence test is conceptually related to the mechanics of cognition or fluid intelligence and comprises general abilities. The test involved asking respondents to match as many numbers and symbols as possible within 90 seconds according to a given correspondence list which is permanently visible to the respondents on a screen. The word fluency test is conceptually related to the pragmatics of cognition or crystallized intelligence. It involves the

fulfillment of specific tasks that improve with knowledge and skills acquired in the past. The word fluency test implemented in the SOEP was based on the animal-naming task (Lindenberger and Baltes, 1995): respondents name as many different animals as possible within 90 seconds. While verbal fluency is based on learning, speed of cognition is related to individuals' innate abilities (Cattell, 1987). The scores are added together across the 90 seconds per test to generate an index which ranges from 0 to 60 (symbol correspondence test), respectively from 0 to 99 (word fluency test). In addition, a measure of general intelligence is generated by averaging the two ability test scores.

One year previously, in 2005, detailed measures of personality were part of the SOEP questionnaire for all respondents in the adult sample (Dehne and Schupp, 2007). These included self-rated measures that were related to the Five Factor Model (McCrae and Costa, 1999) and comprise the five basic psychological dimensions – openness to experience, conscientiousness, extraversion, agreeableness, neuroticism (Big Five) – as well as measures of locus of control. All items related to the personality traits had to be answered on 7-point Likert-type scales (1 – "disagree completely" to 7 – "agree completely"). The scores are summed up to create an index ranging from 1 to 7.

Measures of Cognitive and Non-Cognitive skills of Adolescent Respondents

Since 2006, all adolescents entering the SOEP at age 17 have participated in somewhat more complex intelligence tests which cover the following domains: verbal skills, numerical skills, and abstract reasoning. The tests are modified versions of the I-S-T 2000-Test (Solga et al., 2005) and allow for a total time of 27 minutes for completion of all 60 tasks. Each of the three domains contains 20 individual tasks. In the first part (analogies), the respondent is asked to correctly assign expressions to a sequence of words according to a particular rule. These tasks test the ability to combine based on the vocabulary of the respondent, and, thus, measure verbal potential. In the second part (numerical series) the respondent is asked to insert the correct arithmetic operator into an incomplete equation. These tasks measure numerical potential by testing the adolescent's abstract ability to recombine and logical reasoning. The third part (matrices) measures abstract reasoning. The respondent is asked to select the correct piece out of five possible figures according to a particular logical rule as provided by

a displayed sequence of figures. The allotted times for completing each of the task groups are: 7 minutes for analogies, 10 minutes for numerical series, and 10 minutes for matrices. The scores are added together across the 20 individual tasks per domain to generate an index ranging from 0 to 20. An integrated additive index of verbal and numerical skills provides an adequate assessment of the adolescent's crystallized intelligence, i.e., skills that improve with knowledge acquired in the past, whereas abstract reasoning is related to fluid intelligence and, thus, comprises largely innate abilities. Since 2006, the SOEP questionnaire for adolescents has included items that relate to the Five Factor Model comprising the five basic psychological dimensions: openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism (Big Five). Furthermore, measures of the locus of control were collected from adolescents every year. Again, 7-point Likert type scales (1 – "disagree completely" to 7 – "agree completely") have been used for the items related to the personality traits. As for the sample of adults, the scores can be added together to create an index ranging from 1 to 7.

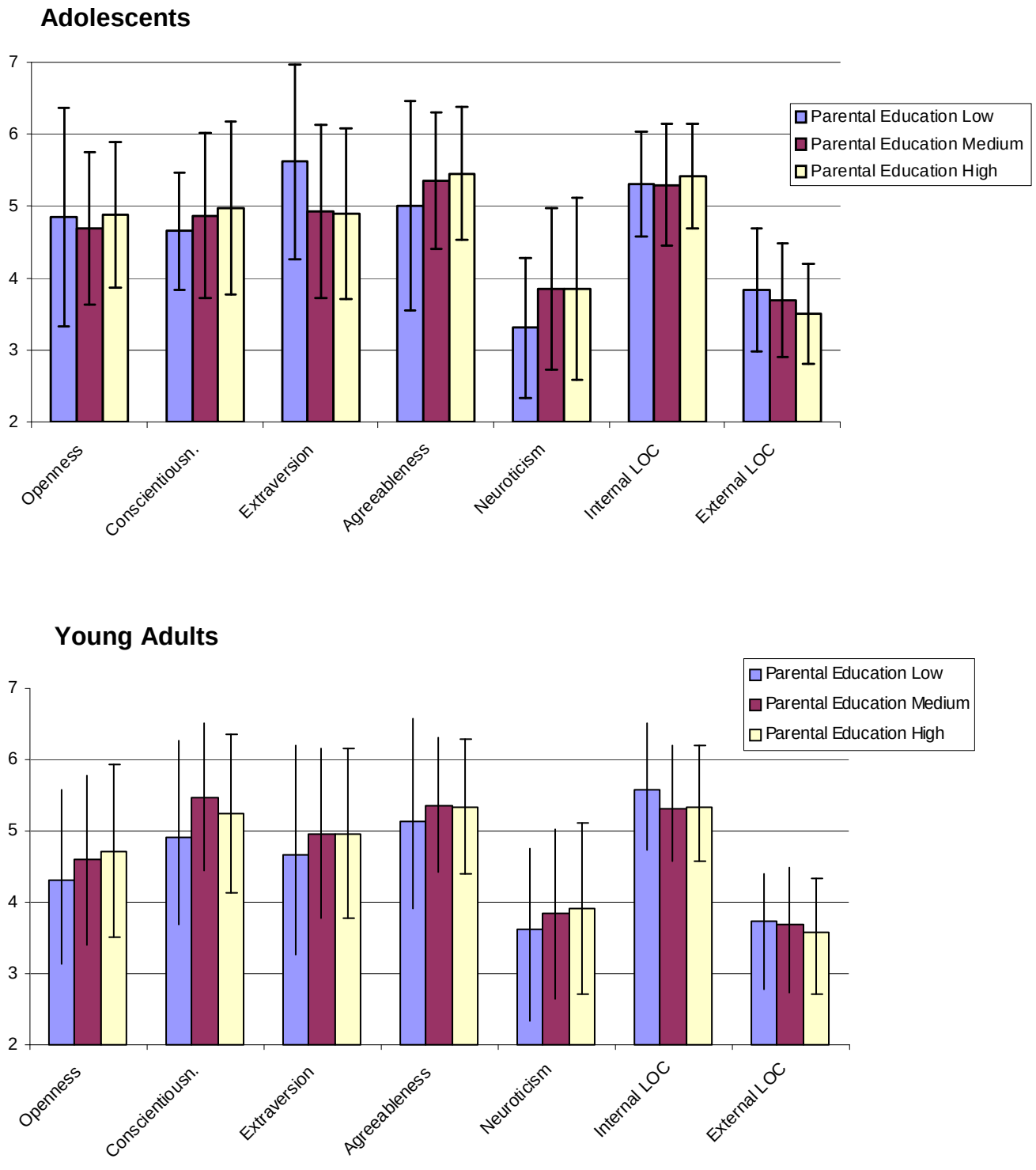
Table A1: Summary Statistics: IQ Test Scores, Personality Traits, Family Background, and Childhood Environment

	Adolescent Children				Young Adult Children			
Variable	Mean	SD	Min	Max	Mean	SD	Min	Max
Children's Characteristics								
Cognitive Skills								
Verbal skills	7.66	3.71	1	19	-	-	-	-
Numerical skills	12.36	4.92	1	20	-	-	-	-
Abstract reasoning	8.98	3.51	0	18	-	-	-	-
Word fluency	-	-	-	-	25.62	10.67	1	82
Coding speed	-	-	-	-	32.71	10.52	5	60
Non-cognitive Skills								
B5: Openness	4.74	1.06	1	7	4.62	1.20	1	7
B5: Conscientiousness	4.94	1.17	1.3	7	5.44	1.06	1.3	7
B5: Extraversion	4.94	1.17	1.3	7	4.95	1.20	1	7
B5: Agreeableness	5.37	0.95	1	7	5.36	0.96	1.3	7
B5: Neuroticism	3.84	1.16	1	7	3.90	1.20	1	7
Locus of control: internal	4.90	0.73	2.25	7	4.83	0.75	1.8	7
Locus of control: external	3.66	0.93	1	6.5	3.64	0.94	1.2	7
Age	17.54	0.80	17	19	22.18	3.22	18	29
Single parent	0.24	0.43	0	1	0.19	0.40	0	1
First born	0.51	0.50	0	1	0.44	0.50	0	1
Number of brothers	0.88	0.88	0	4	0.86	1.03	0	7
Number of sisters	0.79	0.96	0	6	0.82	0.99	0	6
Height (in cm)	174.36	9.47	154	202	175.73	9.05	150	200
Good health	0.83	0.37	0	1	0.79	0.41	0	1
Childhood area: rural	0.31	0.47	0	1	0.30	0.46	0	1
Childhood area: town	0.26	0.44	0	1	0.17	0.38	0	1
Childhood area: city	0.20	0.40	0	1	0.17	0.38	0	1
Childhood area: urban	0.23	0.42	0	1	0.27	0.45	0	1
Childhood area: missing	-	-	-	-	0.08	0.27	0	1
Parents' Characteristics								
Cognitive Skills								
Word fluency	25.90	10.56	1	62	25.66	10.32	1	59.5
Coding speed	27.80	8.22	7	56	25.87	8.62	4	49
Non-cognitive Skills [a]								

B5: Openness	6.33	1.67	1	10.5	6.08	1.69	1	10.5
B5: Conscientiousness	8.53	1.56	2.7	10.5	8.23	1.68	3.3	10.5
B5: Extraversion	6.91	1.58	2.3	10.5	6.62	1.60	1.7	10.5
B5: Agreeableness	7.77	1.55	2.7	10.5	7.52	1.63	2.7	10.5
B5: Neuroticism	5.68	1.61	1	10.5	5.55	1.62	1.3	10.5
Locus of control: internal	6.81	1.41	3	10.5	6.60	1.51	2.5	10.5
Locus of control: external	5.33	1.46	1.5	10.5	5.09	1.37	1.5	9.6
Low education	0.09	0.29	0	1	0.06	0.24	0	1
Medium education	0.63	0.48	0	1	0.64	0.48	0	1
High education	0.28	0.45	0	1	0.30	0.46	0	1
Number of Individuals (cognitive skills) [a]	280				446			
Number of Individuals (non-cognitive skills)	1184				2228			

Source: SOEP 2005-2008. Weighted averages.
Adolescent children: verbal and numerical skills (word analogies, arithmetic operations) are added together to generate an index for crystallized intelligence, whereas abstract reasoning (matrix test) relates to fluid intelligence.
Young adult children and parents: word fluency (animal-naming task) relates to crystallized intelligence, whereas coding speed (symbol correspondence test) refers to fluid intelligence.
With the exception of the means for the personality traits, all summary statistics are taken from this smaller sample. However, the summary statistics of the bigger sample (non-cognitive skills) are virtually the same.

Figure A1: Children's Personality Scores According to Parental Education



Source: SOEP 2005-2008.

[1] The term “non-cognitive skills” is used here to distinguish these skills from typical intelligence measures. However, this does not mean that personal traits do not have any cognitive content.
[2] Unfortunately, the impact of these mediating variables on children’s economic outcomes cannot be investigated with the available dataset as most of the children are still too young for us to observe final educational qualifications and earnings at reasonable points in time of their life cycle.
[3] The advantage of the latter is that, by measuring test scores at adult age, one can observe respondents with completed (secondary) school qualifications and, thus, reduce feedback effects from cognitive and non-cognitive skills on education. Furthermore, personality traits are considered as far more stable at adult age than during childhood or adolescence (Costa and McCrae, 1994).
[4] Due to the limited space, the analysis in this paper is restricted to overall transmission and father-son transmission effects. For differential effects of fathers and mothers on their sons and daughters, see Anger and Heineck (2010a).
[5] Lang et al. (2007) carry out reliability analyses and find test–retest coefficients of 0.7 for both the word fluency test and the symbol correspondence test.
[6] This approach has also been used in the intergenerational mobility literature to account for measurement error (for example, Zimmerman, 1992). Using average test scores is expected to reduce the error-in-variable bias by diminishing the random component of measured test scores. Furthermore, average test scores could be interpreted as an extract of a general ability type, which captures both coding speed and verbal fluency.
[7] The severe reduction in sample size raises the issue of the representativeness of the data, as there might be selection problems with respect to intergenerational associations of interest. However, despite the restrictions on the sample, selection does not seem to be a major problem for the interpretation of the results (see Anger and Heineck, 2010a).
[8] While Costa and McCrae (1994) suggest that personality traits are stable from age 30, recent research by Srivastava et al. (2003) show that an individual's personality traits may also be affected in early and middle adulthood.
[9] This explanation is supported by unreported regressions for a very small sample of young adults aged up to 20, which reveal intergenerational correlations of similar results to older adults aged up to 29.
[10] Although the main direction of intergenerational transmission channels is presumably from parents to their children, there is evidence from the psychology literature that children influence their parents’ values and behavior (for example, Ge et al., 1996). Since the SOEP provides contemporaneous measures and not parental skill measures at the time when parents were young, the influence from children to their parents cannot be ruled out in this study.
[11] Results are available from the author upon request.
[12] The association between parental education and children’s skills will be analyzed separately below.
[13] There is also a gradient in parents’ test scores with respect to their own education. Results are available from the author upon request.
[14] These effects compare to the intergenerational education transmission for Sweden of 0.38 and income transmission effect of 0.30 reported by Mood, Bihagen, and Jonsson (2011).
[15] The restriction of the German sample to younger adults in order to reach a sample average age which is closer to the ones for Norway and Sweden (age 18) slightly reduces the coefficients and precision of the estimates and generates transmission effects of identical size to those in the Scandinavian countries.
[16] The relevant distributional policy at this stage of young adulthood includes means-tested student loans, and until recently, only marginal financial contributions for tertiary education. The funding of universities and students has, nevertheless, been shown to benefit the families with a high socio-economic background more.