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University education and non-cognitive skill development

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Abstract

We examine the effect of university education on students' non-cognitive skills (NCS) using high-quality Australian longitudinal data. To isolate the skill-building effects of tertiary education, we follow the education decisions and NCS - proxied by the Big Five personality traits - of 575 adolescents over eight years. Estimating a standard skill production function, we demonstrate a robust positive relationship between university education and extraversion, and agreeableness for students from disadvantaged backgrounds. The effects are likely to operate through exposure to university life rather than through degree-specific curricula or university-specific teaching quality. As extraversion and agreeableness are associated with socially-beneficial behaviours, we propose that university education may have important non-market returns returns beyond its private labour-market returns.

JEL classification: H52, I12, J24.

1 Introduction

The primary goal of university education is to teach students mastery of an academic subject, human capital that is needed for a growth-oriented and innovative economy (Delbanco 2014; DeVitis 2013). Notwithstanding the importance of academic qualifications, employers also value non-academic qualifications that are often referred to as soft or non-cognitive skills (NCS) (Almlund et al. 2011). David Docherty, the chief executive of the *National Centre for Universities and Business* in Britain, suggested that universities must provide society with workers who do not only have the ability to "continually learn, to think critically and theoretically", but also "to innovate and break the status quo, and to navigate in the unstable waters of the global economy" (Docherty 2012). A recent survey of Australian graduate employers revealed that employers rank "poor or inappropriate academic qualifications or results" low as an issue in graduate hiring, while they care about "interpersonal and communication skills, attitude and work ethic, and motivation" (Graduate Careers Australia 2014, p. 6). Yet, "it is not clear how actively universities develop these traits through their courses or other aspects of university life" (Norton and Cherastidtham 2014, p. 69).

In this study, we therefore evaluate whether universities help to shape NCS, especially of youth from disadvantaged backgrounds. To measure NCS, we use the Big Five personality traits - openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism - which are widely accepted as a meaningful and consistent construct for describing differences in NCS by psychologists (Goldberg 1992, 1993). Some of these NCS - extraversion or openness to new experiences - clearly have high private returns in the labour market (Fletcher 2013; Gensowski 2014; Heineck and Anger 2010; Mueller and Plug 2006; Nyhus and Pons 2005), which is evidence

for their value to employers. Other NCS - e.g. agreeableness - are closely related to economic preferences such as reciprocity and altruism (Becker et al. 2012), or prosociality (Hilbig et al. 2014), which are at the basis of socio-economic development (e.g. Bigoni et al. 2016) and population wellbeing (Post 2005).

Most of the recent literature on the NCS-building effects of the education sector focuses on pre-school programs (e.g. Chetty et al. 2011; Heckman et al. 2010, 2013), although some studies evaluate the skill-building effects of class-room interventions or institutional changes in the secondary education sector (see Schurer 2017, for a review). Jacob (2002), Heckman et al. (2006b), and Lundberg (2013) are among the few studies which explore the role of NCS in shaping college choices, although they do not elaborate specifically on whether university education shapes such skills.[1] We contribute to this literature by positing that university education is an important input into the skill production function of adolescents. University education has the potential to shape NCS because such skills are still malleable during late adolescence and young adulthood (Bleidorn et al. 2013; Cobb-Clark and Schurer 2012, 2013; Elkins et al. 2017; Hopwood et al. 2011; Specht et al. 2011), and because universities provide an intensive new learning and social environment for adolescents.

To identify the effect of university education, we follow the education and NCS trajectories of a cohort of 575 adolescents over eight years using nationally-representative, longitudinal data from the Household, Income, and Labour Dynamics in Australia (HILDA) survey. The data provide measures of NCS before potential university entry, and follow up measures four and eight years later. This unique data feature allows us to use value-added and fixed effects estimation

[1]Heckman et al. (2006b) evaluates the impact of 13+ years of schooling on a summary measure of self-esteem and self-efficacy, relative to less than 12 years of education, which could be interpreted as the impact of college eduction on non-cognitive skills.

models to control for the potential endogeneity in university participation. Because of the richness of our data, we are also able to control for a large number of key inputs into the adolescent skill production function that may vary over time and affect the decision to enter or complete university education (see Elkins et al. 2017).

Our results show that university education has positive effects on extraversion, reversing a downward sloping population trend in outward orientation as people age. It also accelerates an upward-sloping population trend in agreeableness for students from low socioeconomic status, boosting agreeableness scores from the lowest levels observed at baseline to the highest levels at the eight-year follow up. The effects are robust to controlling for individual-specific heterogeneity, time-varying shocks, work experience and modeling assumptions, and they do not differ by gender, university type or field of study. This finding suggests that the causal mechanism is likely to operate through actual exposure to university life, rather than through university-specific teaching styles or quality, or subject-specific contents. Such interpretation is strengthened by the observation that length of exposure to university life is positively associated with NCS development.

The remainder of this paper is as follows. In Section 2 we outline the likely mechanisms through which university education affects non-cognitive skill formation. We propose a model of selection into university by non-cognitive skills, discuss our estimation strategy and the identification assumptions in Section 3. In Section 4 we describe the study design, in particular the specifics of the Australian higher education sector and the data we use. Furthermore, we provide in Section 4 descriptive statistics of NCS development for university students compared to non-university students. Section 5 presents the estimation results, while Section 6 concludes. Supplementary data is provided in an appendix.

2 University education and non-cognitive skill formation: Mechanisms

We hypothesize that university education builds non-cognitive skills (NCS) according to the human capital model of education.[2] University education coincides with the transition from adolescence into young adulthood which has been characterized by rapid change and the peak of personality maturation. The nature of this maturation process is toward increasing levels of agreeableness, conscientiousness, and emotional stability, and decreasing levels of openness to experience and extraversion (see Elkins et al. 2017, for a full review of the literature). We suggest that university training alters this maturation process: Theoretically, it could boost, weaken, or even reverse population trends in personality trait maturation. There are at least three avenues through which trends in personality maturation could be altered.

First, NCS could be shaped by the students' exposure to new demands on their NCS through the cognitively challenging features of the curriculum. Keeping up with course work shapes attention, openness to new ideas, persistence, and the ability to manage scarce time resources, in addition to high level of intellectual and social engagement with teachers and peers. According to academic learning theory (ALT), studying is characterized by both "effort, isolated learning, and independent competence" (Brown et al. 1983, p. 79), and classroom learning that takes place "in social settings where it is guided and broken up into segments by others" (Thomas and Rohwer Jr. 1986, p. 20). ALT further acknowledges that studying is a mix of "skill and will" (Paris et al. 1983,

[2] Individuals living in an OECD country who completed tertiary education earn, on average, 55% more than individuals who did not obtain such a qualification (OECD 2012). These high economic returns of university education suggest that graduates acquire skills that are valued by employers. This interpretation is consistent with the human capital model of education (Mincer 1958; Schultz 1961). Yet, one could argue that university degrees just function as a screening device for employers to select the most innately capable workers. The argument is that university education does not teach additional skills, but students who graduate send a signal to employers that they are smart and productive workers because they were able to apply for and complete university training. This interpretation is consistent with the screening theory of university education (Arrow 1973; Spence 1973; Stiglitz 1975; Weiss 1995).

p. 309), where will refers to a disposition to exert effort, to persist, and to seek and transform information. Thomas and Rohwer Jr. (1986) thus describe academic learning as a combination of emotional factors and cognitive abilities. Because of the challenging nature of academic learning and the demands that are placed on students' NCS necessary to succeed in this environment, exposure to university education may alter students' NCS maturation trends.

A second avenue through which university education may shape NCS is exposure to degree-specific content or teaching styles. Most of the degrees offered at university teach technical or subject-specific skills (e.g. law, engineering, medicine), but liberal arts degrees – degrees that combine humanities and science – teach a broader framework for thought. Liberal arts degrees are intended to produce well-rounded and well-read graduates, who are contemplative, collaborative, and creative.[3] Furthermore, many universities have embarked on a mission to incorporate into their curricula "generic or transferable skills", "...skills which all graduates should possess, and which would be applicable to a wide range of tasks and contexts beyond the university setting" (Gilbert et al. 2004, p. 376).[4] If university education shapes NCS through exposure to degree-specific contents or university-specific teaching strategies, we would expect to see heterogeneity in the skill-building effects of university education across universities and degrees.

A third avenue through which university education may impact on NCS development is exposure to new peer groups and extracurricular activities including sport, politics, and art. Because students from disadvantaged backgrounds are likely to be more affected by a change in

[3]Some argue that the breadth of skills taught through Liberal arts degrees makes graduates more likely to succeed in leadership roles. For a discussion of these issues see Anne Fisher (2016).

[4]Critics in the popular press contend that universities in fact do not but should teach their students NCS, because these prepare students for a fast-paced, globally connected labour market. Journalists Laura Pappano and Thomas L. Friedman suggested that universities should teach their students creativity (New York Times, 5 Feb 2014), humility, leadership, and the ability to learn on the fly (New York Times, 22 Feb 2014). Katie Allen even went so far to claim that British undergraduate university education does nothing more than leading students into high debt and underemployability (The Guardian, 19 Aug 2015).

peer groups through day-to-day interaction with academically inclined peers and academic staff (e.g. Terenzini et al. 1996), we would expect to observe a greater effect of university education on students from disadvantaged backgrounds if this hypothesis were true.

If university education truly builds NCS for students, then we should find that the longer a student has spent at university, the greater the impact of university education on NCS should be. We can test this because we observe the amount of time the students in our data spend at university. Furthermore, since we have information on socio-economic background, university type and course, we can directly test for the second and third hypotheses, and thus may indirectly test for the validity of the first hypothesis.

3 Identification of the impact of university education on NCS development

3.1 Endogeneity in university education

Identifying the causal impact of university education on NCS development is challenging because of the inherent endogeneity in university education. Students self-select into tertiary training if the benefit from education is greater than its cost. A typical model of education choice considers the benefit of university education in terms of net lifetime earnings (Cunha et al. 2005):

$$\begin{aligned} UNI_i &= 1 \text{ if } E(Y_{U,i} - Y_{NU,i} - C_i | I_{i0}) > 0 \\ &= 0 \text{ otherwise.} \end{aligned} \tag{1}$$

$Y_{U,i}$ measures life-time earnings of the individual when entering university, and $Y_{NU,i}$ mea-

sures life-time earnings when not entering university. An individual chooses to enter university ($UNI_i = 1$) if $E(Y_{U,i} - Y_{NU,i} - C_i|I_{i0}) > 0$, which means that the net lifetime return to university is greater than the costs associated with university (C_i). I_{i0} captures the information set available to the adolescent at the time he or she has to make the decision. Cunha et al. (2005) assume that at time $t = 0$, the choice for university is based on expectations about the returns to university education, observed factors that proxy the costs associated with university education, and factors that are observed to the adolescent but that are not observed to the researcher.[5]

Costs usually include tuition fees and living expenses, opportunity costs as well as psychic costs (Jacob 2002). Similar to Jacob (2002), we assume that NCS determine the psychic costs of university education and thus help students to more easily "navigate college life" (p. 591).[6] Both Jacob (2002) and Lundberg (2013) find empirical evidence in favor of this hypothesis. For instance, Lundberg (2013) demonstrates that individuals high on sociability and low on emotional stability are less likely to have completed a college degree, while individuals high on conscientiousness and agreeableness are more likely to do so. Therefore, selection into university is likely to depend on baseline levels of NCS.

Modeling the impact of university education on NCS development is furthermore complicated by the fact that the transition process from adolescence into young adulthood coincides also with the uptake of social responsibilities, changes in relationships and work experiences, all of

[5]Moreover, models of major choice include an expectation about performance in the specific subject. We abstract from modeling expectations about performance in major choice because we are not modeling major choice. One could also argue that students self-select into university if they expected gains in non-cognitive skill development. One would expect self-selection by gains in NCS development if universities explicitly trained NCS as outlined in their academic strategies and curriculum contents, which to the best of our knowledge the majority of universities do not do. To the best of our knowledge, this possibility has not been considered in the theoretical and empirical literature.

[6]In contrast, Heckman et al. (2006a), Carneiro et al. (2003), and Cunha et al. (2005) assume that psychic costs are related to cognitive ability.

which are likely to determine both education choices and the NCS maturation process. Similarly, those factors may also be related to the probability of completing university education. Thus, an evaluation of the impact of university education on NCS development needs to account for the self-selection into university education by NCS and other important confounding factors, some of which may be unobservable. In the next section, we describe our identification strategy to isolate the effect of university education from these confounding factors.

3.2 Modeling and estimating the production function of NCS

In this section we lay out the empirical framework within which we test the effect of university education on youth NCS. We depart our analysis from the perspective that NCS in young adulthood are the result of a cumulative dynamic process, sometimes referred as a maturation process, similar to the acquisition of cognitive and non-cognitive skills of children (Cunha and Heckman 2008; Del Bono et al. 2016; Fiorini and Keane 2014; Todd and Wolpin 2003). We follow the adolescent skill production functions defined in Elkins et al. (2017) which considers inputs choices made by the individual including educational choices, negative and positive experiences including the uptake of social responsibilities, formation of new relationships, health changes, and some fixed mental capacity. The skill production function of individual i at age a is:

$$NCS_{ia} = NCS_a[E_i(a), X_i(a), \theta_{i0}, \varepsilon_{ia}], \tag{2}$$

where $E_i(a)$ is past educational inputs up until age a, $X_i(a)$ are all other relevant inputs, θ_{i0} is the initial skill endowment and ε_{ia} is measurement error in skills or age-specific shocks, which are assumed to be independent of E, X, and θ. In this flexible specification, the im-

pacts of all inputs are allowed to vary by age. However, estimating this specification is not feasible, because information on all relevant, historical inputs and initial endowments in skills is usually not available. To control for all historical inputs into the skill production function and initial skill endowment, we follow an empirical specification widely used in the literature, which controls for these unobservable inputs by conditioning the analysis on a past or baseline value of NCS (see Black and Kassenboehmer 2017; Cunha and Heckman 2008; Del Bono et al. 2016; Fiorini and Keane 2014; Todd and Wolpin 2003). One assumption of this approach is that the impact of each input is independent of the age at which the input occurs (see Fiorini and Keane 2014; Todd and Wolpin 2003, for a discussion).

We adjust this so-called value-added model to the context of the young adult skill production function similar to Elkins et al. (2017) and Cobb-Clark and Schurer (2012). Our outcome measure is personality trait j in time period $t+1$ ($PT^j_{i,t+1}$):[7]

$$PT^j_{i,t+1} = PT'_{i,t}\alpha^j_0 + \alpha^j_1 U_{i,t+1} + \alpha^j_2 FOPS_{it} + X'_{i,t}\beta^j + Z'_{i,t+1}\gamma^j + \varepsilon^j_{i,t+1}. \quad (3)$$

We observe the same individual i in time periods $t+1$ (2013) and t (2005). University education is measured by an indicator variable $U_{i,t+1}$ which takes the value 1 if the individual "has completed university" or "has been studying at university at least in the second year" in $t+1$. The coefficient α^j_1 is the key parameter of interest, measuring the effect of university education on NCS. The reference group consists of adolescents who did not go to university in the time period considered, but pursued alternative vocational training or work experiences. In an extension to the baseline model, we interact the university indicator with the father's occupational prestige

[7]Note, we allow in our specification the impact of baseline skills on contemporaneous skills to differ from 1 in contrast to Elkins et al. (2017) and Cobb-Clark and Schurer (2012), who assume that the impact is 1 and thus use the changes in NCS between two time periods as outcome variable.

score (FOPS) as defined in Section 4.2 measured at baseline t ($U_{i,t+1} \times FOPS_{i,t}$) to allow for heterogeneous effects by parental SES. We include this interaction term because university education is likely to change the peer group or exposure to new ideas for adolescents from low SES to a greater extent than for adolescents from high socioeconomic backgrounds (as suggested in the third mechanism discussed in Section 2).

$PT_{i,t}$ is a vector of five baseline Big-Five personality traits to capture all unobservable past inputs and baseline endowments in skills (θ_{i0}) in order to control for selection by baseline skills and endowments as outlined in Section 3.1. The vector $X^j_{i,t}$ includes baseline control variables that are likely related to the decision to go to university as well as the development of non-cognitive skills between time t and $t+1$. These control variables are strictly measured before our sample members potentially enter university and include age, gender, country of birth, region and state of residence, socio-economic status and health. The vector $Z_{i,t+1}$ captures the uptake of social responsibilities, changes in relationships, work experiences (and other relevant life events) which are important for NCS formation. More specifically, included in $Z_{i,t+1}$ are indicator variables for a battery of specific life events after period t including period $t+1$ and accumulated work experience in $t+1$ since period t. All variables are described in Section 4.2 and their summary statistics are listed in Table 1.

The error term $\varepsilon^j_{i,t+1}$ is assumed to be the sum of remaining individual-specific heterogeneity (μ^j_i) and period-specific shocks ($\varphi_{i,t+1}$). Given that we condition not only on baseline personality trait j, but also all other personality traits, we hope to proxy with these controls most of the unobservable variation in μ^j_i. In contrast, $\varphi_{i,t+1}$ includes all accumulated shocks until $t+1$ that are not captured by $Z_{i,t+1}$. We assume that this value-added model controls for selection into university by conditioning on baseline NCS and a set of other baseline controls. Under

the assumption of zero remaining covariance between both components in $\varepsilon^{j}_{i,t+1}$ and university education ($U_{i,t+1}$), estimating α^{j}_{1} with Ordinary Least Squares (OLS) would yield an unbiased impact estimate of university education on personality trait j.

To complement the value-added specification, we also use coarsened exact matching (CEM) to more transparently narrow down the control group against which the treatment group is compared against (Ho et al. 2007). Although matching methods also rely on the conditional independence assumption, they require fewer functional-form assumptions due to their semi-parametric nature. CEM improves upon standard matching methods, because it is less dependent on a regression model as propensity-score matching and achieves an improvement of the balance of one covariate without making the balance of other covariates between treatment and control group worse, which is common with nearest-neighbour matching (for an overview see Iacus et al. (2011)). For applications in estimating educational outcomes, see Jones et al. (2011) and in health care expenditures, see Schurer et al. (2016).[8]

The assumptions underlying both OLS and CEM estimation of the value-added model to identify a causal impact of university education are that (a) the lagged dependent variable is a sufficient statistic for unobserved input histories and initial endowment, (b) the impact of previous inputs is independent of the age at which they occur, and (c) there is no remaining unobserved heterogeneity which correlates with university education (see Fiorini and Keane 2014, for a dis-

[8]We are matching youth who have entered the university track by 2013 to a statistical twin on the basis of the following categories of pre-treatment variables: Sex (0,1); Age: Being above versus being at or below age 17 in 2005 (0,1); Father's occupation class: Being above or at versus below the sample average on the occupational prestige score (0, 1); Family household income: Being above or at or below the most common income band between A$60,000 and A$70,000 (0,1); Degree of urbanization: Major urban versus non-major urban (0,1); Being from an English-speaking background (0,1); Big Five personality traits in 2005: Being above versus below the median of 4 (on a 7-point scale) for each of the five personality domains, respectively (5 $\times$ 0,1). Out of 192 individuals in the treatment group, we found a perfect match for 112 adolescents (58%). The means of all relevant pre-treatment covariates which are not balanced before matching (Table A.1, Supplementary data) are well balanced between the treatment and the control groups after matching (Table A.2, Supplementary data).

cussion of these assumptions). These assumptions may be violated, specifically the latter of no remaining unobserved heterogeneity. Instead of conditioning on the lagged dependent variable, we therefore also estimate a fixed effects model as an alternative specification in which we regress changes in personality trait j between time periods t and $t+1$ ($\triangle PT^j_{i,t+1} = PT^j_{i,t+1} - PT^j_{i,t}$) on changes in all time-varying regressors between time periods t and $t+1$ (T=2):

$$\triangle PT^j_{i,t+1} = \alpha^j_1 \triangle U_{i,t+1} + \triangle Z'_{i,t+1}\gamma^j + \triangle \varphi^j_{i,t+1}. \quad (4)$$

First-differencing the data allows us to eliminate the influence of all baseline control variables and all remaining unobserved time-invariant factors (μ^j_i) that correlate with $U_{i,t+1}$ and thus confound the parameter estimate of α^j_1. Under the assumption of zero covariance between $\triangle U_{i,t+1}$ and $\triangle \varphi^j_{i,t+1}$, α^j_1 identifies the causal effect of university education on changes in NCS. As we control for changes between t and $t+1$ in the most common period-specific life events and other individual choice variables through $\triangle Z_{i,t+1}$ (life events, work experience, health), we reduce the possibility of a residual correlation between $\triangle U_{i,t+1}$ and $\triangle \varphi^j_{i,t+1}$.[9] Because of data limitations, we are not able to estimate a dynamic fixed effects model which would additionally allow us to control for a lagged dependent variable, and thus for previous NCS inputs.

4 Study Design

4.1 The Australian tertiary education sector

We evaluate the impact of university education on NCS development from the perspective of the Australian tertiary education sector. The Australian higher education system consists of inde-

[9] Note, fixed effects estimation comes at a cost of inefficiencies, and thus standard errors are often too large to identify significant effects, especially in smaller sample sizes.

pendent, self-governing public (38) and private (3) universities and institutions that award higher education qualifications. The Australian Government regulates the tuition fees universities can charge and subsidizes both teaching and research activities. Core teaching activities are subsidized in the magnitude of 0.95% of GDP in Australia, which is a higher contribution than in Britain (0.8%), but lower than in the United States (2.15%) (see OECD 2013, Table B2.4). Although students pay tuition fees for their university degree, they do not face the same credit constraints as students in Britain or the US because of the existence of the Higher Education Credit System (HECS). The financial incentive to invest into a university degree in Australia is comparable to the incentives in Britain, but lower than in the US.[10] Similar to the British and US American tertiary education sector, Australian universities select students mainly on the basis of standardized high-school entry exams.

Australian university life is characterized by a large degree of diversity because of a high proportion of international students and students in postgraduate training. Almost a quarter of all on-shore students are international students, which is large in comparison to both the US (7%) and Britain (17%). International enrollments in Australia capture 8% of global share, ranking fifth world wide after the US, Britain, France, and Germany. Although postgraduate training is among the most expensive in the world, a quarter of all students study for post-graduate degrees in Australia, the same number as in the US, while the proportion is only 17% in the UK. However, full-time students are less frequent in Australia (70%) and Britain (67%) than in the US (80%) (see Moodie 2015, for a review).

In contrast to the US, liberal arts colleges and degrees do not exist in Australia (and Britain).

[10]For instance, the internal rate of return (IRR) for a man who obtained a university degree in Australia, as compared with a man attaining upper secondary or post-secondary non-tertiary education is 9%, similar as for a man in Britain (8.2%), but lower than for a man in the US (12.3%) (see OECD 2013, Table A7.3a).

The idea of liberal arts degrees is to provide students with a focus one major in combination with general education courses in other basic subjects (e.g. philosophy, music).[11] Yet, in the past decade, almost all of Australian universities have started to offer combined science and arts degrees as an attempt to give students greater flexibility, and a wide palette of skills transferable to almost any industry.

In contrast to British and US American universities, the majority of Australian students live in capital cities (almost 80%) and many live with their parents (35%), while only 5% live in colleges or residential halls. Over 60% of students rely on a wage to finance their studies.[12]. Australian student life is less focused on campus than for instance in the United States or Britain, which implies that every-day life changes less for the average Australian student than for the average British or US student. We would therefore expect that the contribution of university education on NCS formation may be stronger in other countries than in Australia.

4.2 The Data

To conduct our analysis, we use data from the Household, Income and Labour Dynamics in Australia (HILDA) Survey. The first wave of the annual survey began in 2001 with 19,914 panel members from 7,682 households, with a top-up sample of 5,477 individuals from 2,153 households in the eleventh wave (Summerfield et al. 2013). It collects information on a wide range of household and individual characteristics, such as labour market dynamics, household income and formation, self-assessed well-being and other health-related outcomes, educational background of both the participants and their parents, lifestyle and values. Of particular interest to our analysis is a mod-

[11]Liberal arts degrees aim at helping students to think deeply about their major choice, and the programs encourage collaboration and mentorship. For an excellent review of the nature of liberal arts degrees see Deanie Vallone (2013).

[12]These statistics are derived from a survey conducted by the Australian Bureau of Statistics (2013).

ule on personality traits that was collected as part of the self-completion questionnaires in waves 5, 9 and 13. We restrict our analysis to nine waves of data collected between 2005 and 2013.

There are 758 adolescents in the HILDA observed in wave 5 (2005) and wave 13 (2013) who were between 15 and 19 years of age in wave 5 and gave full information on their personality traits and education. We lose 17% because they did not complete information on their personality traits or education in wave 13 and another 6% either due to missings in the control variables or because of sample restrictions described below. This leaves us with an estimation sample of 575 adolescents. Summary statistics of all variables used in the analysis are reported in Table 1.

[Insert Table 1 here]

Non-cognitive skills (NCS): We use the the Big-Five Personality Inventory (Goldberg 1992, 1993) collected in waves 5, 9, and 13 to proxy NCS. Of the 40-item Trait Descriptive Adjectives in Saucier (1994), 30 are included in the version used in the HILDA Survey, with an additional six from different sources. Respondents were asked to self-assess on a seven-point scale the degree to which each adjective describes them, with 1 indicating "not at all" and 7 indicating "very well". Of the 36 items, only 28 are used in the derivation of the five personality scales (extraversion, agreeableness, conscientiousness, emotional stability, and openness to experience). Eight items are not used after testing for item reliability (e.g. an item was omitted if the highest factor loading was not on the expected factor). The distribution of most traits is left-skewed, which means that a larger proportion of the sample agrees with the statements about their personality underlying each trait (See Cobb-Clark and Schurer 2012; Elkins et al. 2017, for a detailed description). We standardize each measure to mean 0 and standard deviation of 1.

University education: Whether an individual has university education is derived from information provided about the highest level of education attained and whether the individual is currently studying in any year between 2005 and 2013. We distinguish between two types of university education status: (1) degree completion by 2013, where a degree includes bachelor/honors, a graduate diploma or certificate, or postgraduate training, or (2) a combination of degree completion by 2013 or still studying in 2013 with at least two years at university. We dropped six individuals who were at university for the first year in the year 2013 and 24 individuals who had been at university before 2005. According to this definition, 192 individuals (33%) are or will be university graduates.[13] We observe a large degree of heterogeneity in university participation, where only 25% of adolescents from a disadvantaged background will enter the university track, while 50% do so from advantaged backgrounds. The non-university group comprises individuals who obtained some post-secondary training (teaching college diploma (8%), vocational training certificate (29%)) or who completed Year 12 (42.5%), or completed year 11 or dropped out of high school (19.5%). Hence, we compare NCS between adolescents who entered university training with adolescents who had either vocational training after high school completion or no addition qualification.

Control variables: We control for baseline characteristics measured in 2005 before adolescents potentially enter university. Since our baseline personality traits are measured at different

[13]This includes 29 individuals who had just started university in March 2005 when they were interviewed, assuming that the time period at university was too short to have affected baseline NCS. There are 60 individuals in the non-university group who reported to have been enrolled in some form of tertiary education between 2006 and 2012 but who were neither at university in nor did they complete a degree by 2013. Of these 60 - what we refer to as university drop-outs - 27 provided the name of the university and their field of study. As the majority of the university dropouts stayed at university for less than two years, we left them in the non-university group. However, in a robustness check we omitted the 27 individuals for whom we could corroborate that they really studied at a university from the analysis. We are able to show that our main conclusions are not sensitive to omitting these observations. These results are provided upon request.

stages of the adolescent lifecycle, we control for age by including dummy variables for each age-group (relative to age 15). This is an important set of control variable, because previous research has shown that some personality traits rapidly change during adolescence (Elkins et al. 2017).[14] We further control for gender, country of birth (Australia, English-speaking country, any other country), region of residence (major urban area versus rural), state of residence, socioeconomic status of the father, and health. Although, we have no information on parental input factors in the skill production function, we use parental socioeconomic status to proxy parental attitude to education, past educational inputs and resource constraints. Socioeconomic status is measured both by the Australian Socioeconomic Index 2006 (AUSEI06) occupational status scale (McMillan et al. 2009) - referred to as Father Occupational Prestige Score (FOPS), and household income bands. The FOPS scale is derived from the first edition of the Australian and New Zealand Standard Classification of Occupations. The reference point for the classification is when the individual was aged 14, or, if the father was not in employment or dead then, the classification would be based on any previous employment. Our FOPS measure is bound between 0 (lowest status) and 100 (highest status), and we standardize it to mean 0 and standard deviation of 1. Values of 70 and above indicate high-skilled occupations (professional, managerial, and legislative), while values of under 30 indicate low-skilled occupations (elementary and manual). In a robustness check we explore alternative definitions of FOPS based on quartiles of the FOPS distribution or occupational skill levels.

To capture further differences in previous educational inputs, we control for the type of high school from which the individual graduated (Public, Private Catholic, Private Independent) as a

[14]Strictly speaking, our baseline measures of personality traits are not measured just before our sample members potentially enter university, which is particularly true for our youngest sample members. We assume that a non-linear control for age difference at baseline assessment captures a non-linear age trend in NCS maturation, so that all remaining differences are measurement error only.

crude proxy for quality. Finally, we also control for physical health status (SF-36 (Ware Jr 2000)), because health problems are important input factors into the skill production function of adolescents and young adults (Elkins et al. 2017; Fletcher and Schurer 2017).

It is possible that the decision to go to or complete university is affected by family-, employment- and health-related life events that also affect the maturation of NCS. We therefore control for a battery of life events that occurred in any time period after baseline to capture time-varying shocks. Similar to Elkins et al. (2017) and Cobb-Clark and Schurer (2012), we exploit a battery of positive (e.g. marriage, job promotion, birth of a child) and negative (e.g. death of a family member, unemployment) life events that the HILDA survey collected annually since 2002. Some of these events are under individuals' control, however, others are not (e.g. death of a spouse, becoming a property-crime victim). A full list of these life events is presented in Table 1. Finally, we control for the accumulated work experience of each individual either during or after graduation to ensure that changes in NCS are not driven by post-education-specific work experiences.

University type and degree of study. An important component of our analysis is the exploration of heterogeneity in the effect of university education by the type of university or by degree as a potential mechanism through which university affects NCS. In 2012 of the HILDA survey, participants were asked to provide information on the name of the university where they graduated from and their field of study. We follow Norton and Cherastidtham (2014) to group universities according to their self-identified group membership which is a crude measure of their research intensity and teaching focus. In our sample, 176 out of 192 youth who completed or entered the university track provided information on which university they study or studied at, and 188 provided information on their field of study.

The Group of Eight (Go8) universities market themselves as "Australia's Leading Universi-

ties", because they are ranked as the top eight performers in national research evaluations and international standing. The Go8 universities provide general training in all sciences including medical training and the Australian equivalent of liberal arts degrees.[15] The Australian Technology Network (ATN) is a coalition of five universities that share a common focus on the practical application of tertiary studies and research. The members of this network distinguished themselves as technical colleges before they became accredited as universities. The group of Innovative Research Universities (IRU) comprises seven young universities that share a common mode of operation and a common background, all of which have been founded in the 1960s and 1970s as research universities. The Regional Universities Network (RUN), which comprises six universities, was formed in 2011 to provide tertiary training in remote areas, and to build research expertise in agriculture, fisheries, and environmental science. Finally, there are six universities that do not belong to any network ("Other universities"), some of which are highly-ranked in terms of their research quality.[16] In our sample there are no individuals who received their university education overseas. The majority of students obtained their degree from, or currently study at, a Go8 (31.8%), other (27.3%), or IRU institution (20%). Only 14.2% and 6.8%, respectively obtained their degree from an institution of the ATN and RUN. The field of study classification is based on the Australian Standard Classification of Education (ASCED) (Australian Bureau of Statistics 2001). University students or graduates are grouped into five broad groups: (1) Science, Technology, Engineering or Mathematics (STEM), which includes Architecture and Environment and Agriculture (18%); (2) Medicine, Nursing, and other health-related studies (21%); (3) Education

[15]For instance, Monash University, University of Sydney, and University of Adelaide offer a Bachelor of Arts and Sciences, a double degree that takes four instead of the common three years of duration to complete.

[16]Deakin University, University of Tasmania, University of Wollongong, or Swinburne University of Technology, which are part of this network rank in the top 17 of Australia's university ranking according to the 2012 Excellence in Research for Australia (ERA) initiative.

(13%); (4) Management, Commerce, and Law (23%); (5) and Society and Culture, Creative Arts and Food and Hospitality which we refer to as "Other" (25%).

4.3 Descriptive analysis of NCS trends

Figure 1 describes the trends in each of the five NCS over three measurement periods (2005, 2009, 2013) separately for the university entrants (triangle) and non-university entrants (square). Each symbol represents the mean level in personality trait j and capped lines illustrate their 90% confidence intervals. Individuals in the non-university group start out at a higher level of extraversion in 2005 than individuals in the university group, however a different trend emerges for the two groups over the next eight years (Figure 1(a)). Extraversion scores continuously decline for individuals in the non-university group, and the difference of 0.2 units between their 2005 and 2013 extraversion score is statistically significant. In contrast, the extraversion scores remain constant for individuals in the university group until 2009 and then they slightly increase - although not significantly - in 2013. These differential trends lead to a reversal in level rankings in extraversion over the eight-year window. The gaps in all other NCS between university and non-university entrants remain relatively constant over the eight-year time period (Figure 1(b)-1(e)), although university entrants score consistently higher on all four skills before they enter university.[17]

[17]We cannot say whether the changes between 2005 and 2009 represent the trends in the pre-university period, because most of the adolescents in the university group have entered university already by 2009. We have conducted an informal test on a sample of 32 individuals who will go to university but who have not done so yet by 2009. For this small sample, we can exploit the changes between 2005 and 2009 as pre-university trend and compare this pre-university trend against the trend of the non-university group. For all five personality traits, the changes over the four-year window are not statistically significant for any of the two groups - a result that is consistent with the findings in Cobb-Clark and Schurer (2012) - and they do not differ between the two groups. Although this is not a sufficient test to completely rule out differential growth trends between university and non-university group pre-university, it is tentative evidence against the differential pre-university trend hypothesis.

[Insert Figure 1 here]

Figure 2 reveals important heterogeneities in levels and changes in NCS by socioeconomic status (below versus above the median value on FOPS) for agreeableness. Figure 2(b) shows that agreeableness scores increase for all adolescents between 2005 and 2013 independent of their SES and education choice. However, high SES adolescents who will enter university start out at the highest level of agreeableness (5.25), while their growth trajectory is the weakest. In contrast, low SES adolescents start out with the lowest levels of agreeableness in 2005 independent of whether they will enter university (5.10). Yet, low SES adolescents who will enter university experience the steepest growth in agreeableness by 0.5 units over the next eight years. In 2013, their agreeableness scores are 0.2 units higher than the scores of high SES adolescents who enter university.

[Insert Figure 2 here]

Figure 2 further reveals the strong self-selection into university by conscientiousness for low SES adolescents who will enter university. At baseline, they score already highest in conscientiousness (4.85), exceeding the scores of all other adolescents by between 0.3 and 0.4 units. This is tentative evidence that conscientiousness may be a key determinant of upward mobility (Figure 2(c)). Furthermore, low SES adolescents who will not enter university score lowest scores on emotional stability and openness to experiences at baseline (Figures 2(d) and 2(e)). Yet, growth trends in these NCS are similar for all groups, and thus gaps in NCS by 2013 are the same as in 2005.

In the next section, we test whether differences in the levels of the five personality traits between university and non-university groups in 2013 still remain when conditioning the analysis on starting levels of personality traits in 2005, before the adolescents potentially enter university, and all other relevant input factors into the adolescent skill production function.

5 Estimation results

5.1 Impact of university education on NCS development

To test whether university education shapes NCS skills, we first present the estimation results based on the value-added model described in Eq. (3). The estimated parameters of interest are reported in Table 2. Full estimation results are reported in Table A.3 in the Supplement. The estimation sample includes 575 adolescents who were aged between 15 and 19 in 2005. The dependent variable is personality trait j measured in 2013, standardized to mean 0 and standard deviation of 1. UNI measures whether the sample member completed a university degree or has entered the university track more than one year ago by 2013 (192 individuals). The reference group comprises individuals who went on to either some form of vocational training outside the university track or who did not complete any form of post-secondary training.

[Insert Table 2 here]

Panel A (Without interaction term) shows that university education is significantly associated with extraversion, whereby extraversion scores in the university group are almost one-third of a standard deviation (0.29 SD, SE 0.09) greater than the average score in the non-university group, ceteris paribus. Yet, university education is not associated significantly with any other

NCS for the average adolescent. Almost identical estimates of the effect of university education on extraversion are obtained when using the CEM approach (0.26 SD, significant at the 10% level) based on 113 matched pairs for which all observable characteristics are well balanced between university and the non-university groups (Tables A.2 and A.4, Supplementary data).

Panel B (With interaction term) presents the estimation results of a model in which we interact UNI with a continuous measure of the father's occupational prestige score (UNI $\times$ FOPS). As we standardize the paternal occupational class score to mean 0 and standard deviation 1, the coefficient on this interaction term is interpreted in terms of 1 SD increase away from the zero mean. A 2-SD up- and downward movement away from the mean implies that the father worked in a high-skilled (professional, managerial) and low-skilled occupation (manual, elementary), respectively.

Our conclusions do not change for extraversion, because the interaction effect is zero both in size and significance (0.02 SD, SE 0.08). However, we find a statistically significant interaction effect for agreeableness in the magnitude of -0.23 SD (SE 0.09). Therefore, the marginal effect of university education for adolescents whose fathers rank 1 SD below the mean FOPS (lower levels of SES) score by 0.24 SD higher on agreeableness, while adolescents whose fathers rank 1 SD above the mean FOPS (higher levels of SES) score by 0.21 SD lower on agreeableness. Again, university education is not associated with conscientiousness, openness to experience, or emotional stability in the interaction model.

When controlling for individual-specific, time-invariant heterogeneity by exploiting changes in NCS between 2005 and 2013 and changes in all time-varying covariates, our conclusions remain unchanged (Panels C and D). The effect of university education on extraversion remains large and statistically significant in the first-difference model without (0.26 SD) and with interaction

effects (0.25), respectively. The heterogeneous effects of university education on agreeableness for students from low (0.12 SD) and high (-0.19 SD) SES backgrounds are similar to the ones obtained from the value-added model (Panel D), although the effect is halved for adolescents from low SES backgrounds.

As demonstrated in Figure 2(b), differences in agreeableness scores that emerge between university entrants from high and low SES stem from the observation that youth from disadvantaged backgrounds start from the lowest levels and experience the steepest growth. Adolescents from privileged backgrounds start at the highest levels of agreeableness but experience no growth during university education. One explanation that is consistent with the observed data is that for low SES adolescents university education changes the environment and peer groups more dramatically than for high SES students, and thus low SES students are more likely to adapt their behavioural styles governing interpersonal relationships in response to this change.

We are able to demonstrate in a series of robustness checks that our results for extraversion and agreeableness are not driven by the strong assumption underlying the linear and symmetric specification of the interaction effect between FOPS and university education. Using non-parametric estimation methods (Figure A.1, Supplementary data) or discrete categories for father's socioeconomic status (Table A.6, Supplementary data), reveal the same patterns as described above. We further demonstrate no systematic differences in the impact of university education by gender (Table A.5).

5.2 Potential mechanisms

So far, we have demonstrated a positive and robust link between university education and extraversion, and agreeableness for youth from disadvantaged backgrounds. In Section 2, we hy-

pothesized that youth from disadvantaged backgrounds might be more affected by university education because they experience a bigger change in peer groups and in extracurricular activities available to them.

Another mechanism through which university education may shape NCS is through specific course contents or university-specific teaching programs or quality. To test for this mechanism, we re-estimated the value-added model by regressing personality trait j in 2013 on a set of dummy variables that each captures one of the five university groups (Panel A) or a set of dummy variables that represent the field of study if the individual attends or has completed university education (Panel B). Table 3 reports the estimated coefficients for a model without interaction effects.

[Insert Table 3 here]

Overall, we find little systematic differences in the effect of university education by university grouping (Panel A). The effect of university education on extraversion - which stands out as the most important effect from our previous analysis - is equally strong across all universities. In magnitude, the effect is strongest for students who study at one of the OTHER universities (0.37 SD, SE 0.12), and weakest for students at one of the IRU universities (0.15 SD, SE 0.15). We conducted an F-test of equality of differences in means across all university groups, and fail to reject the null hypothesis.[18] We also find little evidence that the effect of university education on NCS differs by field of study (Panel B).[19]

We conduct another test to confirm that the effects we are measuring are attributable to university education and not to other unobserved factors. If on average university education truly

[18]One exception to previous results is that the effect of university education on openness to experience is positive and significant for Go8 university students (0.28 SD, SE 0.12) and zero for all other university types.

[19]The effect sizes vary slightly for extraversion across field of studies, but the we fail to reject the null hypothesis that the means are the same across all groups.

builds extraversion for all students and agreeableness for students from disadvantaged backgrounds, then we should find that the longer a student has spent at university, the greater this impact should be. We re-estimated the value-added model including years of exposure to university education, a variable which varies between 0 and 8 years, as a dose indicator for university exposure. We find that every additional year spent at university is associated with a 0.07 SD (SE 0.02) increase in extraversion and a 0.10 SD (SE 0.06) increase in agreeableness for youth from low SES backgrounds.[20] Hence, the length of exposure to university life contributes to NCS formation.

We conclude that a likely channel through which university education contributes to changes in agreeableness for youth from disadvantaged backgrounds is exposure to new peer groups and/or extracurricular activities. Furthermore, it is possible that agreeableness and in particular extraversion are shaped through exposure to new learning environments that place higher demands on NCS. We did not find evidence in support of mechanisms related to degree- specific content or teaching styles.

6 Discussion and conclusion

Recently, a public debate has emerged on whether universities teach the right skill-sets that prepare students for a continuously changing and globally expanding labour market. Employer surveys have shown that non-cognitive skill are valued highly by employers, but leading scholars emphasize that university education falls short of teaching students such skills. Yet, no empirical evidence exists on the matter.

We contribute to this discussion by providing a first empirical glance at the role that university education plays in the skill production function of adolescents. Following the education decisions

[20] Full estimation results are provided upon request.

of a sample of Australian youths from 2005 until 2013 and controlling for the self-selection by NCS into university education and other important factors in the skill production function as best as we can given our survey data, we find robust evidence that Australian universities contribute to building sociability (extraversion) and tendencies to cooperate (agreeableness).

Youth who enter the university track or complete tertiary education have significantly higher levels of extraversion. Importantly, this effect does not differ by gender, university type or field of study. Despite the strong self-selection into university type and field of study and the heterogeneity in teaching quality and curriculum across universities, we suggest that the likely mechanisms through which university education shapes outward orientation is through exposure to university life and less so through quality and what is being taught in class. University education may foster these tendencies because it encourages participation in club activities, social functions, and communication with fellow students and academic staff on a continuous basis. This conclusion is strengthened by the finding that years spent at university is positively associated with extraversion. We propose therefore that university education may be associated with higher earnings because university education shapes sociability skills which also have high labour-market returns (Fletcher 2013; Heineck and Anger 2010).

In addition, university education is associated with higher levels of agreeableness for both male and female students from low socioeconomic backgrounds, who started from the lowest baseline scores in adolescents and experienced the steepest growth curve as they entered university. This implies that students from disadvantaged backgrounds catch up with their peers from more privileged backgrounds, thus reducing initial levels of inequality in agreeableness. This is likely due to exposure to new peer groups and/or extracurricular activities. This convergence in agreeableness may have important welfare effects, because agreeableness has been linked to

reciprocity and altruism (Becker et al. 2012) and prosociality (Hilbig et al. 2014), economic preference which are considered to be at the basis of socio-economic development (e.g. Bigoni et al. 2016) and population wellbeing (Post 2005). Therefore, the benefits of university education is not only that it increases individuals' employability and earnings, but that it may directly contribute to the formation of socially-beneficial preferences (see Arrow 1997, for similar arguments).

We cannot say with certainty whether these effects are permanent or temporary, because our data does not provide long-term follow up personality data. Our findings support the conclusion that Australian universities are at least in the short run successful in shaping life skills which employers and society value. The skill-returns of university education and its psychic benefits are substantial for youth from disadvantaged backgrounds. The public discourse is therefore misguided on claiming that university education does not contribute to human capital formation.

Second, the current policy focus on early childhood education to boost non-cognitive skills (see Kautz et al. 2015, for a review) may be too narrow. Our findings suggest that non-cognitive skills can still be shaped at later stages as suggested in Schurer (2017) who summarizes such evidence for the post-primary school sector. We conclude that interventions in the secondary or tertiary education sector may be a promising avenue to boost non-cognitive skills. Future research that identifies the exact channels through which university attendance impacts upon skill formation, for instance the role of peer effects or the impact of teaching innovations or curriculum reforms that universities trial, could provide useful information for universities who seek to strategically target their students' NCS development.

Supplementary material

The HILDA data used in this paper is confidential and approval has to be granted by the Australian Government Department of Social Services. However the replication files are available online on the OUP website. An online appendix is also available as supplementary material.

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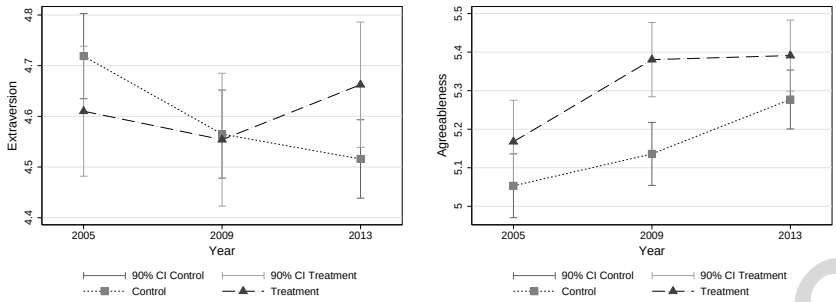
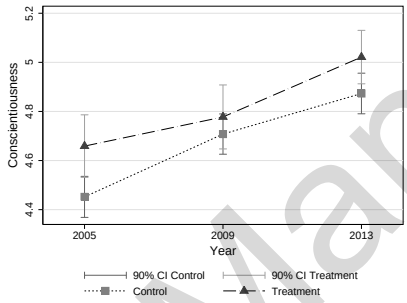
Figures

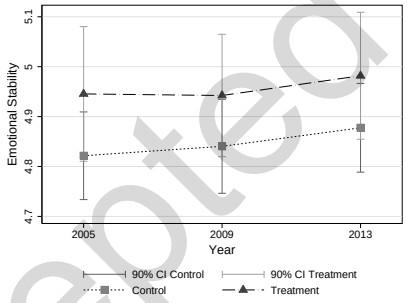


(a) Extraversion

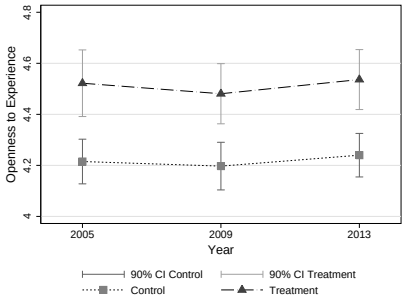
(b) Agreeableness



(c) Conscientiousness

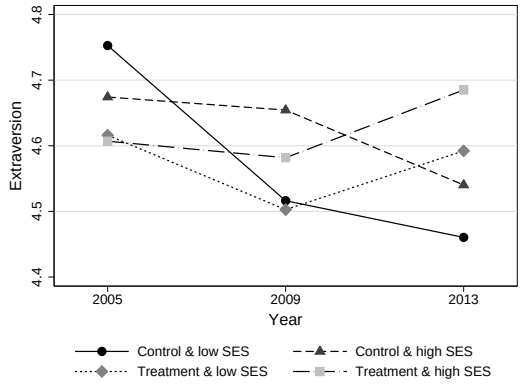


(d) Emotional stability

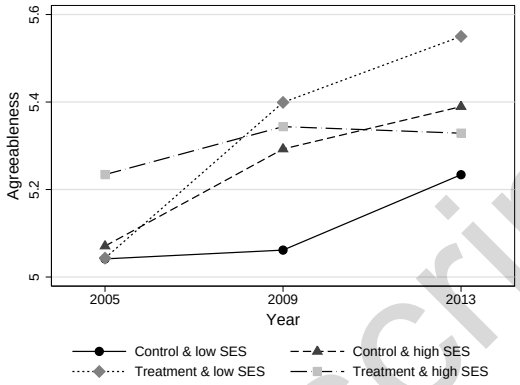


(e) Openness to experience

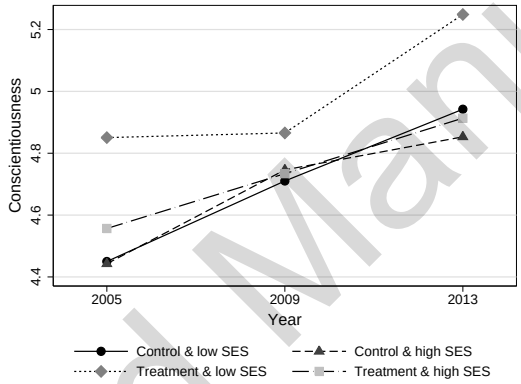
Figure 1: Distribution of personality traits by university status (treatment versus control group) from 2005 to 2013



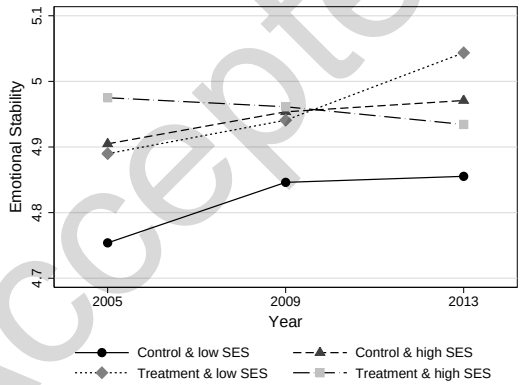
(a) Extraversion



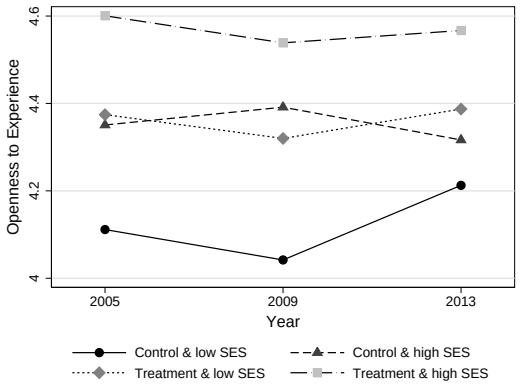
(b) Agreeableness



(c) Conscientiousness



(d) Emotional stability



(e) Openness to experience

Figure 2: Distribution of personality traits in 2005, 2009, and 2013 by university status (treatment versus control group) and SES

Tables

Table 1: Summary statistics of all control variables

	mean	SD	min	max
Extraversion 2013	4.55	1.02	1.7	7
Agreeableness 2013	5.34	0.91	1	7
Conscientiousness 2013	4.94	1.02	1.2	7
Emotional stability 2013	4.93	1.11	1.7	7
Openness to experience 2013	4.34	1.05	1	7
Extraversion 2005	4.68	1.00	1	7
Agreeableness 2005	5.10	0.93	1	7
Conscientiousness 2005	4.52	0.99	1.2	6.8
Emotional stability 2005	4.84	1.05	1.8	7
Openness to experience 2005	4.32	1.04	1	7
At university	0.33	0.47	0	1
FOPS	49.17	23.60	4.9	100
FOPS missing	0.09	0.28	0	1
$0 \leqslant \text{FOPS} \leqslant 30$	0.23	0.42	0	1
$30 < \text{FOPS} < 70$	0.42	0.49	0	1
$70 \leqslant \text{FOPS} \leqslant 100$	0.26	0.44	0	1
Age	24.73	1.38	23	27
Female	0.55	0.50	0	1
Country of birth				
Australia	0.95	0.22	0	1
Other English speaking	0.02	0.12	0	1
Other non-English speaking	0.04	0.19	0	1
Geographic region				
Major urban	0.67	0.47	0	1
Non-major urban	0.33	0.47	0	1
Type of secondary school				
Government school	0.67	0.47	0	1
Catholic non-government school	0.19	0.39	0	1
Other non-government school	0.13	0.34	0	1
Other	0.01	0.10	0	1
Life events since 2005				
Got married	0.14	0.35	0	1
Separated from spouse	0.27	0.45	0	1
Pregnancy	0.22	0.42	0	1
Birth/adoption of new child	0.18	0.38	0	1
Serious personal injury/illness	0.25	0.43	0	1
Serious injury/illness to family member	0.44	0.50	0	1
Death of close relative/family member	0.46	0.50	0	1
Death of a close friend	0.32	0.47	0	1
Victim of a property crime	0.28	0.45	0	1
Fired or made redundant	0.25	0.44	0	1
Changed jobs	0.77	0.42	0	1
Promoted at work	0.38	0.49	0	1
Changed residence	0.78	0.42	0	1
Years in paid work between 2005 and 2013	6.30	0.94	0	7.8
Difference in physical functioning between 2005 and 2013	0.89	20.05	−95	100
University group				
Go8	0.32	0.47	0	1
ATN	0.14	0.35	0	1
IRU	0.20	0.40	0	1
RUN	0.07	0.25	0	1
Other	0.27	0.45	0	1
Field of study				
STEM	0.18	0.39	0	1
Medicine and health related	0.21	0.41	0	1
Education	0.13	0.34	0	1
Management, Commerce, Law	0.23	0.42	0	1
Others	0.25	0.43	0	1
Observations	575			

Note: Estimation sample is 575 teenagers who were aged between 15 and 19 in 2005.

Source: HILDA, waves 5 and 13.

Table 2: Estimated effects of university participation on Big-Five personality traits: Value-added and fixed effects models

	Extrv	Agree	Consc	Emote	Openn
Value-added model (N = 575)					
Panel A: Without interaction term					
UNI	0.292***	−0.023	0.021	0.018	0.101
	(0.085)	(0.080)	(0.079)	(0.084)	(0.085)
R^2	0.40	0.26	0.33	0.27	0.31
Panel B: With interaction term					
UNI	0.289***	0.019	0.026	0.028	0.107
	(0.087)	(0.078)	(0.080)	(0.087)	(0.087)
UNI × FOPS	0.018	−0.225***	−0.025	−0.053	−0.033
	(0.078)	(0.085)	(0.080)	(0.083)	(0.082)
Marginal effect for adolescents from high and low SES					
High	0.306***	−0.206*	0.001	−0.024	0.074
Low	0.271**	0.244**	0.051	0.081	0.140
R^2	0.40	0.27	0.33	0.27	0.31
First-difference fixed effects model (N = 575, T = 2)					
Panel C: Without interaction term					
UNI=1	0.261***	−0.088	−0.113	−0.043	−0.105
	(0.093)	(0.095)	(0.096)	(0.110)	(0.105)
R^2	0.11	0.09	0.18	0.04	0.04
Panel D: With interaction term					
UNI	0.253***	−0.033	−0.118	0.009	−0.075
	(0.096)	(0.094)	(0.097)	(0.115)	(0.111)
UNI × FOPS	0.022	−0.153**	0.015	−0.145*	−0.082
	(0.077)	(0.072)	(0.074)	(0.077)	(0.078)
Marginal effect for adolescents from high and low SES					
High SES	0.274***	−0.186*	−0.103	−0.136	−0.157
Low SES	0.231*	0.120	−0.133	0.154	0.007
R^2	0.11	0.10	0.18	0.04	0.04

Note: Each model controls for the full set of control variables. Full estimation results are reported in Table A.3. The value-added model includes lagged personality traits as additional control variables. Sample includes all respondents aged 15 to 19 in wave 5. FOPS stands for Father Occupational Prestige Score. A one-standard deviation increase in occupational prestige is 23.48 points on a scale from 0 to 100.

Source: HILDA, waves 5 and 13.

* p < 0.1, ** p < 0.05, *** p < 0.01. Standard errors in parentheses.

Table 3: Effect of university education by university type and field of study

	Extrv	Agree	Consc	Emote	Openn
Panel A: Treatment effect by university type					
Go8	0.281**	−0.154	0.146	−0.157	0.281**
	(0.132)	(0.125)	(0.130)	(0.132)	(0.116)
ATN	0.282	−0.124	−0.067	0.080	0.078
	(0.193)	(0.157)	(0.190)	(0.180)	(0.190)
IRU	0.147	0.001	−0.095	0.092	−0.105
	(0.153)	(0.158)	(0.152)	(0.148)	(0.149)
RUN	0.358	0.040	0.123	−0.081	0.021
	(0.239)	(0.221)	(0.294)	(0.303)	(0.277)
Other	0.368***	0.050	0.022	0.104	0.009
	(0.124)	(0.130)	(0.112)	(0.127)	(0.148)
R^2	0.39	0.25	0.32	0.27	0.31
Observations	559	559	559	559	559
Equality of coef. (p-value)	.802	.682	.706	.470	.195
Panel B: Treatment effect by degree discipline					
STEM	0.422***	−0.220*	−0.042	−0.055	0.167
	(0.146)	(0.129)	(0.149)	(0.151)	(0.154)
Medicine and health related	0.287*	0.148	0.230	−0.155	−0.161
	(0.147)	(0.151)	(0.147)	(0.135)	(0.138)
Education	0.273	0.228	−0.020	0.303	0.043
	(0.186)	(0.151)	(0.178)	(0.199)	(0.183)
Management, Commerce, Law	0.158	−0.018	0.088	0.027	0.172
	(0.132)	(0.121)	(0.124)	(0.138)	(0.144)
Others	0.224	−0.199	−0.132	0.044	0.152
	(0.137)	(0.140)	(0.128)	(0.127)	(0.148)
R^2	0.40	0.26	0.33	0.27	0.30
Observations	571	571	571	571	571
Equality of coef. (p-value)	.657	.074	.330	.324	.315

Note: Respondents aged 15 to 19 in wave 5. In total, 176 individuals who completed or are completing their university degree provided information on their university of study and 188 provided information on their field of study. **Group of 8 (Go8)**: The University of Adelaide, The Australian National University, The University of Melbourne, Monash University, The University of New South Wales, The University of Queensland, The University of Sydney and The University of Western Australia; **The Australian Technology Network (ATN)**: Curtin University, University of South Australia, RMIT University, University of Technology Sydney and Queensland University of Technology; **Innovative Research Universities (IRU)**: Flinders University, Griffith University, La Trobe University, Murdoch University, University of Newcastle, James Cook University and Charles Darwin University; **The Regional Universities Network (RUN)**: Central Queensland University, Southern Cross University, University of Ballarat, University of New England, University of Southern Queensland and University of the Sunshine Coast; **Other**: Australian Catholic University, Australian Defence Force Academy, Bond University, Charles Sturt University, Deakin University, Edith Cowan University, Macquarie University, Swinburne University of Technology, University of Canberra, University of Notre Dame Australia, University of Tasmania, University of Western Sydney, University of Wollongong, Victoria University (Victoria University of Technology), Other (please specify). Each model controls for the full set of control variables including lagged personality measures.

Source: HILDA, wave 5 and 13.

* p < 0.1, ** p < 0.05, *** p < 0.01. Standard errors in parentheses.