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NEET Status and Early Versus Later Skills Among Young Adults: Evidence From Linked Register-PIAAC Data

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ABSTRACT

Do skills protect against exclusion in adult ages, and how important are the skills acquired before the age of 16 years versus those acquired later on? We match the scores on numeracy and literacy skills from the 2011 PIAAC for young adults backwards to grade point average (GPA) data from compulsory school education, measured at the age of 16 years (GPA16), and forwards to employment and education register data 2 years after the PIAAC test. There is a high correlation between GPA16 and PIAAC scores even when controlling for parental background, health status, and completion of post-compulsory school education. Including both GPA16 and PIAAC scores in a model of the probability of NEET status 2 years after the PIAAC test shows three times as large differences associated with GPA16 scores than with PIAAC scores, even though the PIAAC test is taken closer in time than the GPA16 results.

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Introduction

The prevalence of not in employment, education, or training (NEET) status among young adults is recognized as a major problem in all of the Organisation for Economic Co-operation and Development (OECD, 2015) countries. In addition to being a serious contemporaneous problem for young adults, NEET status may prove to be an even larger problem for their future development and life opportunities (Nilsen & Reiso, 2014). For them, it is closely related to non-completion of high school, which is also a main concern (Albæk et al., 2015; Falch, Nyhus, & Strøm, 2013). In this article, we explore the association between the level of individual skills acquired at different stages and the probability of being NEET during the early career of young adults.

The questions we ask are, to what extent, do skills protect against exclusion in adult ages, and how important are the skills acquired before the age of 16 years versus those acquired later on? How important is the completion of upper secondary school education for the formation of skills and subsequent NEET status, which is conditional on the skills measured at the completion of compulsory school education? To answer these questions, we match the scores on numeracy and literacy skills from the 2011 Programme for the International Assessment of Adult Competencies (PIAAC) for young adults, aged 16–24 years, from Norway *backwards* to grade point average (GPA) data from compulsory school education, measured at the age of 16 years (GPA16), and *forwards* to the Norwegian employment and education register data 2 years after the PIAAC test.

The negative association between the level of skills and NEET status among young adults may be illustrated by comparing the distribution of numeracy skills in PIAAC for NEETs versus not-NEETs,

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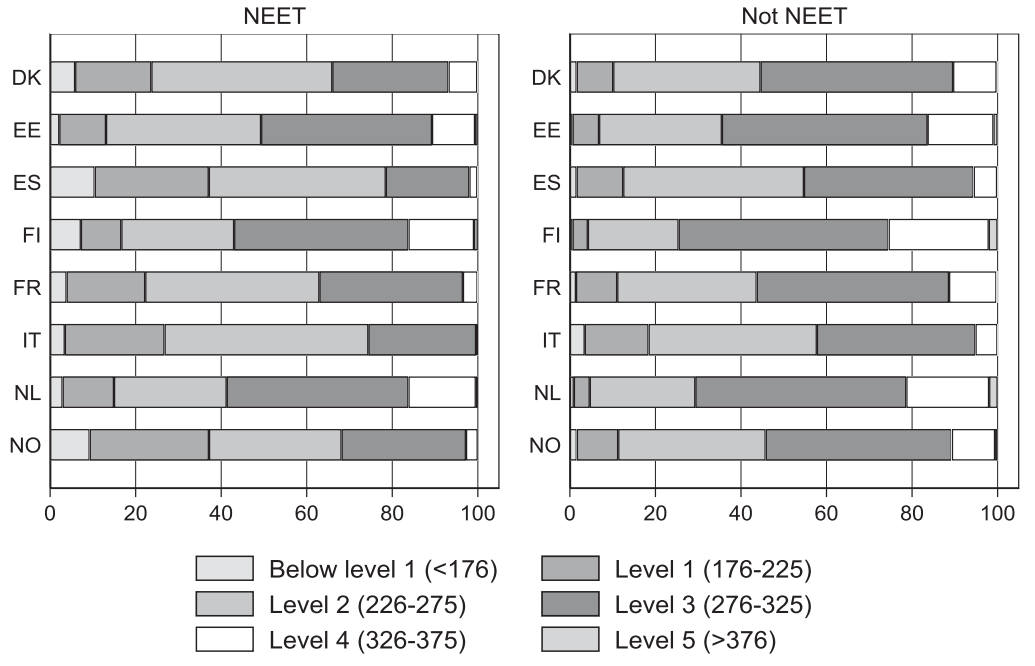

Figure 1. The distribution of numeracy skills by not in employment, education, or training (NEET) status among young adults (aged 16–24 years). Note: The figure shows the distribution of numeracy skills as measured by the Programme for the International Assessment of Adult Competencies (PIAAC) in 2011. The package piaactools in Stata is used to account for the complicated sampling schemes and plausible values.

using international data from the PIAAC survey. Figure 1 shows the pattern among 16- to 24-year-olds across a selection of European countries. In all countries, young NEETs have lower levels of skills than not-NEETs. A simple regression of NEET status on skills, including country dummies, confirms the negative correlation between both numeracy and literacy skills and the probability of being NEET in the same year.[1] The results are presented in Table A1, which show that one standard deviation higher numeracy skills is associated with 4.9 percentage points lower probability of being NEET. Similar results are found for literacy skills.

Our main question concerns the impact of skills on NEET status. However, the arrow of causality underlying the patterns revealed in Figure 1 may go both ways: Low skills may be detrimental to obtaining or sustaining employment, but at the same time, being out of employment or education may be detrimental to the development of skills. To alleviate this problem, in our analysis below, we match the 2011 PIAAC to register data on NEET status in 2013–2 years after the test—and also run specifications including NEET status in 2011 among the explanatory variables.

The skills observed in PIAAC may be a result of inherent abilities, skills acquired before the age of 16 years, and skills acquired after the completion of compulsory school education at the age of 16 years. We use regression analysis to explore, to what extent, the relationship between PIAAC skills and later NEET status diminishes once we control for GPA16. At the same time, we may decompose the total difference in later NEET status associated with GPA16 into a direct relationship conditional on skills observed in PIAAC and an indirect relationship mediated through the association between GPA16 and PIAAC skills.

The NEET rate in Norway is one of the lowest across OECD countries, with only 9% of young adults being NEET compared to an OECD average of 14%. At the same time, there are indications

[1]The regression controls for age, gender, and educational attainment, in addition to country dummies.

that Norwegian NEETs are particularly disadvantaged: In an international perspective, the share of inactive NEETs disconnected from the labour market is high, and this share has been growing over the last decade. Furthermore, the association between low education and NEET status is particularly strong in Norway (OECD, 2018).

Our study relates to the vast research literature focusing on the importance of early life skills (see, e.g., Heckman, 2000), arguing that the investments in skills generate better returns when invested in early life.[2] It also relates to research analysing the long-term effect of the quantity and quality of education. Schneeweis, Skirbekk, and Winter-Ebmer (2014) used data gathered from six countries and found long-term effects on the cognitive performance of extending compulsory school education.

More directly, we contribute to the recent research literature analysing the importance of early life skills for adults, especially the literature using data from the Programme for the International Assessment of Adult Competencies (PIAAC) and the Programme for the International Student Assessment (PISA). Albæk (2017) analyzed, to what extent, the skills measured by the end of compulsory school education persisted in adult ages and post-compulsory school education contributed to further skills of the adult population. Panel data for Danish students in the 2000 PISA study who were re-interviewed in the PIAAC study were used. Results showed a strong positive correlation between early and late literacy skills and that one more year of post-compulsory school education resulted in an increase in literacy skills by 0.07 standard deviations. The author concluded that the estimate of persistence in skills is high and highlighted the importance of compulsory school education. Lasting effects of skills obtained in compulsory school education are also found in Rosdahl (2014), who found a high correlation between the PISA literacy level at age 15 years and the PIAAC literacy level at age 27 years on the same data set used by Albæk (2017).

Gustafsson (2016) analyzed, to what extent, the quality of compulsory school education was correlated with adult literacy and numeracy skills. He used data from five PISA surveys, along with data from corresponding age cohorts for the same set of countries participating in the PIAAC survey. Results for 20 countries showed that the PIAAC performance differences were strongly related to the PISA achievement trends and relations held up when controls were introduced for the level of education attained and for general social and cultural development of the country. The author concluded that the quality of school education has a lasting impact on adult literacy and numeracy skills.

We also relate to the research literature focusing on the relationship between indicators of health and skills. Indicators of health are included because a large research literature has documented strong associations between education and different indicators of health (e.g., self-reported health and obesity) and health behaviour (e.g., smoking). For a recent overview of the research literature, see Galama, Lleras-Muney, and van Kippersluis (2018).

Even though our main contribution is to establish the association between NEET status among young adults and their skills, we add to the above literature associating early skills with later skills using an alternative measure of predetermined early skills. Instead of using results from the PISA study (as, e.g., in Albæk, 2017), we use the skills obtained in compulsory school. Concretely, we link individual register information on high-stake examinations from compulsory school obtained approximately at the time when individuals are undertaking the PISA test. GPA from compulsory school is the criterion for admission to further studies in upper secondary school and should therefore be considered a school performance measure of high importance. In addition, it is the first high-stake school performance measure in the Norwegian educational system. PISA, on the contrary, is a low-stake measure. Performance in PISA has no consequences for the student taking it, which may result in lower effort and downward biased scores. Indeed, a recent working paper by Akyol, Krishna, and Wang (2018) has shown that non-serious behaviour leads to biased PISA scores, providing an inaccurate picture of the actual skills. As GPA16 combines several high-stake examinations as well as classwork assessments, it may serve as a more reliable skill measure than PISA.

[2]For an overview of studies on the importance of public education for future earning and labour market participation, see Hanushek (2002).

The article proceeds with a presentation of the Norwegian educational system, including the data, sample, and variables, followed by a presentation of the results and, finally, a conclusion.

Education in Norway

The Norwegian educational system starts with primary and lower secondary school, which is compulsory for children aged 6–16 years (7–16 years before 1997). There is no ability tracking in compulsory school. For public schools, the place of residence generally decides which compulsory school to attend. Furthermore, the share of students attending private primary and lower secondary schools in Norway is very low, and these schools are most often heavily publicly subsidized. Examinations and grading methods in secondary schools are uniform across the country. As regards the school starting age, parents can apply to the municipality to delay it by 1 year or start 1 year early on pedagogical or psychological grounds. However, Norway practices very strict school enrolment rules, which are based on the year of birth, so changing the school starting year is very rare. Furthermore, there is essentially no grade retention, so almost all students start in compulsory school at the same age and finish together. As of 1994, all students are guaranteed at least 3 years of upper secondary education after completing compulsory school and nearly all students (approximately 95%) go directly from lower secondary to upper secondary schools. When entering upper secondary school, students can choose between a vocational track most often leading directly to a profession and an academic track often leading to further studies at a university or college. Almost 60% of the students choose an academic track.[3] The share of individuals with a university or college degree has risen in Norway during the last decade, as in most other OECD countries. In 2016, among those 25–29 years old (this age group contains half of our cohorts), approximately 46% had higher education, whereas 28% had upper secondary education as their highest educational attainment.[4]

Data, Sample, and Variables

We use data from PIAAC, which has been commissioned by the OECD, including both the public use files for several countries and a separate file for Norway. The latter is merged with individual register data. PIAAC is an individual-level sample survey that measures the skills of the adult population in three key areas: (1) literacy, (2) numeracy, and (3) problem-solving in the ICT environment. We choose to focus on numeracy and literacy. The population in the survey is aged 16–65 years. The survey took place between August 2011 and April 2012 in most participating countries, including Norway (see OECD, 2013, for more information). In Norway, a sample of approximately 8,500 people was drawn, of which approximately 5,000 people were interviewed. The response rate was 62% (Gravem & Lagerstrøm, 2013).

The respondents taking the PIAAC test can obtain a test score between 0 and 500. However, as a respondent answers only a subset of questions, this test score may not be a precise measure of the respondent's skills. Hence, there is not one "true" test score, but the respondent's test score is represented by a distribution of the so-called plausible values in the assessment of skills.[5] In order to take into account the complex assessment design of PIAAC results and the set of plausible values, special macros for data analysis are developed. The macros make sure that both the estimates and the standard error estimations are correct and combine the 10 plausible values in one comprehensive model. The macros are available on the websites of the OECD. We analyzed the international PIAAC-data using piaactools developed for Stata (see Jakubowski & Pokropek, 2019), and the linked PIAAC-register data using version 2 of the PIAAC macro developed for SAS (see Denis, 2014) and SAS Enterprise Guide 7.1 in our analyses.

[3]Including tracks for dance, drama, music, and sports. https://www.ssb.no/en/utdanning/statistikker/vgogjen
[4]https://www.ssb.no/utdanning/statistikker/utniv
[5]See OECD (2013) for more information.

The sample included in this article comprises young adults—that is, individuals who at the time of the PIAAC interview are in the age group 16–24 years. For Norway, this includes 901 individuals.[6] The variables used in the analysis consist of PIAAC variables from both the public use files and linked individual register variables, which are linked and merged by Statistics Norway. In addition to information on literacy and numeracy skills, PIAAC variables include individual information on age, educational attainment (compulsory school, upper secondary school, and university or college degree), gender, parental education (at least one parent with compulsory school, at least one parent with upper secondary school, and at least one parent with a university or college degree), and health. We use a subjective measure as an indicator of health. The respondents in the PIAAC survey are asked how they generally consider their health: excellent, very good, good, bad, or very bad.

The main merit of our data is that we link additional register information at the individual level from Statistics Norway (SSB) to the PIAAC survey. This concerns information on GPA from lower secondary school and if the individual is NEET in the year of the survey (2011) and 2 years after the PIAAC survey (2013).

Information about GPA from lower secondary school is gathered from the Norwegian Education Database. GPA is measured in tenth grade, the final year of lower secondary school, usually at the age of 16 years. This information is available from the 2002/2003 school cohort. GPA is an average of 10 different grades measured at the end of compulsory school. The 10 grades consist of students' grades from both examinations and classwork assessments ("standpunktkarakter").

GPA determines admission to upper secondary school and is, therefore, a high-stake performance measure. Grades vary from 1 (lowest) to 6 (highest). Because of the new definition of elementary school credits after 2006, standardized GPAs are used in all the analyses. For each year, they are standardized within the population, with an average of 0 and a standard deviation of 1. To ease comparison, we also standardize the numeracy and literacy skill measures from PIAAC, with an average of 0 and a standard deviation of 1.

The variable that measured NEET status in 2011 or 2013 is based on register information about employment and education. If an individual is neither registered as employed in Statistics Norway's Employment Register nor registered as being under education in the Norwegian Education Database, the person is categorized as NEET. The descriptive statistics for included variables is presented in Table A2.

The share being NEET in 2011 and 2013 (both based on register data) is 7% and 9%, respectively. The answers for health show that only 10% of the young adults have bad or very bad health. This most likely reflects that we are analyzing young adults of an average age of 19.6 years. This is also reflected in the educational distribution. More than half of the respondents have upper secondary education as their highest educational attainment, and only 6% have a university or college degree. In contrast, 46% of all 25- to 29-year-olds in Norway have a university or college degree, as provided in section "Education in Norway." Finally, we note that the mean value of the standardized GPA score is 0.008 (and not 0). This reflects that the standardization is applied to the whole population of 16- to 24-year-olds, not only our sample. This also reflects that our sample is slightly positively selected with respect to GPA.

Results

Determinants of PIAAC Skills

In this section, to begin with, we present results for the determination of skills. Table 1 provides results from OLS models of PIAAC numeracy skills. The first column of Table 1 shows that girls score less on numeracy skills than do boys of the same age and that completed education is positively associated with PIAAC skills. In Model 2, GPA16 is added.

[6]We exclude one individual who does not have education from Norway.

Table 1. PIAAC numeracy skills among age group 16–24 years.

	Model 1	Model 2	Model 3
Intercept	−0.569*	−0.966***	−1.296***
	(0.331)	(0.273)	(0.300)
Age	0.026	0.056***	0.057***
	(0.019)	(0.015)	(0.016)
Woman	−0.182***	−0.375***	−0.374***
	(0.062)	(0.049)	(0.049)
Education:			
Upper secondary school	0.200**	0.039	0.048
	(0.092)	(0.072)	(0.071)
University/college	0.690***	0.150	0.154
	(0.153)	(0.132)	(0.131)
GPA16		**0.510*** **	**0.498*** **
		(0.027)	(0.028)
Parental education:			
University/college			0.297**
			(0.115)
Upper secondary school			0.281**
			(0.117)
Unknown			0.194
			(0.184)
Health:			
Very good			0.035
			(0.066)
Good			0.129*
			(0.068)
Bad			−0.088
			(0.095)
Very bad			−0.208
			(0.226)
N	901	901	901
R_2	0.07	0.41	0.42

Note: PIAAC = Programme for the International Assessment of Adult Competencies, OLS = Ordinary least square, GPA16 = grade point average measured at the age of 16 years. Results are obtained from OLS models of PIAAC numeracy skills. GPA16 and PIAAC skills are normalized to (0, 1). The reference category for education is compulsory school. The reference category for health is excellent health. The reference category for parental education is compulsory school. Significance: ***: 1%; **: 5%; *: 10%.

One standard deviation higher GPA from compulsory school is associated with .51 standard deviation higher numeracy skills. When we add GPA16 to the model, the coefficients for completed education drop considerably and cease to be statistically significant. Conditional on GPAs, the gender gap becomes larger, reflecting that girls on average have higher grade points than boys. Adding parental education to the model adds explanatory power, but it does not affect other coefficients much. Notably, the coefficient for GPA16 declines very little—from .51 to .498. The inclusion of health adds little significance and has very little consequences for the models. One possible reason for the lack of significance for health variables is that we are analyzing young adults with relatively good health. The descriptive statistics provided in Table A2 shows that almost 70% of the respondents in our sample report good or very good health.

The overall impression is that GPA from lower secondary school is a key determinant of skills also in the subsequent years to come. Results for literacy skills reveal very much of the same pattern (see Table A3). The strong relationship between GPA and PIAAC results suggests that they measure the same thing to some extent. It also suggests that the skills revealed at 16 years of age impact the skills revealed at a later stage, even though it is not possible to distinguish whether they are simply retained into the future, and thus affecting subsequent test scores directly, or if they primarily are correlated with the development of new skills between the two times of measurement. As mentioned earlier, GPA is an average of 10 grades from different fields and from both examinations and classwork assessments, and it is reasonable to assume that it reflects a mixture of both ability and effort. In addition, there comes the contribution from the quality of the school, teachers, and student peers.

Table 2. NEET status and PIAAC skills among age group 16–24 years.

	Numeracy skills			Literacy skills		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
PIAAC skills	**−0.087*** **	**−0.082*** **	**−0.072*** **	**−0.072*** **	**−0.068*** **	**−0.059*** **
	(0.019)	(0.017)	(0.019)	(0.017)	(0.016)	(0.017)
Age	0.180**	0.323***	0.309***	0.179***	0.327***	0.312***
	(0.068)	(0.085)	(0.086)	(0.068)	(0.085)	(0.086)
Age squared	−0.004**	−0.007***	−0.007***	−0.004**	−0.007***	−0.007***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Woman	−0.023	−0.022	−0.026	−0.008	−0.009	−0.014
	(0.022)	(0.021)	(0.023)	(0.022)	(0.021)	(0.023)
Education:						
Upper secondary school		−0.123**	−0.113**		−0.127***	−0.116**
		(0.043)	(0.044)		(0.044)	(0.044)
University/college		−0.141***	−0.135**		−0.145**	−0.138**
		(0.057)	(0.059)		(0.058)	(0.060)
Health:						
Very good			0.037			0.038
			(0.026)			(0.026)
Good			0.056			0.053
			(0.033)			(0.034)
Bad			0.026			0.036
			(0.042)			(0.043)
Very bad			0.131			0.131
			(0.119)			(0.122)
Parental education:						
University/college			−0.148**			−0,154**
			(0.071)			(0.069)
Upper secondary school			−0.160**			−0.167**
			(0.070)			(0.069)
Unknown			−0.010			−0.010
			(0.112)			(0.113)
Constant	−1.788***	−3.273***	−3.006***	−1.787***	−3.312***	−3.032***
	(0.658)	(0.840)	(0.847)	(0.650)	(0.841)	(0.848)
N	901	901	901	901	901	901
R_2	0.07	0.09	0.11	0.08	0.09	0.12

Note: NEET = not in employment, education, or training, PIAAC = Programme for the International Assessment of Adult Competencies. Results are obtained using linear probability models. The dependent variable is NEET in 2013. The reference category for education is compulsory school education. Significance: ***: 1%; **: 5%; *: 10%. PIAAC skills are normalized to mean 0 and standard deviation 1.

We cannot distinguish between these inputs, but the results provided in Table 1 suggest that the impact of these inputs together is lasting and results in high scores at PIAAC as well.

NEET Status 2 Years After PIAAC

We now turn to the matched register-PIAAC data and present the results for the relationship between NEET status in 2013 and results from the test of numeracy skills in the 2011 PIAAC. Table 2 presents the results from three different linear probability models for each type of skills.[7]

Model 1 shows a strong negative relationship between numeracy skills and NEET status 2 years later. One standard deviation higher numeracy skills are associated with 8.7 percentage points lower NEET rates. Model 2 adds education to the model. NEET rates are lower among young adults who have completed upper secondary and college/university education. Still, the coefficient for numeracy skills remains high at 0.082, implying that the association between skills and NEET rates is not due to

[7]NEET status is a binary variable; therefore, a binary logistic or probit could have been used. However, results do not seem to vary much depending on linear probability model or binary logistic model. Using linear probability models eases the interpretation; therefore, we choose to use that throughout the article.

completed education. Finally, we add (subjective) health status and parental education in Model 3. Again, the health status indicators are not significant most likely because of insufficient variation in health status in our sample of young adults. Parental education is a strong predictor of NEET status even in a model with own education and measures of skills. However, the association between NEET status and numeracy skills remains strong: one standard deviation higher numeracy skills are associated with 7.2 percentage points lower probability of being NEET. Models 4–6 show similar results when the skills variable is represented by literacy skills instead of numeracy skills.

The coefficients for numeracy skills are slightly above 1 percentage point larger than the coefficients for literacy skills. However, since the scores on numeracy and literacy skills are highly correlated, we do not provide results obtained from models including both measures.

Adding Skills Measured at 16 Years of Age

GPA from lower secondary school (GPA16) is a measure of skills obtained at 15–16 years of age. In Table 3 we add GPA to the analysis of the relationship between NEET status and PIAAC skills. The inclusion of education and parental education does not change the coefficient for PIAAC skills much; however, adding GPA16 changes the coefficient a lot. The coefficients for adult skills from PIAAC, both numeracy and literacy skills, drop by about two-thirds when adding GPA from lower secondary school, and they are no longer significant. Results for GPA show that, increasing GPA16 by one standard deviation reduces the likelihood of being NEET by 7.2 percentage points (Model 1). In addition, the coefficients for the remaining variables are reduced somewhat, in particular for completed education. However, we still find a significant relationship between education and NEET status in 2013 even after controlling for GPA16.

To see how the two skill variables, GPA16 and PIAAC skills 2 years earlier, interact to protect against NEET status, we use the results provided in Tables 1 and 3. The total effect of GPA on NEET status, β_T, is made up of two components: $\beta_T = \beta_{GP} + \alpha\beta_P$, where the first term,

Table 3. NEET status and PIAAC skills, including GPA, among age group 16–24 years.

	Numeracy skills		Literacy skills	
	Model 1	Model 2	Model 3	Model 4
PIAAC skills	**−0.025**	**−0.024**	**−0.016**	**−0.017**
Numeracy/literacy	(0.020)	(0.018)	(0.018)	(0.017)
GPA16	**−0.072*****	**−0.051*****	**−0.075*****	**−0.054*****
	(0.017)	(0.018)	(0.018)	(0.018)
Education:				
Upper secondary school	−0.102**	−0.070*	−0.102**	−0.071*
	(0.040)	(0.038)	(0.040)	(0.038)
University/college	−0.096*	−0.062	−0.097*	−0.063
	(0.054)	(0.053)	(0.053)	(0.053)
Parental education:				
University/college	−0.114*	−0.087	−0.117*	−0.089
	(0.066)	(0.063)	(0.065)	(0.063)
Upper secondary school	−0.154**	−0.122*	−0.157**	−0.125**
	(0.064)	(0.061)	(0.063)	(0.061)
Unknown	−0.018	−0.036	−0.019	−0.037
	(0.105)	(0.100)	(0.105)	(0.100)
NEET in 2011		0.278***		0.278***
		(0.071)		(0.071)
N	901	901	901	901
R_2	0.14	0.19	0.14	0.20

Note: NEET = not in employment, education, or training, PIAAC = Programme for the International Assessment of Adult Competencies, GPA = grade point average, GPA16 = grade point average measured at the age of 16 years. Results are obtained using linear probability models. The dependent variable is NEET in 2013. The reference category for education is compulsory school. The reference category for health is excellent health. The reference category for parental education is compulsory school. Significance: ***: 1%; **: 5%; *: 10%. The models also include age, age squared, gender (not significant), and health indicators (not significant).

β_{GP}, is the direct association between GPA and NEET status, and the second term, $\alpha\beta_P$, is the indirect association arising from the association between GPA and skills (α) from Table 1, multiplied by the association between skills and NEET status, β_P. We have $\beta_{GP} = -.072$ and $(\alpha\beta_P) = 0.498\ (-.025) = -0.0125$, where .498 is obtained from Model 3 in Table 1. The total effect of GPA is thus −0.085, of which 85% is a direct effect and 15% is operating through higher PIAAC skills.

Dynamics

The last two models are dynamic models that also include the lagged dependent variable: NEET status in 2011. Most of the coefficients are somewhat attenuated, and the coefficient for the lagged dependent variable is 0.278. The coefficients for skills are not much affected. We may interpret the coefficients for skills and GPA as short-term effects (2 years) since the coefficients are estimated conditional on the level of the dependent variable 2 years earlier.

A long-term effect may be obtained by multiplying the coefficients by $1/(1 - a)$, where a is the coefficient for the lagged dependent variable. To see how this factor is calculated, we denote the short-term coefficient b (−0.024 for numeracy skills) and consider the difference in NEET rates between two individuals with a difference of 1 standard deviation in the levels of skills in 2011. In 2013, the high-skilled individual has b lower NEET probability than the low-skilled individual. Two years into the future, the difference is still b, but in addition, there is a difference of a times the difference in NEET rates of the last period. The total difference is, thus, $b + ba = b(1 + a)$. Two more years into the future, the difference is still b, but in addition, there is a difference of a times the difference in NEET rates of the last period. The total difference is, thus, $b + ba(1 + a) = b(1 + a + a^2)$. Two more years into the future, the difference is $b(1 + a + a^2 + a^3)$ and so on. The limit of the geometric series as time approaches infinity is $1/(1 - a)$.[8]

The short-term effects of GPA and PIAAC are −0.051 and −0.024, respectively, and we obtain an estimate of the long-term effect by multiplying by $1/(1 - 0.278) = 1.39$, which gives −0.071 and −0.033. A larger long-term than short-term effect suggests that higher skills is associated with a positive dynamic process that improves outcomes also in the longer run. However, the inclusion of the lagged dependent variable may introduce other problems, depending on the underlying dynamics of the model, and caution should thus be exercised in the interpretation.

Discussion and Conclusion

We explore the role of skills for the probability of being NEET among young adults. To what extent, do formal skills acquired by the end of compulsory school persist and protect against exclusion in adult ages? What is the importance of post-compulsory school education and skills measured in PIAAC after controlling for the ability of compulsory school?

Having linked register information on GPA from compulsory school (GPA16) to the test results from PIAAC for young adults aged 16–24 years, we found GPA16 to be a key determinant of PIAAC scores. As provided in Table 1, there is a strong relationship between GPA16 and PIAAC scores even when controlling for parental background, health status, and completion of post-compulsory school education. Results show that one standard deviation higher GPA from compulsory school education is associated with .5 standard deviation higher numeracy PIAAC skills. This result is in line with what was found by Albæk (2017) and Gustafsson (2016), using a combination of PISA and PIAAC results. Albæk (2017) found in his OLS estimations that one standard deviation higher

[8]Another way of obtaining this result is to consider the steady state where Y and X remain constant: We have the following model: $Y(t) = aY(t - 1) + bX(t)$, where Y is the dependent variable and $Y(t - 1)$ is the lagged dependent variable. X is the explanatory variable and b is the short-run coefficient. In a long-run steady state, $Y(t) = Y(t - 1) = Y$, and $X(t) = X(t - 1) = X$, and we have $Y = aY + bX$; thus, the long-run relation is given by $Y = b/(1 - a)X$.

PISA score is associated with .479 standard deviation higher numeracy PIAAC skills after controlling for own education and gender. In magnitude, this result is very similar to our result. This adds validity to his results since our measure of early skills is from high-stake tests. Adding GPA16 to the model even removes almost all the differences in PIAAC scores associated with the completion of post-compulsory school education.

Linking our data to register-based NEET status 2 years after PIAAC, we found large NEET differences associated with GPA16 scores, as given in Table 3—two to three times higher than the differences associated with the subsequent PIAAC scores even though the PIAAC scores were obtained closer in time to the measurement of NEET status. This result may seem surprising, but it is in line with the "early intervention" results famous in the literature (see, e.g., Heckman, 2000).

The results are robust to the inclusion of subjective health status and parental education. Even though we do not know what determines GPA16, this observation shows that what is revealed in GPA16 that is relevant to adult NEET status is not limited to health or the joint impact of parents' nature or nurture as revealed by their level of education, but it arises from other factors, such as abilities or background influences, not correlated with parental education or differences in teacher quality or other aspects of compulsory or preschool quality. About 85% of the association between GPA16 and NEET status is direct, whereas 15% goes through the association between GPA16 and subsequent PIAAC scores.

Without conditioning on GPA16, there is a strong association between PIAAC scores and NEET status 2 years later (Models 3 and 6 in Table 2). The differences in NEET rates associated with PIAAC scores are very similar between numeracy and literacy skills. These differences are quite robust to the inclusion of post-compulsory school education in the equation, as provided in Table 2, suggesting that they are not obtained solely through the completion of formal education. The differences due to PIAAC scores are not, however, robust to the inclusion of GPA16, suggesting that a large part of the difference arises from the association between skills revealed already at GPA16 and the subsequent PIAAC scores.

There is a large difference between the NEET rates of those who had completed post-compulsory school education versus those who had not. Part of this difference arises from differences in measured skill levels, both at GPA16 and in PIAAC, but a strong and significant association remains even after controlling for skills. Measures of numeracy or literacy skills, or of schooling abilities at 16, are not sufficient to remove the strong effect of completion. The fact that once we condition on GPA16, very little remains of the relationship between the completion of post-compulsory school education and PIAAC scores suggests that there are other features of schooling or the completion of schooling than merely the formation of numeracy or literacy skills that affect NEET rates. We cannot, however, distinguish these data from stigma effects, other effects of dropout, such as less learning of other skills, or differential sorting of unobservables (not revealed by health, parental education, and GPA16) into completion.

Skills appear to protect against NEET rates among young adults. We do not know how they are acquired and thus cannot provide causal evidence on the formation of skills necessary for clear-cut policy prescriptions. However, since we know when skills are measured, we have been able to conclude that early skills protect more than later skills. This result suggests that early intervention is particularly useful, but one should be careful about drawing too strong conclusion with respect to policy implications, in particular, since different policy measures may have a different impact on the formation of relevant skills at different ages. Spurious or inherent factors may be more important for the early measures of skills than for the later ones or vice versa. More research is needed to provide clear policy conclusions.

To our knowledge, our study is the first one to explore the relationship between PIAAC scores and later outcomes. This design allows us to go beyond the correlations observed between skills and contemporaneous outcomes that are necessarily ridden with questions related to the arrow of causality. Further research may more closely look into other outcomes, such as employment versus education and the quality of jobs as measured by their wages. Still, the NEET rate among young

adults is clearly among the most crucial outcomes to understand, in particular, because NEET status at this age may be detrimental to the participation and future life opportunities of young adults.

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Appendix

Table A1. Skills and NEET among age group 16–24 years. International PIAAC data.

	Numeracy		Literacy	
	Coef.	(SE)	Coef.	(SE)
PIAAC skills	−0.049***	(0.005)	−0.043***	(0.006)
Age	0.163***	(0.036)	0.167***	(0.036)
Age squared	−0.004***	(0.001)	−0.004***	(0.001)
Woman	0.010	(0.008)	0.016**	(0.008)
Education:				
Upper secondary school	−0.051***	(0.015)	−0.057***	(0.015)
University/college	−0.043*	(0.024)	−0.051**	(0.024)
Country dummies:	Yes		Yes	
Intercept	−1.689***	(0.354)	−1.731	(0.359)
N	21,669			

Note: OLS = Ordinary least square, PIAAC = Programme for the International Assessment of Adult Competencies, NEET = not in employment, education, or training, SE = Standard error. Results are obtained using OLS models. The dependent variable is NEET in 2011. The reference category for education is compulsory school. The skill variables are standardized for the age group 16–24 years, with mean 0 and standard deviation 1. Significance: ***: 1%; **: 5%; *: 10%.

Table A2. Descriptive statistics. Mean values (measured as shares when nothing else is stated).

Variable	Mean value (share)	Standard deviation
Age (years)	19.6	2.62
Woman	0.49	0.50
GPA (standardized score)	0.08	1.00
NEET in 2011	0.07	0.25
NEET in 2013	0.09	0.29
PIAAC numeracy test score	274.9	41.47
PIAAC literacy test score	278.1	36.51
Health:		
Excellent	0.23	0.42
Very good	0.40	0.49
Good	0.27	0.44
Bad	0.09	0.28
Very bad	0.01	0.10
Education:		
Compulsory school	0.41	0.49
Upper secondary school	0.53	0.50
University/college	0.06	0.24
Parental education:		
Compulsory school	0.05	0.21
Upper secondary school	0.38	0.49
University/college	0.54	0.50
Unknown	0.03	0.18
N	901	

Note: GPA = grade point average, NEET = not in employment, education, or training, PIAAC = Programme for the International Assessment of Adult Competencies.

Table A3. PIAAC literacy skills among age group 16–24 years.

	Model 1	Model 2	Model 3	Model 4	Model 5
Intercept	−1.430***	−0.732*	−1.175***	−1.145***	−1.511***
	(0.301)	(0.389)	(0.320)	(0.341)	(0.342)
Age	0.073***	0.030	0.064***	0.064***	0.065***
	(0.015)	(0.022)	(0.018)	(0.018)	(0.018)
Woman	−0.002	−0.022	−0.238***	−0.228***	−0.235***
	(0.069)	(0.068)	(0.054)	(0.055)	(0.055)
Education:					
Upper secondary school		0.198**	0.018	0.017	0.025
		(0.103)	(0.081)	(0.081)	(0.080)
University/college		0.768***	0.165	0.177	0.175
		(0.170)	(0.146)	(0.143)	(0.143)
GPA16			0.570***	0.550***	0.552***
			(0.029)	(0.032)	(0.033)
Parental education:					
University/college				0.293***	0.306**
				(0.132)	(0.133)
Upper secondary school				0.230*	0.239*
				(0.134)	(0.135)
Unknown				0.223	0.231
				(0.228)	(0.229)
Health:					
Very good					0.060
					(0.075)
Good					0.093
					(0.080)
Bad					0.029
					(0.112)
Very bad					−0.257
					(0.259)
N	901	901	901	901	901
R_2	0.05	0.07	0.42	0.42	0.42

Note: OLS = Ordinary least square, PIAAC = Programme for the International Assessment of Adult Competencies, GPA16 = grade point average measured at the age of 16 years. Results are obtained using OLS models. The dependent variable is PIAAC literacy skills. The reference category for education is compulsory school. The reference category for health is excellent health. The reference category for parental education is compulsory school. Significance: ***: 1%; **: 5%; *: 10%.