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Do Universities Shape their Students' Non-Cognitive Skills?

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NON-TECHNICAL SUMMARY

Recently, a public debate has emerged on whether universities teach the right skill-sets that prepare students for a continuously changing and globally expanding labor market. Various articles from leading scholars and journalists emphasize that university education falls short of teaching students creativity, socioemotional skills, attributes of ownership, and the ability to learn on the fly. They argue that such non-cognitive skills are valued highly by employers and by society-at-large.

In this paper we contribute to this discussion by providing a first empirical glance at the role that university education plays in building non-cognitive skills, an alternative component of human capital. We follow the educational decisions and the evolution of non-cognitive skills - proxied by the Big Five personality traits and mental health - of 618 Australian adolescents over eight years. We pay particular attention to possible interactions between university education and socioeconomic status.

We find that university education has significant effects on outward orientation and mental health, and agreeableness for students from low socioeconomic status. These effects cannot be explained by individual-specific heterogeneity, time-varying life events, work experience or differences in the initial level of non-cognitive skills. The buffering effects of university education on extraversion are equally strong across all university groups and fields of study, suggesting that they are not driven by self-selection of students into specific degrees or universities.

We draw two conclusions from our findings. First, university education in Australia is successful in shaping some non-cognitive skills which employers and society value. The public discourse is misguided on claiming that universities need a major overhaul of curriculums and the way they teach students. Second, our robust findings contribute to a wider discussion that seeks to enhance non-cognitive skills through the education sector.

Our findings also suggest that non-cognitive skills can still be shaped at later stages. This conclusion may result in the possibility for targeting interventions to boost non-cognitive skills in the secondary and tertiary education sector.
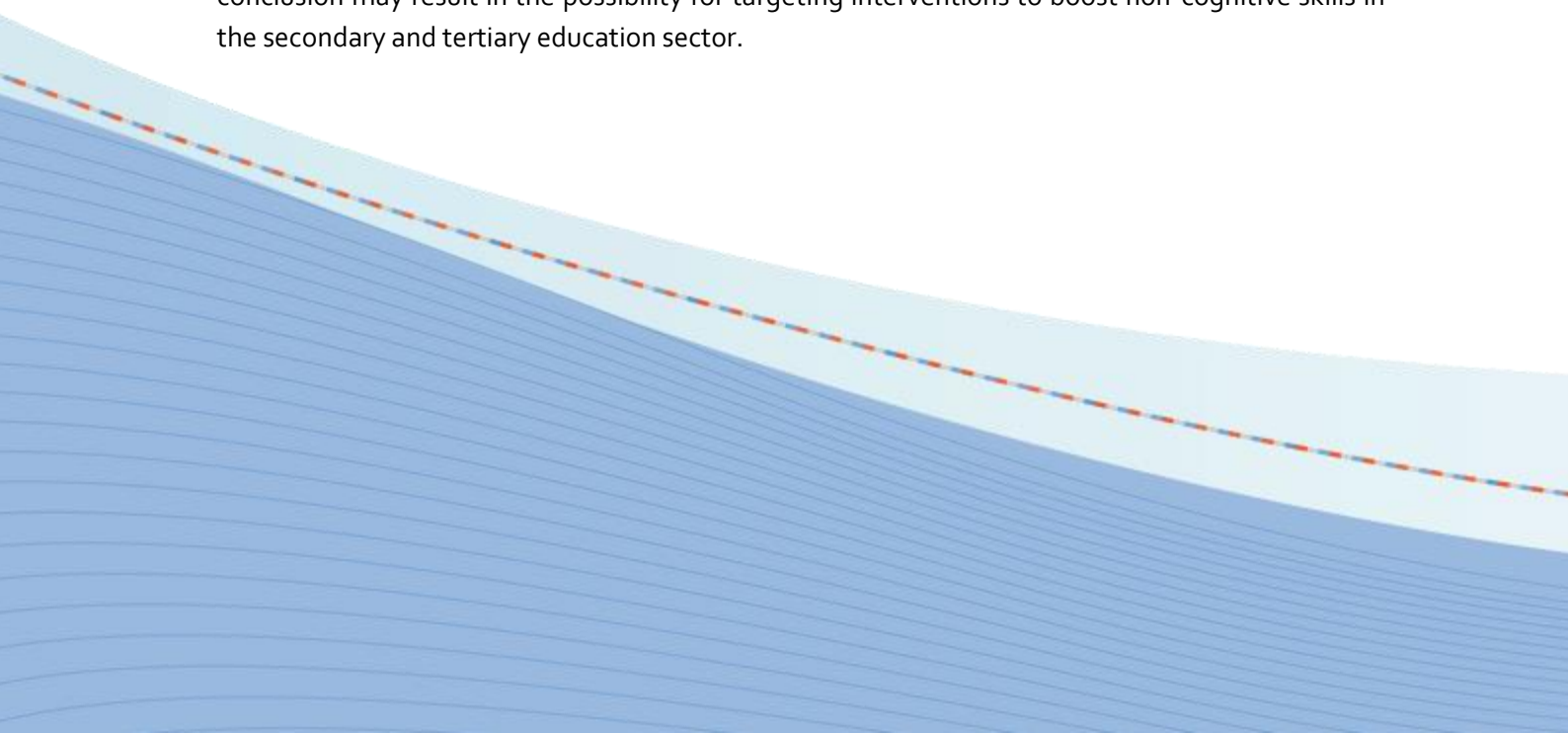
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Abstract

This paper examines the effects of university education on students' non-cognitive skills, an alternative component of human capital, using data from an Australian birth cohort. We follow the educational decisions and the evolution of non-cognitive skills - proxied by the Big Five personality traits and mental health - of 618 adolescents over eight years. We pay particular attention to possible interactions between university education and socioeconomic status. We find that university education has significant effects on outward orientation and mental health, and agreeableness for students from low socioeconomic status. These effects cannot be explained by individual-specific heterogeneity, time-varying life events, work experience or differences in the initial level of non-cognitive skills. The buffering effects of university education on extraversion are equally strong across all university groups and fields of study, suggesting that they are not driven by self-selection of students into specific degrees or universities.

1 Introduction

The primary goal of university education is to teach students mastery of an academic subject with the aim to provide the necessary human capital for a growth-oriented and innovative economy (Delbanco 2012; DeVitis 2013). However, employers value in their employees also general skills that are often referred to as non-cognitive skills (NCS). Behavioral styles that indicate sociability, conscientiousness or intellect have high labor market returns and are associated with higher productivity at the workplace (see Almlund et al. 2011, for an overview of the literature). We study whether university education helps to shape NCS of an Australian birth cohort. Although numerous proxies for adulthood NCS have been considered in the literature, we use the Big Five personality traits - Openness to Experience, Conscientiousness, Extraversion, Agreeableness, Neuroticism - which are widely accepted as a meaningful and consistent construct for describing individual differences by psychologists (Goldberg 1992, 1993).[1] We pay particular attention to the possible heterogeneity in the treatment effect of university education and NCS, such as socioeconomic status (SES), gender, university type, and field of study.

The digital age and globalization arguably have changed the composition of the skill-sets sought after by employers relative to the skill-sets that made an employee productive in the post industrialization era. Many jobs that used to require training in apprenticeships require today a university degree. As a result, almost a third of each birth cohort obtain a tertiary qualification

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[1]It has been shown that these Big-Five personality traits have value to employers. Facets of the Big Five personality traits have been linked with job performance (Judge 1999). Higher wages are generally associated with higher scores on the openness to experience scale (Heineck and Anger 2010; Mueller and Plug 2006), although the productivity gains of openness to experience reported in Heineck and Anger (2010) disappear when exploiting the longitudinal nature of their data. Higher scores on the agreeableness and neuroticism scale are associated with lower wages (Fletcher 2013; Heineck and Anger 2010; Mueller and Plug 2006; Nyhus and Pons 2005). Conscientiousness improves school performance and health behaviors (Roberts et al. 2007), it has also been shown to boost wages at the start of young people's careers (Fletcher 2013; Nyhus and Pons 2005). Gensowski (2014) has shown that the impact of conscientiousness on wages is furthermore increasing with age and education, as is the positive role of extraversion.

in Australia and in other countries of comparable economic development (OECD 2013). Despite this great demand for the services provided by universities, critics contend that universities no longer teach the right skill-set that a modern economy needs.

For instance, journalists Laura Pappano and Thomas L. Friedman suggested that universities should teach their students creativity[2], humility, leadership, and the ability to learn on the fly.[3] Katie Allen criticized British universities, claiming that their undergraduate degrees lead only to high student debt and under-employability.[4] David Docherty, the chief executive of the UK Council for Industry and Higher Education, suggested that universities should provide society with people who have the ability to "continually learn, to think critically and theoretically, to be reflective and reflexive, to innovate and break the status quo, and to navigate in the unstable waters of the global economy".[5] Nicholas Biddle and Sarah Bell called for a new approach to measure and teach skills in the Australian education sector, suggesting that NCS should be the focus of such reform effort.[6]

These commentators may have a point. For instance, each year Graduate Careers Australia surveys graduate employers about their recruitment intentions and the quality of graduate applicants. 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". In 2013, more than 20 per cent of employers reported that they would have recruited more graduates had a larger number of better candidates been available

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[2]"Learning to Think Outside the Box", New York Times, 5 Feb 2014.

[3]"How to Get a Job at Google", New York Times, 22 Feb 2014. Psychologist Adam Grant suggested that colleges should recruit creative students who have strong character traits and emotional skills rather than focussing on grade-point averages. "Throw Out the College Application System", New York Times, 4 Oct 2014.

[4]"UK graduates are wasting degrees in lower-skilled jobs", The Guardian, 19 August 2015.

[5]"Employability: university education isn't just about developing skills", The Guardian 5 April 2012.

[6]"School should be about more than just measuring intelligence", The Conversation, 17 December 2014.

(Graduate Careers Australia 2014, p. 6). Many Australian universities seek to build graduate attributes that include non-academic personal traits attractive to employers. However, according to Norton and Cherastidtham (2014, p. 69), "it is not clear how actively universities develop these traits through their courses or other aspects of university life".

To date there is indeed little empirical evidence on whether universities actively shape their students NCS.[7] Most of the literature focuses on the skill-building effects of pre-school programs (e.g. Chetty et al. 2011; Heckman et al. 2010, 2013). Some studies evaluate the skill building effects of class-room interventions (Kautz and Zanoni 2014) or institutional changes (Dahmann and Anger 2014; Dee and West 2011) in the secondary education sector. Lundberg (2013a) explores the relationship between character traits and the probability of obtaining a college degree. However, her work aims at re-defining what makes the college type, and does not discuss the role of college education in building NCS. We posit that university education has a high potential for shaping NCS because these skills appear to be more malleable between late adolescence and young adulthood (e.g. Bleidorn et al. 2013; Cobb-Clark and Schurer 2013, 2012; Hopwood et al. 2011; Specht et al. 2011) and because universities provide an intensive, new learning environment for adolescents.

Identifying the treatment effect of university education on the evolution of NCS is challenging. Observed differences in NCS between young adults with university education and young adults without university education may be due to pre-treatment differences in NCS or growth trajectories. Figure 1 illustrates the three alternative scenarios that equally explain young adulthood differences in NCS. **Scenario 1** describes the generic treatment effect of university education.

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[7]From here onward we use the terms character traits, soft skills, non-cognitive skills and personality traits interchangeably. We are aware that the concepts may differ from each other to some readers but for simplicity we consider these terms as a summary expression for facets of human behavior that is distinct from cognitive ability.

Both treatment and control group start at the same level of NCS and experience the same growth trajectory before the potential university entry. However, once the treatment group enters university, their growth trajectory changes. As a consequence, young adults who went to university have a higher level of NCS than young adults who did not.
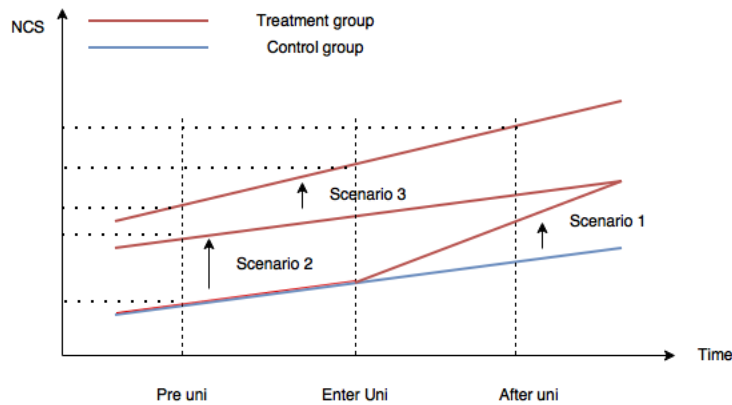
Figure 1: Illustration of three different data scenarios that are consistent with observing different levels in non-cognitive skills in young adulthood between treatment (university graduates) and control group (non-university graduates)

Alternatively, NCS of young adults with university qualification could be at a higher level than the NCS of young adults in the treatment group, because they had already a higher level of NCS pre-treatment. **Scenario 2** reflects the case of selective entry into university education by NCS.[8] Although no empirical evidence exists on this possibility, it could also be the case that youth in the treatment group experienced already a steeper growth trajectory of NCS pre-university education that was triggered by other experiences (**Scenario 3**).

To identify **Scenario 1**, we will follow the education and NCS trajectories of a cohort of 15 to 19 year-old Australians over eight years using data from a nationally-representative longitudinal survey, the Household, Income, and Labour Dynamics in Australia (HILDA) Survey. In HILDA,

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[8]Human capital accumulation, often measured by years of education, has been shown to correlate strongly with conscientiousness (Almlund et al. 2011) and Lundberg (2013a,b) demonstrated for a young US American cohort that some NCS correlate strong with the probability of graduation from college (Lundberg 2013a, p. 436).

measures of NCS are available before these adolescents potentially enter university (2005), and then four (2009) and eight years (2013) later.[9] These unique data features allow us to control for the self-selection into university education by NCS (**Scenario 2**) and other forms of individual-specific, unobserved heterogeneity. Although three measurement periods are available, these data do not facilitate a rigorous test of **Scenario 3**. The reason is that there are only 32 individuals in our sample for whom we have NCS-change data in before these youth enter university. On average, these youth do not change significantly their NCS, and their pre-university changes do not differ from changes in NCS from youth who will not go on to university. This result is consistent with evidence from Cobb-Clark and Schurer (2012), who have shown that NCS do not respond to the experience of life events over a four-year window.

To rigorously deal with **Scenario 2**, we apply various estimation methods. We use fixed effects methods to control for individual-specific unobserved heterogeneity that may correlate with NCS maturation and the decision to go to university. In our case, this individual-specific effect is likely to capture all accumulated human capital including unobserved motivation and NCS, the quality of the high school from which the student graduated, and the quality of the home environment. Since fixed effect methods cannot deal with time-varying shocks, we also control for a wide range of life events that may affect both university participation and the maturation process of personality traits (Cobb-Clark and Schurer 2012). We further complement the fixed effects analysis with coarsened exact matching (CEM), a relatively new and flexible matching

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[9]To the best of our knowledge HILDA is currently one out of three studies worldwide which collected the Big-Five personality data over three time periods for a large sample. The other study is the (Finnish) Jyvaeskylae Longitudinal Study of Personality and Social Development (JYLS), which began in 1968. The sample size of this study is 369 individuals and it is not nationally representative. Another exception is the German Socio-Economic Panel which collected the Big-Five personality instrument for their youth sample (roughly 300 individuals) in every year between 2006 and 2012.

estimator to explicitly control for differences in initial NCS (Ho et al. 2007; Iacus et al. 2011).[10]

Last, the HILDA survey collected complete information on the university name and field of study

for the university graduates in our sample, which we can use to explore the heterogeneity in the

treatment effect of university education.

2   University education, human capital, and personality

A university degree has high private returns. Across all OECD countries, individuals with com-

pleted tertiary education earn, on average, 55% more than individuals who did not obtain such a

qualification and such premiums have increased by 10 percentage points in the last ten years. Al-

most one-third of the OECD population completed university education in 2012 (OECD 2012). In

more upwardly-mobile countries such as Australia (Leigh 2007), almost 40% of each birth cohort

has obtained a tertiary qualification in 2012 (OECD 2012).[11] Australia's higher level of tertiary

education participation rates, despite high tuition fees, can be explained by the availability of

Government-funded loans and subsidies to relieve the costs of university education since the

late 1980s,[12] and by the particularly high private returns of a university degree in the magnitude

of a US$120,000 net increase in lifetime earnings (OECD 2012).[13] Its high private returns make

university education a classic investment good (e.g. Freeman 1999).

There are more than just economic benefits of university education. High levels of skills

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[10]For applications in health and education economics see Schurer et al. (2015) and Jones et al. (2011).

[11]The average is higher for younger cohorts (25-34 year old: 45%), and lower for older cohorts (55-64 year old: 30%).

[12]These are the Higher Education Loan Programme (HELP) and the Higher Education Contribution Scheme (HECS). Some students are directly funded by the Commonwealth Government through subsidies and means-tests support programmes such as Youth Allowance and Ausstudy Payment.

[13]This calculation is based on 2008 data. Similar figures are presented in Borland (2002) for the scenario of a 4% discount rate and in Daly et al. (2010) for different bachelor degrees. Overall, the private rate of return in Australia lies somewhere in-between 20% pre-HECS and up to 15% post-HECS (Borland 2002; Daly et al. 2010; Leigh 2008).

usually grant access to jobs that are more interesting, require continuous learning, and are less physically straining over the life cycle.[14] Job satisfaction and autonomy is higher for employees who work in occupations that require university qualifications. Finally, students operate in an environment where thinking deeply is considered a virtue and where one can broaden one's own cultural interests at low cost. Higher education has therefore also the characteristics of a consumption good.

Nevertheless, university education also comes at costs that are not necessarily of a monetary, but of a psychic nature (e.g Heckman et al. 2006a). Even with high levels of cognitive ability, studying and sitting exams, dealing with failure and constant deadlines is hard. Going to university requires a strong academic mind-set and intellectual engagement, and a sincere enjoyment of challenge. Conley (2003, 2005) has devised a model on college readiness, which stresses the importance of "tools" or "habits of mind" (p. 39). The tools comprise various skills and aptitudes, such as

> "...critical thinking, analytic thinking and problem solving; an inquisitive nature and interest in taking advantage of what a research university has to offer; willingness to accept critical feedback and to adjust based on such feedback; openness to possible failures from time to time; and the ability and desire to cope with frustrating and ambiguous learning tasks" (Conley 2003, p. 8).

Conley's idea of college readiness makes clear that the choice to go to university will be highly selective, not only on cognitive but especially on non-cognitive abilities. Lundberg (2013a), using a representative sample of young US Americans, shows that NCS measured by the Big Five

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[14]Differences in levels of physical pain between university graduates and individuals with minimum education peak dramatically before retirement age (Schurer et al. 2014).

personality traits is strongly linked with the the probability to complete a 2- or 4-year college degree.[15] Her study finds that individuals high on sociability and low on emotional stability are less likely to have finished a college degree, while individuals high on conscientiousness and agreeableness are more likely to do so. Most interestingly, individuals from low socioeconomic backgrounds increase their probability to graduate from college by being more open to experience (Lundberg 2013a), which Lundberg interprets as a signal for being a pioneer.

Notwithstanding the arguments of important selection effects into university education, working one's way through a university degree is a treatment in itself. At high-quality universities academic staff expect and demand a high level of intellectual engagement from students such as inquisitiveness, engagement with intellectual problems, the delivery of assignments on time, honesty, and the ability to manage scarce time resources. Going through such a treatment for three to five years is likely to shape NCS. Such a treatment-effect hypothesis is consistent with the human capital model of education (Mincer 1958; Schultz 1961) which states that university education teaches students subject-specific knowledge and skills that are highly valued by employers. This hypothesis is in stark contrast to the screening theory of university education (Arrow 1973; Spence 1973; Stiglitz 1975; Weiss 1995) which proposes that university education does not teach labor-market relevant skills, but functions as a screening device for employers to separate the more from the less productive workers.

Little is known about the NCS-shaping effects of the education sector. The current literature is limited to the skill-building effects of pre-school programs (e.g. Chetty et al. 2011; Heckman et al. 2010, 2013, 2014). However, some recent work has explored the role that the secondary ed-

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[15]Strictly speaking, Almlund et al. (2011) also report statistics on the associations between the Big-Five personality traits and university education in Germany, but their article is an overview article of the economics of personality psychology, and the authors touch upon the issue only marginally. They find that university education is positively correlated with conscientiousness and negative with neuroticism.

ucation sector could play in building NCS (Dahmann and Anger 2014; Dee and West 2011; Kautz and Zanoni 2014) and the causal relationship between years of schooling and NCS (Heckman et al. 2006b; Kassenboehmer et al. 2015). Heckman et al. (2006b) use a structural equation model to estimate the causal effect of years of schooling on cognitive and non-cognitive skills using observational data from the National Longitudinal Survey of Youth (NLSY79). The authors measure cognitive skills with five components of the Armed Forces Qualifying Test (AFQT) and NCS with locus of control and self esteem. Individuals with a total number of years of schooling that indicates a college degree score 0.5 SD higher on arithmetic reasoning, 0.75 SD higher on word knowledge, 0.7 SD higher on paragraph comprehension, 0.7 SD higher on math knowledge, and 0.6 SD higher on coding speed than individuals who only completed year 12 or less (Heckman et al. 2006b, Figure 4). Individuals who completed 13 or more years of schooling score 0.4 SD higher on locus of control than individuals who have less than 12 years of schooling (Heckman et al. 2006b, Figure 5). Kassenboehmer et al. (2015) also investigate the impact of education on adult cognitive and non-cognitive skills. To identify the causal effect, the study explores exogenous variation in education induced by a schooling reform implemented at different times across Australian states and territories, which raised the minimum school leaving age. Findings based on data from the HILDA survey suggest that providing women at the margin of dropping out of school with one extra year of schooling in the 1960s led to an increase in their cognitive skills by 0.15 SD, openness to experience, a NCS related to crystallized intelligence, by more than 0.2 SD, and their risk tolerance and future orientation by 0.12 SD 40 years later.

Some studies evaluate the NCS building effects of high-school interventions (Dahmann and Anger 2014; Kautz and Zanoni 2014). For instance, Kautz and Zanoni (2014) study the long-term effects of OneGoal, a Chicago-based intervention that aimed at helping disadvantaged high

school students successfully transition from high school into college. The program adopted some traditional approaches to improve outcomes, such as helping students to select colleges, write applications, and improve their test scores, but it also adopted a new curriculum that included the teaching of NCS such as time management, goal attainment, teamwork, and self-reflection using data from the Chicago Public School system. The study shows that participation in the OneGoal program had significant effects on eleventh-grade NCS for both female (0.17 SD) and male students (0.12 SD).

Dahmann and Anger (2014) investigate the short-term effects of a reduction in the length of high school on students' NCS using a school reform carried out at the state level in Germany as a quasi-natural experiment. The school reform shortened the academic track of high-school education from nine to eight years in most of Germany's federal states, while the content of the curriculum remained unchanged. The authors exploit variation in the length of the academic-track high school education over time and across states to identify the effect of schooling on students' Big Five personality traits and control perceptions which they measure for adolescents and young adults in the German Socio-Economic Panel (SOEP). On average, the study finds that a shortening of the high school track caused students to be more extroverted and less emotionally stable. Importantly, the study finds that male students and students from disrupted families became more agreeable and more extroverted.

We build on this literature by estimating the treatment effect of university education on NCS from the perspective of the Australian tertiary education sector. The Australian higher education system consists of independent, self-governing public and private universities and higher education institutions that award higher education qualifications. There are 38 public universities but only 3 private universities in Australia. Similar to the US tertiary education sector, Australian

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universities select students, among others, on the basis of a standardized high-school entry exam. Students also have to pay tuition fees for their university degree, but due to the existence of the Higher Education Credit System (HECS), students do not face a credit constraint, unlike many students in the US. Although in both countries the government sector spends a large fraction of tax-income on subsidizing core teaching activities, this is only 0.8% of GDP in Australia while it is around 2% of GDP in the United States (OECD 2013). In combination with lower tuition fees, this means that Australian universities are less well equipped than US universities to enrich campus life. While the US university system is dominated by a rich campus life, general liberal arts degrees, and undergraduate students spending four years on campus, students in Australia spend generally three years at university and they commute to campus. Therefore, in Australia everyday life changes less for the average student when entering university, because the majority of them stay with their families.

3   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 labor 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 module on personality traits that was collected as part of the self-completion questionnaires in waves 5, 9 and 13 and the cognitive ability test scores available in wave 12. We therefore restrict our

analysis to nine waves of data collected between 2005 and 2013.

3.1   Estimation Sample

We conduct the main analysis with a sample of 618 adolescents who were between 15 and 19 years of age in wave 5 (2005), when data on personality traits were first collected. About 35% of these 618 individuals (216) will either graduate from university or have entered university for at least one year at some point in time before 2013 and 125 individuals (20%) have graduated from university by 2013.[16] We observe a large degree of heterogeneity in university participation, where only 25% of adolescents from a disadvantaged background, as measured by the father's occupational prestige score, will enter the university track, while 50% do so from advantaged backgrounds.

3.2   Variable definition

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,

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[16]We excluded from the analysis 39 individuals who were already at university in 2005. In 2005, we have 1231 teenagers in the respective age-group 15-19. The majority of these teenagers, 858 or 70%, can be tracked and have completed an interview in 2013. The main reasons for dropping out of our sample are: (1) Sample member no longer living with household (N=97, 8.8%); (2) Refused to respond - other reason (N=90, 7.3%); (3) Household not issued to field due to persistent non-response (N=79, 6.4%); and (4) Refused - too busy (N=42, 3.4%). We conclude from these numbers that there is heterogeneity in the reasons for why teenagers can no longer be tracked. Important for our analysis is that teenagers moving out of the house is not the main reason for dropping out of the sample. For these 97 teenagers it could be the case that they change their personality the most because they leave their parents home. In this case, we would under-estimate the effect of university education on personality change.

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, for a detailed description). We standardize each measure to mean 0 and standard deviation of 1. A measure of mental health is derived from the SF-36 mental health scale (Ware Jr 2000) available in each year between 2005 and 2013. This mental health measure is standardized to mean 0 and standard deviation of 1, where larger values correspond to better mental health.

Human Capital: We derive a binary indicator of 'degree attainment' from a variable that indicates the highest level of education achieved in any particular wave. An individual with university education has obtained either a bachelor or honors degree, a graduate diploma or graduate certificate, or a master or doctoral degree. We include in this definition individuals who have entered the university track after 2005 for at least one year.

Cognitive ability Cognitive skills were assessed in Wave 12 with three standard tasks: (1) the 'Backward digits span' test (BDS), (2) a 25-item version of the 'National American Reading Test' (NART) and (3) the 'Symbol-digit modalities' test (SDM). Details on how they were conducted are provided in Wooden (2013). The BDS measures working memory span and is a traditional sub-component of intelligence tests. The interviewer reads out a string of digits which the respondent has to repeat in reverse order. NART is a short version of the National Adult Reading Test that measures pre-morbid intelligence. Respondents are shown 25 irregularly spelled words which they have to read out loud and pronounce correctly. SDM was originally developed to detect cerebral dysfunction but it is now a recognized test for divided attention, visual scanning and

motor speed. Respondents have to match symbols to numbers according to a printed key that is given to them. Participation rates were high (> 93% in each test) (Wooden 2013, p. 4). We use the average of the three scores, after scaling each to be a percentage of the maximum observed score of all participants, as a summary measure of cognitive ability. This measure is standardized to mean 0 and standard deviation of 1.

Control variables: We control in all regression models for age and gender, and the father's occupation using the Australian Socioeconomic Index 2006 (AUSEI06) occupational status scale (McMillan et al. 2009) which is derived from the Australian and New Zealand Standard Classification of Occupations (First Edition, 2006). The reference point for the classification is when the individual was aged 14.[17] This 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 80 and above indicate professional, managerial, and legislative occupations, while values of under 30 indicate elementary and manual occupations. We also control for household income, maternal education, country of birth with three dummy variables indicating whether the individual was born in Australia, in a mainly English-speaking country (i.e. United Kingdom, New Zealand, Canada, USA, Ireland and South Africa), or in any other country. In addition, we include a binary variable to indicate whether the individual lived in a non-major urban area according to the Australian Standard Geographical Classification (2001). To capture differences in previous education quality, we control for the type of high school the individuals graduated from (Public, Private Catholic, Private Independent).

It is possible that the decision to go to or complete university is affected by family-, employment-

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[17]If the father was not in employment then, the classification would be based on any previous employment; if the father was deceased, then his occupation when he was alive was used.

, and health-related life events that also affect the maturation of NCS. We control for these factors in different ways. Similar to Cobb-Clark and Schurer (2012), we exploit a battery of positive (e.g. marriage, job promotion) and negative (e.g. death of a family member) life events that the HILDA survey collected between 2002 and 2013 to control for time-varying shocks. 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 A.1 in the Online Appendix. Second, we control for changes in physical health with a continuous measure of health derived from the SF-36 inventory (Ware Jr 2000). Third, we control for the accumulated work experience of each individual either during or after graduation to ensure that changes in soft skills are not driven by post-education work experiences.

University type and degree of study. An important component of our analysis is the exploration of heterogeneity in the treatment effect of university education by the type of the university from which the student obtained his or her degree. In 2012 of the HILDA survey participants were asked to provide information on the name of the university where they graduated from and which field of study they obtained their degree in. In total, there are 39 Australian universities. We follow Norton and Cherastidtham (2014) to group universities according to their group membership. The Group of Eight (Go8) universities market themselves as "Australia's Leading Universities", because they are ranked as the top eight performers in national research evaluations and international standing.[18] The Australian Technology Network (ATN) is a coalition of five Australian 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

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[18]The Go8 comprise 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.

before they became accredited as universities.[19] The group of Innovative Research Universities (IRU) comprises seven 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.[20] The Regional Universities Network (RUN), which comprises six universities,[21] was formed in 2011 to take advantage of the regional focus of the Gillard Labor Government. Finally, there are six universities that do not belong to any network and we label these as "Other universities".[22] Some of the universities clustered in this group are highly-ranked in terms of their research quality such as Deakin University, University of Tasmania, University of Wollongong, or Swinburne University of Technology, ranking in the top 17 of Australia's university ranking according to the Excellence in Research for Australia (ERA) initiative (ERA, 2012 National Report).[23] In our sample there are no individuals who received their university education overseas.

Field of study classification is based on the Australian Standard Classification of Education (ASCED) (Australian Bureau of Statistics (ABS, 2001). University students or graduates are grouped into five broad groups: (1) Science, Technology, Engineering or Mathematics (STEM)[24]; (2) Medicine, Nursing, and other health-related studies; (3) Education; (4) Management, Commerce, and Law; (5) and Society and Culture, Creative Arts and Food and Hospitality which we refer to as "Other". Summary statistics of all variables used in the analysis are reported in Table B.1 in the Online Appendix

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[19]The ATN comprise Curtin University of Technology, University of South Australia, RMIT University, University of Technology Sydney and Queensland University of Technology.

[20]The IRU comprise Flinders University, Griffith University, La Trobe University, Murdoch University, University of Newcastle, James Cook University and Charles Darwin University.

[21]Central Queensland University, Southern Cross University, University of Ballarat, University of New England, University of Southern Queensland and University of the Sunshine Coast

[22]Deakin University, University of Western Sydney, University of Wollongong, Victoria University, University of Tasmania, Swinburne University of Technology

[23]National reports on the ERA 2012 can be accessed online at: `http://www.arc.gov.au/era-national-reports`.

[24]This category includes Architecture and Environment and Agriculture.

3.3 Summary statistics

Figure 2 shows the mean levels in all five NCS in 2005, 2009, and 2013 (and their 95% confidence intervals) separately for the treatment and the control groups. In the raw data, individuals in both treatment and control groups start out at the same level of extraversion in 2005, however a gap emerges four years later that widens further until 2013 (Figure 2(a)). The gaps and trends in conscientiousness, emotional stability, and openness to experience remain constant over the eight-year time period. The only exception is for agreeableness, where youth that will not go on to university are on a constant trajectory of agreeableness between 2005 and 2009, while youth who will go to university continually increase their agreeableness scores (Figure 2(b)). These figures show also that youth who will go on to university score significantly higher pre-treatment (2005) in agreeableness and openness to experience, and do not differ in initial levels of extraversion. This suggests that controlling for initial differences in personality is important for some NCS (Scenario 2).[25]

We cannot say whether the changes between 2005 and 2009 represent the trends in the pre-treatment period (Scenario 3), because many adolescents in the treatment group have entered university already by 2006. We have conducted an informal test on a small 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-treatment trend and compare this pre-treatment trend against the trend of the control 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

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[25]In a separate analysis we have estimated the relationship between youth NCS and the probability of graduating from university by 2013. We find that youth conscientiousness, extraversion for men, and agreeableness for youth from privileged backgrounds are significantly associated with the probability to graduate from university in 2013. Youth openness to experience no longer has a statistically significant effect on university education, once cognitive ability is controlled for. See Table E.1, Online Appendix.

(a) Extraversion   (b) Agreeableness   (c) Conscientiousness

(d) Emotional stability   (e) Openness to experience
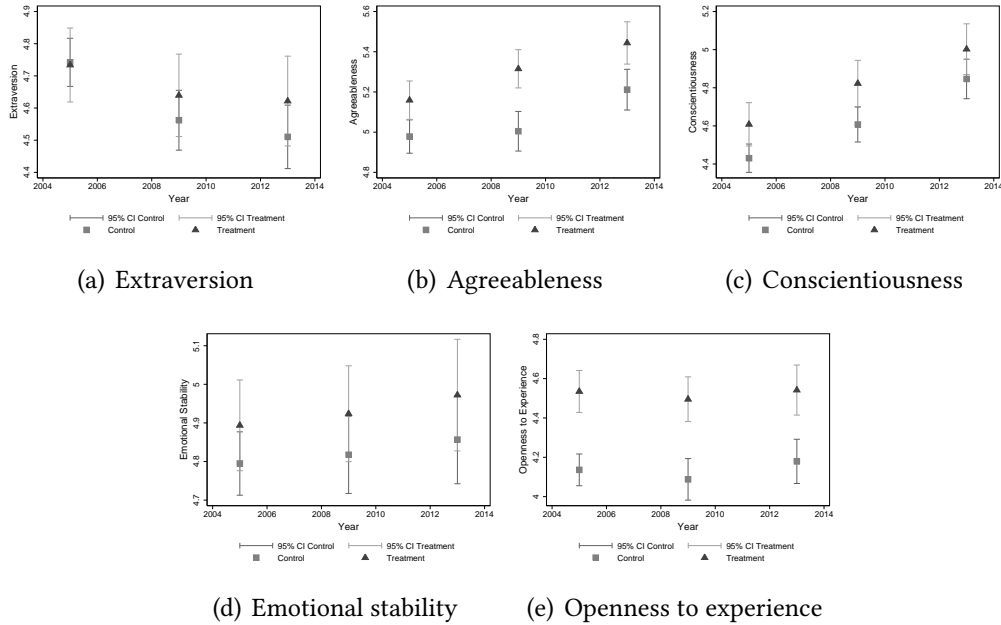
Figure 2: Distribution of personality traits from 2005 to 2013

is consistent with the findings of Cobb-Clark and Schurer (2012) - and they do not differ between the two groups.[26] By far, this is not a sufficient test to rule out differential growth trends between treatment and control group pre-university, but in the absence of better data this is the best we can do.

Exploring intra-individual changes between 2005 and 2013, we find that on average all youth in our sample became more conscientious by 0.44 standard deviations (SD), more agreeable by 0.22 SD, and less extroverted by 0.12 SD. However, these youth experienced no changes in emotional stability and openness to experience (Table B.1, Online Appendix). Although personality-trait changes are zero on average, some individuals increase while others decrease their personality scores over time, as can be seen in Figures 3(a) to 3(e). Changes in personality traits are depicted on the horizontal axis using the original score. For instance, a negative change of 2 implies

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[26]The relevant p-values of the test of equality of means of changes in each respective personality trait between treatment and control groups are: Extraversion: p=0.207; Agreeableness: p=0.171; Conscientiousness: p=0.613; Emotional Stability: p=0.189; Openness to Experience: p=0.525. The total estimation sample is 348 individuals and 10.5%, or 32 individuals, will go on to university after 2009.

that individuals reduced their score on average by 2 units on an index that ranges from 1 to 7. Important differences emerge across the sexes and SES.

For some individuals the distribution is slightly shifted towards the left or right indicating a tendency to decrease or increase in the relevant personality trait. For instance, male adolescents from low socioeconomic backgrounds tend to become less emotionally stable, extraverted, and agreeable, and more open to experience, while men and women from high socioeconomic backgrounds tend to become slightly more extraverted and more emotionally stable. Young women generally tend to become more agreeable and less open to experience, while young men tend to become slightly more open to experience independent from their socioeconomic backgrounds.

There are also important pre-treatment differences in other observable characteristics. For instance, youth in the treatment group are three quarters and one quarter more likely to have a mother with at least 12 years of education and who completed at least a vocational qualification, respectively (p-values in both cases < 0.001). Youth in the treatment group also have fathers who worked in occupations that rank almost 14 percentage points higher than the fathers of youth in the control group. Youth in the treatment group are also more likely by a quarter to live in major urban areas (Table C.1, Online Appendix). These differences emphasize the importance of controlling for these pre-treatment characteristics.

In our sample, 199 youth who completed or entered the university track provided information on which university they study or studied at and their field of study. The majority of students obtained their degree from, or currently study at, a Group of Eight (Go8) institution (30.7%, 61 students) or at an institution classified as "Other" (26.6%, 53 students). The largest proportion of universities in this "Other" category are Deakin University, University of Wollongong, University of Western Sydney, University of Tasmania, which are all research active and offer a great
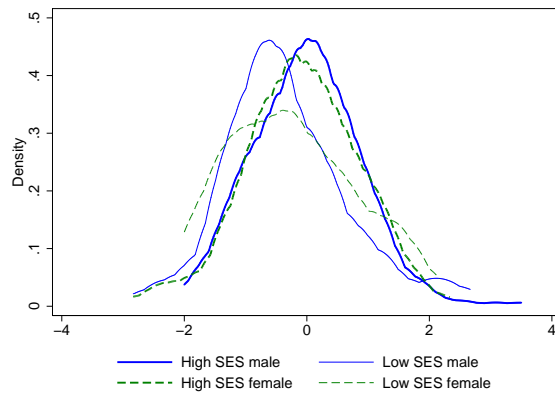
(a) Extraversion
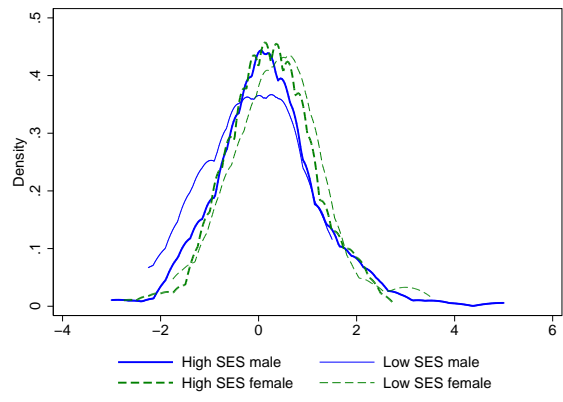
(b) Agreeableness
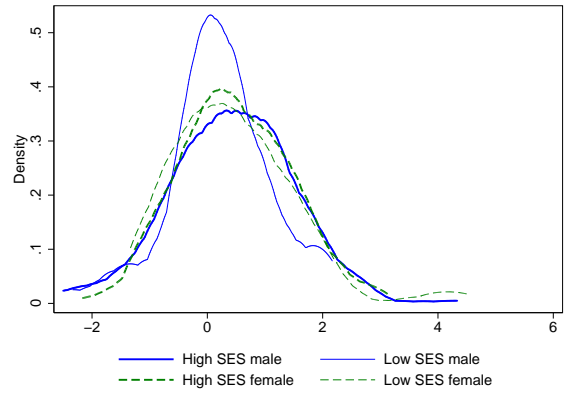
(c) Conscientiousness
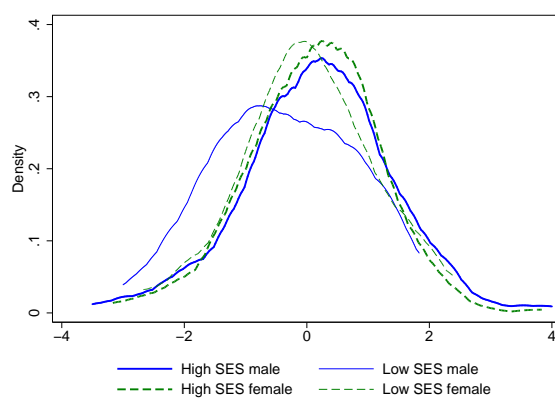
(d) Emotional stability
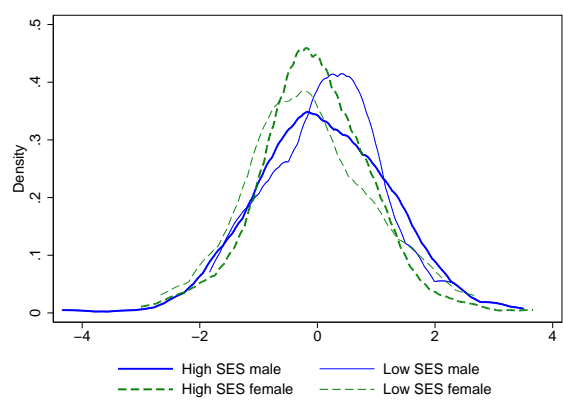
(e) Openness to experience

Figure 3: Change in Big-Five personality scores between 2005 and 2013, by gender and socioeconomic background

variety of degrees and breadth of curriculums. More than 20% of youth in the university track (40 students) study at or obtained their degree from an institution that is part of the Innovative Research University (IRU) network, while only 16.1% (32 students) and 6.5% (13 students) obtained their degree from an institution of the Australian Technology Network (ATN) and Regional Universities Network (RUN), respectively. The most common degrees are in order of magnitude: Management, commerce or law (24.6%); Society and Culture, Creative Arts and Food and Hospitality referred to as "Other" (24.6%); Medicine or health-related degrees (20.8%); STEM (17%); and Education (13.2%).

4 Empirical strategy and estimation results

4.1 Model specification

In this section we lay out the empirical framework within which we test the treatment effects of university education on youth NCS development. We start out with the same specification as in Cobb-Clark and Schurer (2013, 2012) and then we outline how we account for self-selection into university education. Let $\triangle \text{PT}^j_{i,05/13}$ represent the change in personality trait j between 2005 and 2013, where positive changes indicate an increase in the respective trait:

$$\triangle \text{PT}^j_{i,05/13} = \alpha^j_1 U_i + \alpha^j_2 U_i \times \text{FOC}_i + \alpha^j_3 \text{FOC} + X'_{i,05}\beta^j + \text{LE}'_{i,06/13}\gamma^j + W'_{i,05/13}\delta^j + \varepsilon^j_i, \quad (1)$$

The indicator variable U_i takes the value 1 if the individual has completed university or has been studying at university for at least one year by 2013. We interact the university indicator with father's occupational class $U_i \times \text{FOC}_i$ to allow for heterogeneous treatment effects by parental SES. There may be important differences in the effects by SES as university education changes the

peer group for those from low SES to a much greater extent than for those from high socioeco-
nomic backgrounds. The coefficient α_1^j is the key parameter of interest, measuring the treatment
effect of university education on NCS change.

The vector $X_{i,05}^j$ includes control variables that were measured in 2005 (indicators for age-
groups, parental SES, foreigner status, region of residence, type of secondary school). The vector
$LE_{i,06/13}$ includes a wide range of indicator variables that take the value 1 if an individual reports
the experience of a specific life event at any point between 2006 and 2013, and 0 otherwise.
The vector $W_{i,05/13}$ includes measures of work experience accumulated since 2005 and physical
health in 2005. We estimate Eq. (1) separately for each of the five personality traits using Ordinary
Least Squares (OLS).

Under the assumption of zero covariance between ε_i^j and U_i, α_1^j identifies the causal effect
of university education on personality change. Although we control for a rich set of background
variables and individual-specific life events, it is unlikely that OLS estimation can establish a
causal relationship between university education and changes in personality traits. To improve
upon this specification, we estimate a first difference, fixed effects regression model to wipe out
all time-invariant factors that may confound our estimates of interest, where the time difference
is taken between 2005 and 2013:[27]

$$\triangle PT_{it}^j = \alpha_1^j \triangle U_{it} + \alpha_2^j \triangle U_{it} \times \triangle FOC_{it} + \alpha_3^j \triangle FOC_{it} + \triangle LE_{it}' \gamma^j + \triangle W_{it}' \delta^j + \triangle \varepsilon_i^j + \triangle \xi_{it}. \quad (2)$$

[27]We also estimated a within-fixed effects model exploiting three time periods, i.e. observations from 2005, 2009,
and 2013. Our estimation results are more noisy, although the main conclusions remain, because the four-year
window is too short for noticeable changes. These results are provided upon request.

The first-difference specification in Eq. (2) eliminates the influence of all time-invariant variables - baseline control variables from the year 2005, unobserved time-invariant factors, and the permanent component in personality trait j (ε_i^j) - that could confound the parameter estimate of α_1^j. Under the assumption of zero covariance between $\triangle U_{it}$ and $\triangle \xi_{it}$, α_1^j identifies the causal effect of university education on changes in NCS. We are controlling for time-varying factors such as the experience of life events - for instance the experience of a health shock or the loss of a parent which could affect the ability to finish university education - in addition to changes in parental socioeconomic status, accumulation of work experience, and changes in physical health between 2005 and 2013. The zero covariance assumption is violated if there are any remaining correlations in changes in unobservable shocks with university education.

Fixed effects estimation comes at a cost. It identifies the treatment effects of interest only for individuals who sufficiently change their treatment status and outcomes. It is also an inefficient estimation method, and thus standard errors are often too large to identify significant treatment effects. An alternative way to control for the self-selection into university education by initial NCS and socioeconomic status is to use a matching estimation method. We use coarsened exact matching (CEM) that calculates the average treatment effect of the treated (ATT) as the average difference in outcomes between an individual in the treatment group and his or her perfect statistical twin in the control group. Statistical twins are matched exactly on the basis of discrete values of all relevant pre-treatment variables (Ho et al. 2007; Iacus et al. 2011). This matching method allows us to more transparently balance the data between treatment and control group including baseline levels of NCS. In contrast to propensity score matching, which matches treatment and control group on the basis of closeness on a summary measure of covariates, the propensity score, CEM suggests to coarsen continuous variables into intuitive categories, and then conduct

1:1 matching without replacement. For this group of exact matches the covariates are perfectly balanced and the treatment effect can be calculated non-parametrically as a difference in means on the matched data, assuming that there are no further unobserved confounding variables. For the unmatched treatment group members, CEM suggests to widen the intervals into which the control variables can be categorized. The advantage of this approach is that no modelling assumptions about functional form need to be made.[28] We are matching youth who have entered the university track by 2013 to a statistical twin on the basis of the following approximate 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 or below the sample average on the occupational prestige score (0, 1)

- Maternal education: Mother has 12 years or less of education (0, 1)

- Family household income: 12 categories of income intervals starting with less than $10,000 household income and ending with more than $200,000 household income

- Degree of urbanization: Major urban versus non-major urban (0,1)

- Being from an English-speaking background (0,1)

- High-school: private, public, or catholic (1, 2, 3)

- Big Five personality traits and mental health in 2005: Being above versus below the median of 4 (on a 7-point scale) for each of the five personality domains, respectively (5 × 0,1).

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[28]It should be emphasized that CEM, just as much as regression analysis and conventional matching methods, identify the treatment effect of interest by conditioning on a key set of control variables and the ignorability assumption that there are no relevant omitted variables. Although they cannot be interpreted as causal effects, they make the treatment variable (here: university education) more independent of the potentially confounding variables (here: initial levels of personality). For applications in estimating health care expenditures, see Schurer et al. (2015), and educational outcomes, see Jones et al. (2011).

Out of 216 individuals in the treatment group, we found a perfect match for 158 individuals (73%). The means of all relevant pre-treatment covariates are well balanced between the treatment and the control groups (Table C.2, Online Appendix).

4.2   University education and changes in non-cognitive skills

To test whether university education shapes NCS skills we first present the estimation results of Eq. (1) using OLS. The estimated parameters of interest are reported in Table 1. Full estimation results are reported in Table D.1 (Online Appendix). The estimation sample includes 618 adolescents who were aged between 15 and 19 in 2005. The dependent variable is a measure of change in each of the Big-Five personality traits between 2005 and 2013, standardized to mean 0 and standard deviation of 1. For comparison, we also estimate the same model for changes in mental health. The main independent variable is an indicator of having entered the university track by 2013 for at least one year (216 individuals), which is referred to as UNI.[29] To allow for heterogeneity in the university effect by family background, we include a continuous measure of the father's occupational class and an interaction term between the dummy variable of university track and the father's occupational class ($UNI \times FOC$). 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.

Having entered the university track is associated with an increase in extraversion by one-third of a standard deviation (0.36 SD, standard error 0.10) for the average teenager.[30] The interaction

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[29]Alternatively, we consider in the treatment group only the 158 individuals who completed university. As their treatment effects are almost equivalent to the ones obtained from the slightly larger treatment group, we discuss only the results for the larger group.

[30]The average adolescent is born into a family where the father's occupation class score is standardized to 0,or 49 on the original score that ranges from 4.9 to 100. Scores from 80 onward represent manual occupations of professionals, legislators, and managers. A score lower than 30 represent manual and elementary occupations.

Table 1: Estimated effects of university participation on changes in the Big-Five personality traits and mental health: OLS and Fixed Effects models

	Extrv	Agree	Consc	Emote	Openn	Mental
OLS model (N = 618)						
UNI	0.359***	−0.061	−0.089	0.035	0.049	0.166*
	(0.096)	(0.083)	(0.087)	(0.088)	(0.093)	(0.088)
UNI × FOC	0.021	−0.222**	0.031	−0.059	−0.038	−0.068
	(0.089)	(0.088)	(0.088)	(0.082)	(0.087)	(0.080)
FOC	−0.018	0.089	−0.057	−0.053	−0.059	−0.055
	(0.059)	(0.064)	(0.060)	(0.058)	(0.063)	(0.057)
R^2	0.07	0.05	0.06	0.09	0.05	0.06
First-difference fixed effects model (N = 618, T = 2)						
UNI	0.242***	0.033	−0.078	0.042	0.005	0.189**
	(0.081)	(0.084)	(0.082)	(0.086)	(0.087)	(0.090)
UNI × FOC	0.026	−0.162**	−0.017	−0.126*	−0.093	−0.137**
	(0.067)	(0.068)	(0.064)	(0.065)	(0.066)	(0.068)
R^2	0.09	0.08	0.18	0.05	0.03	0.06

Note: Includes all respondents aged 15 to 19 in wave 5. Father's occupational class is defined via the Father's 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.

effect between university track and father's occupational class is not statistically significant (0.02 SD, standard error 0.09).

Teenagers whose fathers' score two standard deviations below the mean occupational class report positive changes in agreeableness of 0.38 SD, while teenagers whose fathers' score two standard deviations above the mean occupational class report negative changes of -0.50 SD.[31] A two-standard deviation increase or decrease in father's occupational class away from the mean implies that the father worked either in legislative/managerial or an elementary occupation, respectively.[32] University education is not significantly associated with changes in conscientious-

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[31]The calculation is based on the estimated interaction term UNI × FOC: $−0.061 \pm 2(SD) \times (−0.222)$.

[32]For comparison, we also estimated models that used the mother's level of schooling (some secondary schooling,

ness, openness to experience or emotional stability. However, we find a positive effect of university education on mental health in the magnitude of 0.17 SD (standard error 0.09).

When controlling for individual-specific, time-invariant heterogeneity by estimating Eq. (2), our conclusions about the treatment effects on extraversion, agreeableness and mental health do not change (lower panel in Table 1). The treatment effect of university education on changes in extraversion remain large and statistically significant in the first-difference estimation model (0.24 SD, standard error 0.08), although the magnitude of the effect is reduced by one third.

In the first-difference model, the heterogeneous treatment effect of university education on agreeableness for students from low socioeconomic background is almost the same in the one obtained from the OLS model. A student whose father's occupational class is 2 SD below the sample average increases her agreeableness by 0.36 SD, while a student from privileged background decreases her agreeableness by almost 0.3 SD.[33]

The differential path in the evolution of agreeableness between the socioeconomic classes stems from the observation that young men and women from low socioeconomic backgrounds increase their levels of agreeableness while young men and women from advantaged backgrounds keep their levels constant while attending university. Both start out with the same levels of agreeableness in 2005 in a statistical sense, but the average score is higher for children from advantaged backgrounds (5.15 versus 5.28, p-value = 0.66). By 2013, their scores differ by roughly one-third of a standard deviation (5.72 versus 5.30, p-value = 0.08). One explanation that is consistent with the observed data is that children from disadvantaged backgrounds adopt more strongly the be-

year 11 or equivalent, year 12 or equivalent). Qualitatively, the results are similar, so that adolescents from families where the mother has little schooling tend to become more agreeable throughout university education, but the interaction effects are not statistically significant. Results provided upon request.

[33]The estimated coefficient on university education is 0.033 (standard error 0.084), and the estimated interaction effect between university education and father's social class is -0.162 (standard error 0.068). The calculation is based on the estimated interaction term $\text{UNI} \times \text{FOC}: -0.033 \pm 2(\text{SD}) \times (-0.162)$.

havioral styles governing interpersonal relationships at university.

In this first-difference model the treatment effect of university education on mental health is even stronger than in the OLS model, and the interaction effect of university education and father's occupational class is statistically significant. A university student from low SES increases her mental health by 0.32 SD, while a student from a privileged background experiences almost no change in mental health (-0.08 SD). This result is consistent with the a heterogeneous treatment effect of university education on emotional stability, which we now find in the fixed effects model in the magnitude of 0.30 SD for low SES students.[34]

To complement both OLS and fixed effects analysis, we also present the average treatment effects on the treated (ATT) in Table 2 using coarsened exact matching in order to balance the covariates between treatment and control group including baseline levels of NCS. The ATT is interpreted as the difference in the change of personality trait j over eight years between youth who went to university and youth who did not, but who had very similar observable characteristics as youth in the treatment group. The ATT of university education on extraversion is 0.35 SD and the treatment effect is highly statistically significant (t-stat 2.99). In line with our OLS and fixed effects results, we also find a statistically significant difference in emotional stability (0.24 SD) and mental health (0.4 SD). What is different from our previous findings is that - when controlling for initial differences in conscientiousness - we now find a statistically significant difference in conscientiousness of 0.3 SD between the treatment and the control group (t-stat 2.62). The explanation is that youth who will go on to university start out already at a higher level of conscientiousness than youth who will go alternative pathways. The higher level of conscientiousness makes it less likely for these youth to improve upon the conscientiousness.

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[34]The calculation is based on the estimated interaction term $\text{UNI} \times \text{FOC}$: $-0.042 \pm 2(\text{SD}) \times (-0.126)$.

Table 2: Average treatment effect on the treated: Differences in changes in personality and mental health between treatment and control group estimated with Coarsened Exact Matching (CEM)

	Treatment	Control	Diff	t-stat	p-value
Extraversion	0.08	−0.27	0.35	2.99	0.003
Agreeableness	0.09	0.14	−0.06	−0.57	0.569
Conscientiousness	0.46	0.17	0.30	2.62	0.009
Emotional stability	0.17	−0.07	0.24	1.84	0.067
Openness to experience	−0.09	0.03	−0.13	−1.04	0.301
Mental health	0.17	−0.23	0.40	3.25	0.001
Observations	158				

Note: Reported are differences in mean by treatment and control group and p-value of t-test on equality of mean between treatment and control group. Out of 216 individuals who entered or completed university, we were able to find for 158 a perfect match and discarded the remaining individuals. Includes all respondents aged 15 to 19 in wave 5.

4.3 Gender differences in treatment effect of university education

We explore further the possible heterogeneity in the treatment effect of university education between the sexes. We present the estimation results for OLS models only as the sample size within each group becomes too small for a meaningful statistical inference. As the OLS and fixed effects from the previous section yielded comparable results, there is no loss of generality in proceeding with OLS analysis. These additional results are presented in Table 3.

The positive effect of university education on extraversion is obtained for both male (0.41 SD, standard error 0.14) and female university students (0.33 SD, standard error 0.13) and the difference in magnitude between the two treatment effects is not statistically significant (t-stat 0.41). The positive treatment effect of university participation on agreeableness for students from low socioeconomic backgrounds is obtained for male youths. University education increases the agreeableness score of male adolescents whose fathers worked in elementary occupations relative to the mean (FOC < 2 SD below the mean) by 0.83 SD. Male adolescents whose fathers

worked in professional or managerial occupations (FOC $>$ 2 SD above the mean) decreased their

agreeableness scores by 0.75 SD relative to the mean.[35]

Table 3: Estimated effects of university participation on changes in the Big-Five personality traits and mental health by gender (OLS)

	Extrv	Agree	Consc	Emote	Openn	Mental
Male adolescents (N=272)						
UNI	0.411***	0.044	−0.020	0.134	0.109	0.040
	(0.141)	(0.158)	(0.163)	(0.148)	(0.163)	(0.142)
UNI × FOC	0.007	−0.393**	−0.082	−0.100	0.047	−0.036
	(0.133)	(0.155)	(0.137)	(0.122)	(0.146)	(0.131)
FOC	−0.031	0.072	−0.120	−0.034	−0.102	−0.066
	(0.077)	(0.093)	(0.089)	(0.082)	(0.091)	(0.071)
R^2	0.12	0.14	0.12	0.17	0.12	0.09
Female adolescents (N=346)						
UNI	0.332**	−0.083	−0.170	−0.002	0.061	0.255**
	(0.133)	(0.096)	(0.112)	(0.110)	(0.119)	(0.121)
UNI × FOC	0.003	−0.155	0.008	−0.042	−0.106	−0.114
	(0.124)	(0.109)	(0.116)	(0.112)	(0.113)	(0.114)
FOC	0.032	0.131	0.044	−0.053	0.005	−0.049
	(0.091)	(0.081)	(0.085)	(0.085)	(0.084)	(0.093)
R^2	0.10	0.07	0.07	0.10	0.08	0.12

Note: Includes all respondents aged 15 to 19 in wave 5.

Source: HILDA, waves 5 and 13.

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

Finally, the positive treatment effect of university education on mental health is obtained for female youth only. Female students from middle-income classes improve their mental health score by 0.26 SD (standard error 0.12) over the eight-year period. Although the interaction term of university education with father's occupational class is large in magnitude (-0.11 SD) - indicating greater benefits for female students from disadvantaged backgrounds - it is not statistically significant due to a very large standard error of 0.11.

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[35]The calculation is based on the estimated interaction term UNI × FOC: $0.04 \pm 2(\text{SD}) \times (-0.39)$.

4.4 Heterogeneity in the treatment effect by type of university

In this section we test whether the treatment effects of university education on NCS depend on the type of university or field of study. In Table 4 we report the estimated coefficients from an OLS model in which we regress the outcome variable - changes in personality between 2005 and 2013 - on a set of dummy variables that reflect one of the five university groups (upper panel) or a set of dummy variables that represent the field of study if the individual attends or has completed university education (lower panel). Each model controls for the full set of variables as in the benchmark model. Due to sample size restrictions, we were not able to estimate the treatment effects of university type or field of study type allowing for interactions with family background or fixed effects models.

Overall, we find little systematic differences in the treatment effects by university grouping, as can be seen from Table 4. The treatment effect of university education on extraversion - which stands out as the most important treatment effect from our previous analyses - is equally strong across all universities. In magnitude, the treatment effect is strongest for students who study at one of the RUN universities (0.67 SD, SE 0.27), and weakest for students at one of the IRU universities (0.23 SD, SE 0.17). We conducted an F-test of equality of differences in means across all university groups, and could not reject the null hypothesis at a 5% level of significance. With the exception of students studying at one of the Other universities, almost all students experience a decline in agreeableness. The effect sizes range between -0.26 SD (Go8) and -0.11 (ATN), although the standard errors are very large. The likely reason for these imprecise results is that the small sample sizes within each group are small.

Table 4: Treatment effect of university education by university type and field of study

	Extrv	Agree	Consc	Emote	Openn	Mental
Treatment effect by university type						
Go8	0.387***	−0.255*	−0.018	−0.074	0.056	0.224
	(0.149)	(0.146)	(0.156)	(0.132)	(0.138)	(0.151)
ATN	0.423**	−0.109	−0.281	−0.036	0.092	0.012
	(0.203)	(0.174)	(0.177)	(0.168)	(0.185)	(0.177)
IRU	0.226	−0.146	−0.164	0.150	−0.117	0.242*
	(0.172)	(0.175)	(0.155)	(0.158)	(0.168)	(0.143)
RUN	0.666**	−0.140	0.135	0.029	0.067	0.055
	(0.270)	(0.200)	(0.215)	(0.257)	(0.227)	(0.272)
Other	0.316**	0.082	−0.085	0.006	0.073	0.026
	(0.138)	(0.121)	(0.139)	(0.132)	(0.155)	(0.131)
R^2	0.08	0.05	0.06	0.10	0.06	0.06
Observations	601	601	601	601	601	601
Treatment effect by field of study						
STEM	0.665***	−0.260*	−0.233	0.056	−0.089	0.153
	(0.164)	(0.135)	(0.161)	(0.162)	(0.179)	(0.143)
Medicine and health related	0.339**	−0.007	0.196	−0.206	−0.040	0.115
	(0.165)	(0.147)	(0.169)	(0.132)	(0.152)	(0.134)
Education	0.278	0.181	−0.103	0.299*	0.035	0.239*
	(0.208)	(0.202)	(0.170)	(0.180)	(0.159)	(0.141)
Management, Commerce, Law	0.158	−0.077	−0.147	−0.000	0.168	−0.043
	(0.138)	(0.144)	(0.133)	(0.135)	(0.151)	(0.146)
Others	0.337**	−0.262*	−0.177	0.047	0.045	0.287
	(0.158)	(0.139)	(0.153)	(0.140)	(0.157)	(0.179)
R^2	0.08	0.05	0.06	0.10	0.06	0.06
Observations	614	614	614	614	614	614

Note: Respondents aged 15 to 19 in wave 5. **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).

Source: HILDA, wave 5 and 13.

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

We further explore whether the treatment effect of university education differs by field of study (lower panel of Table 4). We find little evidence that the treatment effect of university education on extraversion differs across field of study. Although the effect sizes vary between 0.67 SD for STEM students to 0.16 SD for Commerce students (SE 0.13), the differences in means across all five fields of study are not statistically significant.[36] We find heterogeneity in the treatment ef-

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[36]We conducted an F-test of equality of differences in mean changes in extraversion across all fields of study. The

fect of university education on agreeableness, conscientiousness and emotional stability by field of study. Students in the STEM and Other fields of study decrease significantly their levels of agreeableness by 0.26 SD, an effect that is statistically significant at the 10% level. Students in Education significantly increase their scores of emotional stability and mental health by 0.30 SD and 0.24 SD, respectively, and these effects are statistically different from the treatment effects in other fields of study.[37] Students in Medicine and Nursing increase their levels of conscientiousness by 0.20 SD, and reduce their scores on emotional stability by -0.21 SD, although there is too much noise in the data to be sure that these two effects are not due to chance (SE 0.17).

5 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 labor market. The New York Times and The Guardian have featured many opinion pieces reflecting this change in thought. Various articles from leading scholars and journalists emphasized that university education falls short of teaching students creativity, socioemotional skills, attributes of ownership, and the ability to learn on the fly. They argue that such non-cognitive skills are valued highly by employers and by society-at-large. However, there is no empirical evidence on whether universities do indeed fall short of teaching such alternative skill sets.

We contribute to this discussion by providing a first empirical glance at the role that university education plays in building non-cognitive skills. Following the education decisions of a sample of Australian youths from 2005 until 2013 and controlling for the self-selection into university edu-

p-value of the F-test statistic is 0.356.

[37]We conducted an F-test of equality of differences in mean changes in emotional stability and mental health across all fields of study. The p-values of the F-test statistics are 0.005 and 0.09 respectively.

cation, we find strong evidence that Australian universities contribute to building, at least some, non-cognitive skills. Young people who enter the university track or complete tertiary education have significantly increased their levels of extraversion, which is a measure of sociability and outward orientation. University life 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. In addition, university education appears to act as a buffer against mental health shocks. Youths who go onto university are significantly less likely to experience large negative changes in their mental health relative to comparable youths who do not go to university.

University education also boosts scores on agreeableness, a proxy for cooperation and kindness, for students from low socioeconomic backgrounds. It is true that youths from disadvantaged backgrounds start out with lower levels of agreeableness before they enter the university track, and thus there is more potential for upward mobility for them than for youths from privileged backgrounds. However, the effects remain robust when controlling for individual-specific, time-invariant heterogeneity and specifically conditioning on the initial differences in agreeableness.

Somewhat surprising is the finding that university education has very little impact on shaping non-cognitive skills that are commonly associated with a hard work ethic and responsiveness (conscientiousness), and intellect (openness to experience). In the case of conscientiousness this could be the case because youths who enter the university track are highly self-selected by high levels of conscientiousness. When controlling for this self-selection with our matching method, we do indeed find a positive treatment effect of university education on conscientiousness. The same does not hold true for openness to experience. An important finding is that the treatment effect of university education on extraversion does not differ by university type or field of study.

This suggests that despite the strong self-selection into university type and field of study by cognitive ability and socioeconomic background, and despite the heterogeneity in teaching quality and curriculum, there seems to be a general characteristic inherent to all universities to shape outward orientation.

We draw two conclusions from our findings. On the one hand, university education in Australia is successful in shaping some non-cognitive skills which employers and society value. The public discourse is misguided on claiming that universities need a major overhaul of curriculums and the way they teach students. On the other hand, our robust findings contribute to a wider discussion that seeks to enhance non-cognitive skills through the education sector. The current policy focus is centered on early childhood education (e.g. Chetty et al. 2011; Dee and West 2011; Heckman et al. 2010, 2013). Our findings suggest that non-cognitive skills can still be shaped at later stages, which supports also the evidence presented in Dahmann and Anger (2014) and Kautz and Zanoni (2014) for secondary school in Germany and Chicago, respectively. This conclusion may result in the possibility for targeting interventions to boost non-cognitive skills in the secondary and tertiary education sector.

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ONLINE APPENDIX

A Definition of life events in any given year

Table A.1: Negative and positive life events

Questions
Negative life events
Serious personal illness or injury
Serious personal illness to family member
Death of spouse or child
Death of close family member or relative
Death of a close friend
Victim of physical violence
Victim of property crime
Family member detained in jail
Fired or made redundant
Major worsening of finances
Positive life events
Got married
Got back together with spouse
Pregnancy
Birth or adoption of new child
Promoted at work
Major improvement of finances
Changed jobs

Note: Life-events are part of a self-completion questionnaire of HILDA
Life-event data is available from Wave 2 (2002) onwards

B   Sample summary statistics

Table B.1: Summary statistics of selected variables

	mean	SD	min	max
Extraversion (change)	−0.12	0.95	−2.8	3.5
Agreeableness (change)	0.22	0.99	−3	5
Conscientiousness (change)	0.44	1.02	−2.5	4.5
Emotional stability (change)	0.08	1.15	−3.5	4
Openness to experience (change)	0.01	1.05	−4.3	3.7
Mental health (change)	0.53	18.41	−56	60
Extraversion (1 SD increase)	0.19	0.39	0	1
Agreeableness (1 SD increase)	0.22	0.41	0	1
Conscientiousness (1 SD increase)	0.31	0.46	0	1
Emotional stability (1 SD increase)	0.22	0.42	0	1
Openness to experience (1 SD increase)	0.19	0.39	0	1
Mental health (1 SD increase)	0.15	0.36	0	1
Extraversion (1 SD decrease)	0.25	0.43	0	1
Agreeableness (1 SD decrease)	0.12	0.33	0	1
Conscientiousness (1 SD decrease)	0.09	0.28	0	1
Emotional stability (1 SD decrease)	0.19	0.39	0	1
Openness to experience (1 SD decrease)	0.17	0.37	0	1
Mental health (1 SD decrease)	0.14	0.35	0	1
Complet(ed/ing) bachelor	0.35	0.48	0	1
Father OSS	49.80	23.48	4.9	100
Age	24.87	1.43	23	27
Female	0.56	0.50	0	1
COB: AUS (ref.)				
COB: Eng speaking	0.01	0.12	0	1
Cob: Other	0.05	0.21	0	1
Section of State: Major urban (ref.)				
Non-major urban	0.32	0.47	0	1
Got married	0.15	0.36	0	1
Separated from spouse	0.27	0.45	0	1
Pregnancy	0.22	0.41	0	1
Birth/adoption of new child	0.17	0.38	0	1
Serious personal injury/illness	0.24	0.43	0	1
Serious injury/illness to family member	0.45	0.50	0	1
Death of close relative/family member	0.46	0.50	0	1
Death of a close friend	0.31	0.46	0	1
Victim of a property crime	0.28	0.45	0	1
Fired or made redundant	0.24	0.43	0	1
Changed jobs	0.78	0.41	0	1
Promoted at work	0.41	0.49	0	1
Changed residence	0.79	0.41	0	1
High schools				
Public	0.20	0.40	0	1
Private catholic	0.13	0.34	0	1
Private independent	0.01	0.10	0	1
Years in paid work between 2005 and 2013	6.42	0.93	0	7.8
Difference in physical functioning between 2005 and 2013	0.83	19.98	−95	100
Observations	618			

Note: Estimation sample is 618 teenagers who were aged between 15 and 19 in 2005.

C Balance of covariates before and after coarsened exact matching

Table C.1: Difference in means of relevant covariates (before treatment and) before matching between youth who will graduate from university and youth who will not

	Treatment	Control	Diff	t-stat	p-value
Extraversion 13	4.67	4.50	0.17	1.84	0.067
Agreeableness 13	5.41	5.32	0.09	1.09	0.275
Conscientiousness 13	5.20	4.89	0.31	3.33	0.001
Emotional stability 13	5.03	4.87	0.16	1.59	0.112
Openness to experience 13	4.52	4.32	0.20	2.12	0.035
Mental health (13)	74.52	72.58	1.94	1.27	0.204
Extraversion (change)	0.07	−0.19	0.26	3.00	0.003
Agreeableness (change)	0.13	0.26	−0.13	−1.43	0.153
Conscientiousness (change)	0.42	0.44	−0.02	−0.19	0.851
Emotional stability (change)	0.14	0.06	0.08	0.78	0.438
Openness to experience (change)	−0.09	0.04	−0.13	−1.34	0.181
Mental health (change)	2.79	−0.30	3.08	1.85	0.065
Extraversion 05	4.60	4.69	−0.09	−0.94	0.349
Agreeableness 05	5.28	5.07	0.22	2.59	0.010
Conscientiousness 05	4.77	4.45	0.33	3.67	0.000
Emotional stability 05	4.90	4.82	0.08	0.86	0.393
Openness to experience 05	4.60	4.27	0.33	3.51	0.000
Mental health (05)	71.73	72.88	−1.15	−0.75	0.455
Age	25.01	24.83	0.18	1.39	0.164
Female	0.70	0.51	0.19	4.20	0.000
DV: ASGC 2001 Section of State	0.20	0.36	−0.16	−3.82	0.000
Father OSS	59.02	46.44	12.58	6.06	0.000
$1 - $9,999	0.01	0.01	0.00	0.37	0.708
$10k - $19,999	0.02	0.03	−0.01	−0.43	0.670
$20k - $29,999	0.04	0.05	−0.00	−0.20	0.845
$30k - $39,999	0.04	0.09	−0.06	−2.31	0.021
$40k - $49,999	0.04	0.09	−0.06	−2.31	0.021
$50k - $59,999	0.07	0.08	−0.01	−0.60	0.548
$60k - $79,999	0.13	0.11	0.02	0.60	0.547
$80k - $99,999	0.10	0.15	−0.05	−1.50	0.135
$100k - $124,999	0.12	0.14	−0.02	−0.49	0.627
$125k - $149,999	0.12	0.09	0.03	1.24	0.215
$150k - $199,999	0.17	0.07	0.11	3.97	0.000
>$200k	0.12	0.09	0.03	1.24	0.215
Observations	618				

Source: HILDA, waves 5 and 13

Note: Includes all respondents aged 15 to 19 in wave 5. Father's occupational class is defined via the Father's Occupational Prestige Score. A one-standard deviation increase in occupational prestige is 23.48 points on a scale from 0 to 100.

Table C.2: Difference in means of relevant covariates (before treatment and) before matching between youth who will graduate from university and youth who will not

	Treatment	Control	Diff	t-stat	p-value
Extraversion 13	4.75	4.38	0.37	2.84	0.005
Agreeableness 13	5.43	5.51	−0.08	−0.85	0.394
Conscientiousness 13	5.20	4.92	0.28	2.31	0.021
Emotional stability 13	5.16	4.89	0.28	2.03	0.043
Openness to experience 13	4.47	4.43	0.03	0.26	0.796
Mental health (13)	76.15	72.36	3.79	1.92	0.056
Extraversion (change)	0.08	−0.27	0.35	2.99	0.003
Agreeableness (change)	0.09	0.14	−0.06	−0.57	0.569
Conscientiousness (change)	0.46	0.17	0.30	2.62	0.009
Emotional stability (change)	0.17	−0.07	0.24	1.84	0.067
Openness to experience (change)	−0.09	0.03	−0.13	−1.04	0.301
Mental health (change)	2.86	−3.96	6.82	3.25	0.001
Extraversion 05	4.67	4.65	0.02	0.17	0.866
Agreeableness 05	5.34	5.37	−0.03	−0.32	0.748
Conscientiousness 05	4.74	4.76	−0.02	−0.18	0.861
Emotional stability 05	4.99	4.96	0.03	0.25	0.802
Openness to experience 05	4.56	4.40	0.16	1.29	0.197
Mental health (05)	73.29	76.32	−3.03	−1.63	0.104
Age	25.03	24.80	0.23	1.30	0.194
Female	0.65	0.65	0.00	0.00	1.000
DV: ASGC 2001 Section of State	0.20	0.29	−0.10	−1.86	0.064
Father OSS	57.39	53.32	4.07	1.42	0.155
$1 - $9,999	0.02	0.02	0.00	0.00	1.000
$10k - $19,999	0.02	0.04	−0.02	−0.72	0.475
$20k - $29,999	0.05	0.02	0.03	1.29	0.199
$30k - $39,999	0.03	0.09	−0.06	−2.07	0.039
$40k - $49,999	0.05	0.08	−0.04	−1.25	0.212
$50k - $59,999	0.08	0.06	0.02	0.49	0.627
$60k - $79,999	0.15	0.08	0.07	1.72	0.086
$80k - $99,999	0.08	0.13	−0.05	−1.42	0.156
$100k - $124,999	0.14	0.15	−0.01	−0.17	0.863
$125k - $149,999	0.12	0.11	0.02	0.39	0.700
$150k - $199,999	0.16	0.12	0.04	0.88	0.378
>$200k	0.11	0.11	0.01	0.20	0.845
Observations	266				

Source: HILDA, waves 5 and 13

Note: Includes all respondents aged 15 to 19 in wave 5. Father's occupational class is defined via the Father's Occupational Prestige Score. A one-standard deviation increase in occupational prestige is 23.48 points on a scale from 0 to 100.

D Full estimation results: OLS

Table D.1: Estimated effects of university participation on changes in the Big-Five personality traits and mental health (OLS estimates)

	Extrv	Agree	Consc	Emote	Openn	Mental
Complet(ed/ing) bachelor=1	0.359***	−0.061	−0.089	0.035	0.049	0.166*
	(0.096)	(0.083)	(0.087)	(0.088)	(0.093)	(0.088)
Complet(ed/ing) bachelor=1 × Father OSS	0.021	−0.222**	0.031	−0.059	−0.038	−0.068
	(0.089)	(0.088)	(0.088)	(0.082)	(0.087)	(0.080)
Father OSS	−0.018	0.089	−0.057	−0.053	−0.059	−0.055
	(0.059)	(0.064)	(0.060)	(0.058)	(0.063)	(0.057)
Age	0.086*	−0.029	−0.023	0.150***	−0.040	−0.014
	(0.049)	(0.050)	(0.050)	(0.050)	(0.052)	(0.049)
Female	−0.120	0.169**	0.109	0.021	−0.147*	0.099
	(0.088)	(0.082)	(0.081)	(0.085)	(0.087)	(0.085)
COB: Eng speaking	−0.123	0.161	0.115	0.197	−0.341	0.271
	(0.190)	(0.297)	(0.289)	(0.234)	(0.296)	(0.262)
COB: Other	−0.232	−0.568***	−0.230	−0.118	−0.123	0.132
	(0.235)	(0.157)	(0.185)	(0.193)	(0.154)	(0.244)
Non major urban	0.039	−0.050	−0.103	−0.117	−0.118	−0.083
	(0.091)	(0.094)	(0.096)	(0.095)	(0.093)	(0.095)
Got married	−0.108	−0.152	−0.001	−0.004	−0.173	−0.139
	(0.119)	(0.118)	(0.118)	(0.131)	(0.121)	(0.116)
Separated from spouse	0.196*	−0.139	−0.030	0.091	−0.036	0.129
	(0.101)	(0.097)	(0.095)	(0.096)	(0.097)	(0.100)
Pregnancy	0.139	0.080	0.160	0.281	0.165	0.144
	(0.187)	(0.249)	(0.174)	(0.232)	(0.261)	(0.180)
Birth/adoption of new child	−0.195	−0.223	−0.224	−0.333	−0.098	−0.006
	(0.201)	(0.258)	(0.192)	(0.246)	(0.265)	(0.199)
Serious personal injury/illness	−0.053	0.115	−0.054	−0.183**	0.170*	−0.129
	(0.096)	(0.098)	(0.099)	(0.093)	(0.096)	(0.100)
Serious injury/illness to family member	0.069	−0.021	0.149*	0.040	−0.004	0.042
	(0.084)	(0.083)	(0.084)	(0.084)	(0.086)	(0.085)
Death of close relative/family member	0.028	−0.003	0.212**	0.166**	−0.044	−0.020
	(0.083)	(0.086)	(0.086)	(0.081)	(0.084)	(0.089)
Death of a close friend	0.134	0.132	0.031	0.192**	−0.014	0.187**
	(0.086)	(0.096)	(0.092)	(0.091)	(0.093)	(0.093)
Victim of a property crime	0.010	−0.006	−0.021	0.009	−0.039	0.077
	(0.094)	(0.100)	(0.101)	(0.094)	(0.094)	(0.098)
Fired or made redundant	−0.070	−0.064	−0.004	0.015	−0.009	−0.110
	(0.101)	(0.101)	(0.098)	(0.096)	(0.101)	(0.101)
Changed jobs	−0.001	0.023	0.013	0.236**	−0.208*	0.058
	(0.106)	(0.114)	(0.113)	(0.107)	(0.106)	(0.109)
Promoted at work	−0.014	0.033	0.106	−0.051	−0.046	−0.025
	(0.086)	(0.089)	(0.092)	(0.085)	(0.087)	(0.086)
Changed residence	−0.074	0.114	0.070	−0.206*	−0.051	0.013
	(0.109)	(0.101)	(0.104)	(0.110)	(0.106)	(0.115)
Catholic non-government school	0.056	0.018	0.165	−0.131	0.170	−0.036
	(0.109)	(0.102)	(0.103)	(0.110)	(0.111)	(0.089)
Other non-government school	0.093	−0.139	−0.014	0.035	0.157	0.119
	(0.119)	(0.119)	(0.122)	(0.106)	(0.132)	(0.125)
Other	−0.968***	0.213	−0.674***	−0.076	−0.066	0.534
	(0.223)	(0.262)	(0.256)	(0.567)	(0.563)	(0.507)
Years in paid work between 2005 and 2013	0.023	0.012	−0.047	−0.031	−0.013	−0.052
	(0.049)	(0.051)	(0.055)	(0.043)	(0.046)	(0.055)
Difference in physical functioning between 2005 and 2013	0.064	−0.004	0.063	0.101*	−0.005	0.075
	(0.047)	(0.041)	(0.045)	(0.051)	(0.044)	(0.049)
Flag Father OSS missing	0.188	−0.040	−0.022	−0.117	−0.010	0.025
	(0.134)	(0.135)	(0.138)	(0.152)	(0.143)	(0.144)
Flag secondary school missing	−0.387*	0.043	0.350	−0.036	0.189	−0.172
	(0.229)	(0.287)	(0.231)	(0.183)	(0.277)	(0.221)
Flag Work experience missing	−0.034	0.045	0.009	0.168	−0.048	−0.107
	(0.113)	(0.104)	(0.112)	(0.114)	(0.111)	(0.106)
Flag Physical Health Missing	0.195	0.112	0.603	−1.271**	0.392	−0.306
	(0.345)	(0.409)	(0.407)	(0.531)	(0.702)	(0.251)
Constant	−0.085	−0.104	−0.287	−0.200	0.329*	−0.138
	(0.173)	(0.176)	(0.180)	(0.178)	(0.169)	(0.183)
R^2	0.07	0.05	0.06	0.09	0.05	0.06

Source: HILDA, waves 5 and 13.

Note: Includes all respondents aged 15 to 19 in wave 5.

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

E Selection effects into university education

To understand better the selection effect into university education by NCS, we estimated a logistic regression model of the effect of NCS measured in 2005 on the probability of graduating from university by 2013 for our youth sample. The dependent variable is binary, taking the value 1 if the individual had graduated from university by 2013, and 0 otherwise. Further control variables are cognitive ability measured in wave 12, a continuous measure of internal locus of control measured in wave 4, being female, country of birth, non-major urban area, and high school type (private, public, catholic). Conditioning on non-missing observations, the estimation sample in this section is 618 individuals. We consider only wave 13 data on education to allow the young sample members enough time to enter (and complete) university. Many students from disadvantaged backgrounds, for instance, enter university as mature students. The base probability of having completed a university degree by 2013 for this youth sample is 14% for men and 26% for women, 29% for youths from high SES and 13% for youths from low SES. Youth conscientiousness stands out as the single most important predictor of university graduation among the Big Five personality traits.

Table E.1 reports the estimation results. A one-standard-deviation increase in conscientiousness increases the probability of a university degree by 4.7 percentage points (p.p.) or 24% from the sample mean, while this association does not differ across the sexes (t-stat 0.006) and socioeconomic status of the parents (t-stat 0.47). Further, we find a penalty of extraversion on university graduation but it is statistically significant for men only (-3.7 p.p.) and in magnitude this penalty is strongest for male youth from high socioeconomic status backgrounds (-4.7 p.p.). Agreeableness is positively correlated with university graduation but only so for youth from high socioeconomic

backgrounds (6.6 p.p.). The effects of conscientiousness, extraversion for men, and agreeableness for youth from privileged backgrounds on university graduation are equivalent to 53%, 42%, and 74%, respectively of the effect of cognitive ability. Youth openness to experience no longer has a statistically significant effect on university education, once cognitive ability is controlled for.

Table E.1: A logit model for attaining a university degree by 2013, showing marginal effects at mean

	All	Male	Female	High SES	Low SES
Cognitive ability	0.089***	0.041***	0.132***	0.118***	0.054***
	(0.015)	(0.014)	(0.028)	(0.031)	(0.015)
Extraversion in 2005	−0.025*	−0.037**	−0.019	−0.047	−0.010
	(0.014)	(0.017)	(0.022)	(0.029)	(0.013)
Agreeableness in 2005	0.020	−0.007	0.019	0.066**	−0.006
	(0.016)	(0.016)	(0.029)	(0.030)	(0.015)
Conscientiousness in 2005	0.047***	0.041***	0.040	0.059**	0.037***
	(0.015)	(0.015)	(0.026)	(0.029)	(0.014)
Emotional stability in 2005	−0.001	0.009	0.004	−0.026	0.007
	(0.016)	(0.015)	(0.028)	(0.032)	(0.014)
Openness to experience in 2005	0.023	0.017	0.035	0.005	0.021
	(0.016)	(0.015)	(0.028)	(0.029)	(0.017)
Base prob	0.20	0.14	0.26	0.29	0.13
Pseudo R^2	0.16	0.21	0.16	0.16	0.17
Observations	618	298	318	269	347

Source: HILDA, waves 5 and 13.

Note: The sample includes individuals who were interviewed throughout waves 5 to 13, but excludes 63 individuals who entered but have not completed university yet from the control group. NCS are measured in wave 5, while university graduation is measured in wave 13. This regression model controls for age, gender, socioeconomic status, region, and country of origin.

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