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THE EFFECT OF NONCOGNITIVE TRAITS ON HEALTH BEHAVIOURS IN ADOLESCENCE

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ABSTRACT

This paper investigates the relationship between personality traits and health behaviours in adolescence using a large and recent cohort study. In particular, we investigate the impact of locus of control, self-esteem and work ethics at ages 15–16 years on the incidence of health behaviours such as alcohol consumption, cannabis and other drug use, unprotected and early sexual activity and sports and physical activity. We use matching methods to control for a very rich set of adolescent and family characteristics, and we find that personality traits do affect health behaviours. In particular, individuals with external locus of control, low self-esteem or with low levels of work ethics seem more likely in engage in risky health behaviours. Copyright © 2014 John Wiley & Sons, Ltd.

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1. INTRODUCTION

The objective of this paper is to analyse the role of noncognitive traits on health behaviours in adolescence. In particular, we study the effect of locus of control, self-esteem and work ethics recorded when the child is 15–16 years old on subsequent risky health behaviours up to when she or he is 19–20 years old.

We contribute to the existing literature in two ways. First, we provide evidence from a more recent dataset based on a large cohort of English children born in 1990 and followed for 7 years, starting in 2004. Our analysis is focused on personality traits in adolescence. A variety of studies have shown that personality traits are relatively malleable, at least over the early life cycle. There is some evidence that policy interventions can target adolescents to promote useful traits and suppress harmful ones early in life. Existing studies either rely on relatively dated data (NLSY79 for Heckman *et al*., 2006 and 1970 British Cohort Study for Preevo and ter Weel, 2013) or do not have a specific focus on adolescents (Chiteji, 2010 and Cobb-Clark *et al*., 2012). Second, we use propensity score matching (PSM) to investigate the relationship between personality and health and ordinary least squares (OLS) estimation. OLS is widely regarded in providing an estimate of an upper bound on the causal effect, and PSM may be thought to tighten that bound.

Risky behaviour with respect to health is important and costly. In particular, risky health behaviours among youths are a major concern for many Western developed countries (see US CDC [Centers for Disease Control and Prevention], 2011). Many studies point to early initiation of these behaviours being strongly related to dependency in adulthood (Chen and Kandel, 1995).

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The issue seems to be particularly relevant for the British population: According to the United Nations Children's Fund Innocenti Report on child poverty (UNICEF Innocenti Research Centre, 2007), the prevalence of risky behaviours amongst UK youths is higher than in other similar Organisation for Economic Co-operation and Development (OECD) countries. Hale and Viner (2012) show that British children aged between 16 and 24 years are likely to drink over double the daily recommended amounts on their heaviest drinking day in the last week, and their frequent drug use is higher than for older respondents (Craig and Hirani, 2010 and NHS Information Centre, 2011). Abortion and sexually transmitted infections (STIs) rates peak in adolescence (Department of Health, 2011), and 16- to 24-year olds account for over half on new STIs diagnosed in the UK (Health Protection Agency, 2011).

The incidence of risky health behaviour in the UK is higher than in other Organisation for Economic Co-operation and Development countries, and the impact on a public universal health care system, such as the National Health Service, is likely to be considerable. So providing further evidence of the effect on personality on health behaviours from a recent cohort of English teenagers could be an important contribution to the current policy debate.

Individual risky health behaviours pose a major burden for health and for the health services. In 2006–2007, smoking-related costs on the National Health Service were £3.3bn, alcohol costs were £3.3bn and overweight and obesity costs were £5.1bn (Scarborough *et al*., 2011). In England and Wales in 2003/2004, drug use was estimated to impose economic and social costs of £15.4bn (Gordon *et al*., 2006). In the USA in 2000, the annual health costs for STIs reached $17bn (CDC [Centers for Disease Control and Prevention], Division of STD Prevention, 2000). There are also other social and economic costs related to risky health behaviours, such as increased incidence of violence and crime, accidents, mental health disorders and loss of educational opportunities.

The rest of this paper is organized as follows. Section 2 provides a brief overview of the existing literature; Section 3 presents the data and explains the personality indicators and health-related outcomes that it contains; Sections 4 and 5 discuss the estimation methods and the results, respectively; and Section 6 concludes with a discussion of the policy implications of the work. The headline finding of the research is that we broadly support the idea that noncognitive skills are important in determining health choices in early adult life. Individuals with external locus of control, low self-esteem and low levels of work ethics[1] are all more likely to engage in risky behaviours, such as cannabis and drugs taking and unprotected sex.

2. OVERVIEW OF THE EXISTING LITERATURE

The evidence on the effect of personality on health has suggested a variety of transmission mechanisms, such as health-related behaviours, longevity and social relationships. Almlund *et al.* (2011) provide an excellent review of the studies conducted in this area. They conclude that most of the literature from psychology and health sciences shows that personality traits such as conscientiousness, openness to experience and agreeableness generally have a positive effect on longevity and health behaviours (Hampson *et al*., 2007; Gale *et al*., 2008; Hampson *et al*., 2010; Lodi-Smith *et al*., 2010). However, most of these studies tend to use small or unrepresentative samples (see Roberts *et al*., 2007 for a review and Bogg and Roberts, 2004 for a meta-analysis).

The economics literature in this area is limited. Heckman *et al*. (2006) use data from the US NLSY1979 and show that locus of control and self-esteem affect the probability of smoking, using marijuana and being a teenager mother. Chiteji (2010) uses data from the US Panel Study of Income Dynamics to show that locus of control and self-efficacy (which refers to the evaluation of one's ability to be effective in performing tasks that are necessary to realize an outcome) are associated with lower alcohol consumption and more physical exercise. Preevo and ter Weel (2013) use data from the 1970 British Cohort Study and show that early conscientiousness decreases adult BMI, alcoholism, cannabis use and smoking. Last, Cobb-Clark *et al*. (2012) use Australian data to show that individuals with an internal locus of control are more likely to eat well and exercise regularly.

[1]These concepts are explained and defined in Section 3.

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The economics literature has also investigated the stability of personality traits over the lifecycle (Cobb-Clark and Schurer, 2013) and the relationship between personality traits and economic preferences (see, for example, Becker *et al*., 2012); education outcomes, such as study behaviour (Delaney *et al*., 2012), class attendance (Lounsbury *et al*., 2004) and human capital investments (Coleman and DeLeire, 2003); and labour market outcomes, such as occupational attainment, wages (Duncan and Dunifon, 1998; Nyhus and Pons, 2005; Osborne Groves, 2005; Cobb-Clark and Tan, 2011; Drago, 2011) and unemployment transitions (Cuesta and Budria, 2012).

Conventional economic analysis relies heavily on using economic incentives to affect behaviour. Although there is some evidence that suggests that this can be successful in preventing the adoption of unhealthy behaviours, there is clearly room for working on behaviour through preferences as well. Cobb-Clark *et al*. (2012) suggest that economic constraints can provide only a limited explanation of the choices relating to health behaviours in standard economic models based on utility maximization. Personality traits can have profound effects on both preferences and constraints, and economists have only recently become interested in investigating the role of noncognitive traits in investments in health. Indeed, health economists have devoted a significant amount of effort to investigate the determinants of risky health behaviours and have shown the importance of factors such as education (Grossman, 2000 and Cutler and Lleras Muney, 2005; Grossman, 2006), risk attitudes (Anderson and Mellor, 2008), time preference (Van Der Pol, 2011) and peer effects and social networks (Van Der Pol, 2011). However, this literature has not taken personality traits directly into account. Thus, it is natural to extend this exploration of the role of preferences to consider also the role of psychological traits using large-scale and nationally representative data with a focus on the causal relationships between personality and health.

3. DATA

This paper uses data from the Longitudinal Study of Young People in England (LSYPE). This is a large-scale cohort survey of English adolescents, selected to be representative of the young people in England but at the same time as oversampling specific groups. Adolescents were interviewed for the first time when they were in school year 9 in 2004 at the age of 14 years. In addition, LSYPE can be linked to the National Pupil Database, a pupil-level administrative database that matches pupil and school characteristics data to pupil attainment and contains detailed information on test scores for all the LSYPE children. We use this data to obtain information about LSYPE children's results in test scores at age 11 years (key stage 2 scores).

In the first wave, around 15 500 young people were interviewed. In the first four waves, parents/guardians were also interviewed. Our final sample includes around 5000 observations of children with nonmissing information on personality traits, cognitive ability, health behaviours and other essential information on the child's birth and family background (the selected observations were not significantly different from the original data in terms of their observable characteristics).

The study is managed by the Department of Education and covers a wide range of topics, including academic achievements, family relationships, attitudes toward school, family and labour market and some more sensitive or challenging issues, such as risky health behaviours (smoking, alcohol drinking and drug taking) and personal relationships. We focus on four groups of outcomes observed at wave 6: cannabis and drug use, sex behaviour, drinking and sport and physical activity. These questions are answered by the child through self-completion questionnaires, in order to minimize the risk of misreporting on these sensitive topics. Unfortunately, information about smoking is only available in LSYPE until wave 3, and no information is collected about nutrition habits. Table I lists the variables that constitute the behavioural outcomes of interest.

Personality is complex, and factor analysis has been utilized extensively in personality psychology to identify a number of common factors derived from a variety of questions (Piatek and Pinger, 2010; Almlund *et al*., 2011; and Cobb-Clark *et al*., 2012). Although our data does not include information about the Big Five personality traits that have been the focus of some recent research (see Almlund *et al*., 2011 for a review of possible alternatives), it does include a series of questions on locus of control, self-esteem and attitudes to work.

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Table I. Outcomes

Health behaviours	Variable
Ever tried cannabis	1 if yes
Ever tried other drugs such as cocaine, lysergic acid diethylamide (LSD), ecstasy, heroin, crack and speed	1 if yes
Age of first sexual intercourse	1 if 15 years or younger
Ever had unprotected sex	1 if yes and ever had unprotected sex
Heavy drinking	1 if drinking at least three to four times a week in the last year
Often drunk	1 if gets drunk most or every times drinks
Never drunk	1 if never gets drunk when has an alcoholic drink
Low physical activity	1 if does sports hardly ever or never.

Locus of control refers to individual beliefs about whether life events are mostly internally or externally determined (Rotter, 1966). People with an external locus of control believe that what happens in life is largely determined by events beyond their control, whereas individuals with internal locus of control generally believe that life events are mostly caused by their own decisions and behaviours. We measure locus of control using children's responses to six questions (see the Appendix for details). We follow previous literature in the field (see, for example, Cobb-Clark *et al*., 2012 and Piatek and Pinger, 2010) and use factor analysis to create indexes of internal and external locus of control. Children are coded as external if they have a score in the top quartile of the distribution of the external index, derived from factor analysis. We also test this definition, by classifying children as external if they have a score in the top third or fifth of the distribution of the external index (Appendix Table S1).

Self-esteem refers to an individual perception of her or his own value. LSYPE data includes two questions on self-esteem (see Appendix for details) asked at waves 2 and 4. We construct an indicator of low self-esteem equal to 1 if they have placed themselves in the most distressed category for one of the two questions at least once between the two waves (around 26% of the children in the sample).[2]

Almlund *et al*. (2011) suggest that competence, dutifulness, self-discipline, perseverance and work ethic are all facets of conscientiousness. LSYPE includes four questions on working attitudes (see Appendix for details), and we use factor analysis to create an index of work ethics. Children are coded as having high work ethics if they have a score in the top quartile of the distribution of the index.

We estimate two versions of our model, progressively increasing the set of independent variables. All of the variables we control for are, arguably, predetermined variables – that is, not themselves influenced by personality traits. Our first, most parsimonious, model only includes at-birth characteristics such as birthweight, whether the child was premature, ethnic background, sex of the child and family characteristics such as marital status and age of the mother at birth. In the second preferred model, we include a measure of cognitive ability at age 11 years (key stage 2 scores) and other family's characteristics (measured at wave 1) that are unlikely to have changed since the child's birth, such as maternal education, child and mother disability, grandparents' education and older siblings.[3] We include a measure of cognitive ability in our preferred specification as this is likely to have an important effect on health behaviours, and because we want to test whether personality traits capture independent effects other than the cognitive ability. Further, key stage 2 score is unlikely to be endogenous with respect to personality, as it is derived through a standardized and objective test (rather than through teachers' or parents' evaluations), and it is completed at age 11 years, 4 years earlier that the measure of personality was utilized in our analysis. We provide a correlation matrix of personality traits and cognitive ability in Appendix Table S2.

[2]Alternative/more restrictive indicators of low self-esteem were constructed to test the robustness of our estimates and results are available on request.

[3]Extensions to model 2 were estimated that also controlled for maternal employment and household income at wave 1. Results are reported in Table S5 in the Appendix.

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Table II presents descriptive statistics on the outcome variables, broken down by personality traits. Individuals with external locus of control and low self-esteem are more likely to engage in risky behaviours, such as cannabis and drug taking or early and unprotected sexual activity and less likely to engage in regular physical activity. Interestingly, the association with alcohol consumption is less pronounced. On the other hand, children with a high level of work ethics seem less likely to engage in risky health behaviours.

4. ESTIMATION

Although we begin by using OLS, to control for observable confounders, this is well known to lead to biased estimates of the causal effects because of neglected heterogeneity. The linear model can be written as follows:

$$H_i = \alpha + P_i'\beta + X_i'\gamma + \varepsilon_i$$

where H_i represents a particular health behaviour, P_i' is a vector of psychological traits (binary indicators of external locus of control, low self-esteem and high work ethics) and X_i' is a vector of child's and family's characteristics. We cannot, in this data, address the selection on unobservables problem. There is simply no quasi-experimental variation across our sample to exploit. However, we can go some way towards addressing the other problems. Moreover we do try to lower the upper bound provided by OLS estimation, through the inclusion of a more detailed set of independent variables. Second, we exploit PSM that does not rely on functional form assumptions and restricts inference to samples where we can find overlap in the distribution of covariates across the treatment. PSM may be thought of as assuming the selection problem way because it relies on conditional independence that implies no selection on the unobservables conditional on the observables.

On the other hand, matching methods have some desirable features: The observations used to estimate the causal effect are selected without reference to the outcome, as in a controlled experiment; it dominates other methods based on selection on observables (such as OLS), thanks to its more convincing comparison of treated and control units; it offers interesting insights for a better understanding of the estimation of causal effects and there is some (debated) evidence suggesting that it contributes to a reduction in the selection bias (Dehejia and Wahba, 2002; Smith and Todd, 2004, and Dehejia, 2005). At the very least, matching provides a convincing way to select the observations on which other estimation methods can be based. Matching is more robust than OLS because it does not restrict the way in which personality may affect behaviours to be linear, and inference is limited to samples that are effectively comparable, on the basis of the covariates distribution. Matching attaches appropriate weights to the observations in the control group, so that the distribution of their observable characteristics is realigned to the treatment group.

Propensity score matching has been used in various recent papers investigating the determinants of child well-being (see, for example, Ruhm, 2008; Berger *et al*., 2005; and Goodman and Sianesi, 2005) and the effect of personality traits (Caliendo *et al*., 2010). The idea of PSM is to match children with different personality

Table II. Descriptive statistics of outcome variables by locus of control, self-esteem and work ethics

	Whole sample	External	Low self-esteem	High work ethics
Mean (SD)				
Ever tried cannabis	0.33 (0.47)	0.37 (0.48)	0.40 (0.49)	0.23 (0.42)
Ever tried other drugs	0.12 (0.32)	0.15 (0.35)	0.16 (0.36)	0.07 (0.25)
Had first sexual intercourse younger than 16 years old	0.31 (0.46)	0.38 (0.48)	0.36 (0.48)	0.25 (0.43)
Ever had unprotected sex	0.43 (0.49)	0.50 (0.50)	0.49 (0.50)	0.36 (0.48)
Heavy drinking	0.23 (0.42)	0.21 (0.41)	0.22 (0.42)	0.20 (0.39)
Often drunk	0.29 (0.46)	0.33 (0.47)	0.33 (0.47)	0.28 (0.45)
Never drunk	0.09 (0.28)	0.09 (0.29)	0.08 (0.28)	0.11 (0.31)
Low physical activity	0.13 (0.33)	0.15 (0.35)	0.17 (0.37)	0.12 (0.32)

All outcomes are recorded at wave 6.

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traits (for example, with and without low self-esteem) who are as comparable as possible in all other respects so that they have similar propensities to be treated. More specifically, first, we estimate the conditional probability of having a specific personality trait, called the propensity score, such as having low self-esteem for each child, given our covariates. Then, estimated propensity scores are used to create a matched control group, and for each treated child, we find the comparison member with the closest propensity score. Nonmatched individuals are dropped from the analysis. Our analysis is performed using *psmatch2*, and appropriate tests have been run, in order to compare covariate distributions across our matched groups to ensure that adequate balance has been obtained (results available in Appendix Table S3).[4]

5. RESULTS

The results from the estimation of the effect of personality traits on health behaviours are presented in Tables III and IV. The effect of personality traits on health behaviours is very stable, and the size and magnitude of the effects do not change when we include one or more traits at the same time. The results presented in both Tables III and IV suggest that noncognitive skills generally have significant effects on health behaviours, and the effects are sizeable. In our discussion, we will focus on the results from PSM estimation of model 2 (Table IV), as this is our preferred specification.[5]

Figures 1 and 2 show the distribution of propensity scores across treatment and control groups. Both graphs show that there is sufficient overlap between the treatment and control groups.

Personality has a notable effect on some risky health behaviours and particularly cannabis and drug use, unprotected sex and low level of physical activity. The results from PSM estimation are generally consistent with those reported from OLS estimation, with slightly lower effects, on average, reported from PSM estimation. Nonetheless, the degree to which PSM tightens the OLS bound is surprisingly small. OLS seems to do a reasonable job despite our reservations. In most cases, where the OLS estimates are statistically significant, the corresponding PSM estimate is typically insignificantly different and generally slightly smaller. Results from balance test for PSM model are reported and discussed in Appendix Table S3.

In model 2, having an external locus of control increases the risk of taking cannabis, having ever had unprotected sexual intercourse or being younger than 16 years at first sexual intercourse by about 15–16% with respect to the sample mean and has a stronger negative effect on the chances of trying other drugs (+40%). These negative effects of external locus of control are not surprising, as external individuals tend to think that their choices have less impact on their future, which they believe are mostly driven by luck and external circumstances. As a consequence, they also seem less cautious in engaging in various risky health behaviours. As already noted, personality traits do not seem to have a relevant effect on drinking habits.

Young people with low self-esteem face an increased risk of taking drugs (+50%) and cannabis (+30%), engaging in early or unprotected sexual activity (around +18%) and having a low level of physical activity (+20%). A high level of work ethics seem to decrease chances of engaging in risk-taking behaviours, such as cannabis or drug use (−25% to −30%), early or unprotected sex (results between −13% and −16%) and low levels of physical activity (−30%.).

As expected, children with low self-esteem seem to underestimate the consequences of their risky health behaviours, and, possibly because they struggle to see themselves as valuable, they are less cautious with respect to their health. On the other hand, children with strong work ethics are more likely to carefully evaluate the consequences of their actions and to have a proactive orientation towards the future.

[4]Our approach is similar to Goodman and Sianesi (2005), and we use propensity score matching with the nearest neighbour method with replacement (as it has been shown to reduce bias relative to matching without replacement, Dehejia and Wahba, 2002) and then used the *common* option, so that off-support observations are automatically dropped. Similar results were obtained with other matching methods.

[5]Estimates are provided for model 2 and not for more complex models because it seems unwise to match according to data that are more likely to have changed between waves 1 and 6. However, sensitivity analyses have been run including some further variables (e.g. household income and maternal employment at wave 1). The main results are unchanged and are available in the Appendix.

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Table III. Effect of personality traits on health behaviours – ordinary least squares estimation results

	Ever tried cannabis	Ever tried other drugs	Had first sexual intercourse younger than 16 years old	Ever had unprotected sex	Heavy drinking	Often drunk	Never drunk	Low physical activity
Model 1								
External locus of control	0.024	0.025***	0.066***	0.064***	−0.030**	0.033**	0.006	0.023**
	(0.016)	(0.010)	(0.018)	(0.019)	(0.014)	(0.016)	(0.010)	(0.011)
High work ethics	−0.090***	−0.043***	−0.052***	−0.081***	−0.030**	−0.003	0.017+	−0.016
	(0.016)	(0.010)	(0.018)	(0.018)	(0.015)	(0.016)	(0.010)	(0.011)
Low self-esteem	0.106***	0.053***	0.069***	0.082***	0.009	0.029**	−0.014	0.035***
	(0.015)	(0.010)	(0.017)	(0.018)	(0.013)	(0.015)	(0.009)	(0.010)
No. of observations	5188	5190	3790	3928	4765	4656	4656	5239
F stat (p-value)	27.56 (0.000)	18.43 (0.000)	9.19 (0.000)	9.61 (0.000)	11.72 (0.000)	5.79 (0.000)	10.96 (0.000)	19.19 (0.000)
R^2	0.05	0.04	0.02	0.02	0.02	0.01	0.02	0.04
Model 2								
External locus of control	0.057	0.039	0.049	0.052	0.017	0.041	−0.008	0.016
	(0.016)***	(0.011)***	(0.019)**	(0.020)***	(0.016)	(0.017)**	(0.011)	(0.012)
High work ethics	−0.080	−0.038	−0.052	−0.075	−0.032	0.003	0.015	−0.017
	(0.016)***	(0.011)***	(0.019)***	(0.020)***	(0.015)**	(0.017)	(0.011)	(0.011)
Low self-esteem	0.102	0.056	0.066	0.082	0.012	0.033	−0.010	0.036
	(0.015)***	(0.010)***	(0.017)***	(0.018)***	(0.014)	(0.016)**	(0.010)	(0.011)***
No. of observations	4941	4942	3620	3742	4547	4443	4443	4988
F stat (p-value)	17.08(0.000)	10.19 (0.000)	4.99 (0.000)	5.13 (0.000)	12.22 (0.000)	3.74 (0.000)	6.11 (0.000)	9.01 (0.000)
R^2	0.07	0.05	0.03	0.03	0.06	0.02	0.03	0.04

Standard errors are in brackets.
*Indicates that the underlying coefficient is significant at 10% level;
**at 5%; and
***at 1%. Additional variables included in the analysis are listed at p. 9.

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Table IV. Effect of personality traits on health behaviours – propensity score matching results

	Ever tried cannabis	Ever tried other drugs	Had first sexual intercourse younger than 16 years old	Ever had unprotected sex	Heavy drinking	Often drunk	Never drunk	Low physical activity
Model 1								
External locus of control	0.062 (0.031)**	−0.001 (0.022)	−0.013 (0.035)	0.068 (0.036)+	0.005 (0.03)	0.058 (0.032)*	0.020 (0.021)	0.042 (0.021)**
No. of observations	5419	5420	3960	4113	4984	4871	4871	5474
High work ethics	−0.039 (0.028)	−0.059 (0.018)***	−0.090 (0.033)***	−0.071 (0.035)***	−0.005 (0.027)	0.008 (0.031)	0.011 (0.022)	−0.044 (0.022)*
No. of observations	6819	6827	4865	5064	6216	6072	6072	6893
Low self-esteem	0.117 (0.030)***	0.049 (0.019)***	0.0499 (0.033)	0.121 (0.034)***	0.034 (0.027)	0.026 (0.031)	−0.003 (0.021)	0.017 (0.023)
No. of observations	7621	7629	5417	5650	6942	6776	6776	7721
Model 2								
External locus of control	0.056 (0.024)***	0.052 (0.0159)***	0.045 (0.027)*	0.067 (0.028)***	0.006 (0.021)	0.039 (0.024)	−0.001 (0.016)	0.016 (0.017)
High work ethics	−0.075 (0.022)***	−0.036 (0.014)***	−0.049 (0.026)*	−0.050 (0.027)*	−0.029 (0.021)	0.005 (0.023)	0.022	−0.039 (0.016)***
Low self-esteem	0.097 (0.021)***	0.062 (0.014)***	0.061 (0.024)***	0.069 (0.025)***	0.021 (0.019)	0.035 (0.022)		0.032 (0.016)***
No. of observations	4941	4942	3620	3742	4547	4443		4988

Standard errors are in brackets.
*Indicates that the underlying coefficient is significant at 10% level;
**at 5%; and
***at 1%. Model 1 includes one personality trait at a time and other basic covariates listed at p. 9. Model 2 includes all personality traits at one time and other covariates as discussed at p. 9.

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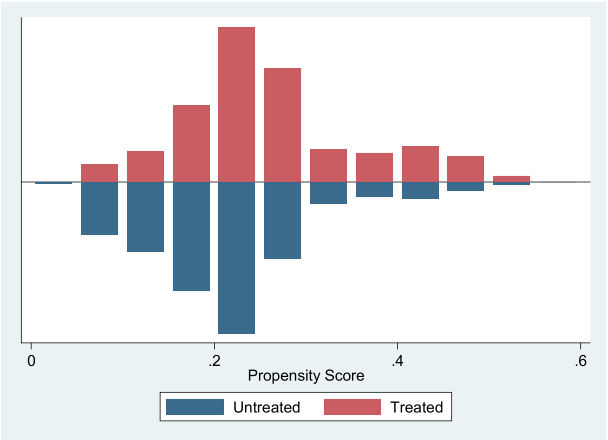

Figure 1. Histogram of propensity scores of treatment vs. control group (model 2 high work ethics = 1 – outcome: ever tried drugs)

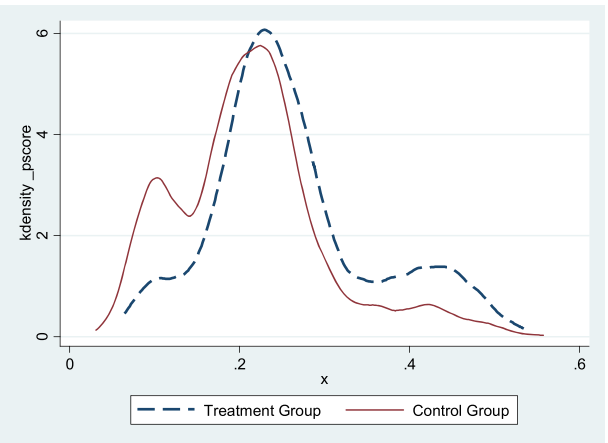

Figure 2. Kernel graphs of propensity score for treated and control group

Our findings are consistent with previous literature from psychology and economics. For example, Hampson *et al*. (2007) show that extraversion, agreeableness and conscientiousness affect health-related behaviours, such as smoking, diet and exercise (with correlation coefficients between 0.06 and 0.12); Gale *et al*. (2008) find that one standard deviation increase in age 10 years locus of control decreases the risk of adult obesity by 8%; Cobb-Clark *et al*. (2012) show that one standard deviation increase in internal behaviour increases the chances of healthy habits by around 2 p.p.

As shown in Appendix Table S4, the effects of personality traits are comparable with the effect of other important variables, such as the presence of siblings, the child's gender, having a young or single mother or growing up with a disabled parent, and are, in most cases, stronger than the effect of child's special needs and maternal education.

Generally, children who were less healthy at birth or had a disability or a special need are less likely to engage in risky behaviours. Boys seem more likely to experiment with cannabis, drugs, excessive drinking and risky sexual behaviour and so are children who grew up in a single parent family or have older siblings. Interestingly, ethnic minorities (and especially children with an Asian background) seem less likely to engage in risky behaviours, and maternal education increases the chances of taking drugs or cannabis or being a heavy

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drinker (possibly because of higher income and less supervision). Children who perform better in test scores at age 11 years also have slightly increased chances of trying cannabis, drugs or being heavy drinkers, but the size of the effect is marginal.

Additional sensitivity tests are included in the Appendix. As already explained, Appendix Table S1 presents results from the estimation with OLS and PSM of a model where we test our definition of external locus of control. Individuals are defined as being external if they have a score in the top third or fifth of the distribution of the index of locus of control. The results from Table S1 are consistent with previous ones. External locus of control increases the chances of engaging in risky behaviours such as trying cannabis or other drugs and engaging in early or unprotected sexual activity. Appendix Table S5 shows results from the estimation of a model that also includes maternal employment status and family income at wave 1. The main results are unchanged, and the effect of personality traits on health behaviours does not seem to be affected by the inclusion of these additional variables.

6. DISCUSSION AND POLICY IMPLICATIONS

In this section, we will focus on the interpretation of our results and, in particular, on the possible policy implications of our analysis. Our results show that personality plays a role in determining teenager choices in terms of risky health behaviours. Therefore, there is a potential for policies to exploit possible changes in personality in order to promote positive health choices later in life.

According to Borghans Duckworth *et al.* (2008), 'the answer to the question of whether change in personality is possible must be a definitive yes […]. However, change may be more difficult later in the life cycle'. Cobb-Clark and Schurer (2013) have shown that changes in locus of control are modest on average and are concentrated among the young or very old, so personality traits seem to be more likely to be malleable earlier in life. Furthermore, the psychological literature has shown that genetic factors are largely responsible for stability in personality in adulthood, whereas environmental factors are mostly responsible for change (Plomin and Nesselroade, 1990; Blonigen *et al.*, 2006). Therefore, it is essential to understand if and how it is possible to act on those environmental factors that mediate changes in personality.

Public policies focused on improving outcomes for children and adolescents have traditionally been centred on educational outcomes, such as increasing the number of years of schooling or improving school attainments, as education is a strong predictor of labour market participation, future wages and occupational choices. However, the role of noncognitive skills in promoting positive economic and social behaviours and human capital investments has recently received increased attention from economists and policy makers. Public policies focused on teenager and young people are gradually moving away from simply improving education outcomes or access to higher education for individuals from low socio-economic status to fostering a variety of noncognitive skills and emotional literacy that are correlated with lifetime outcomes.

A variety of interventions have been suggested that exploit the early malleability of personality to improve long-term outcomes. Selective personality-targeted interventions that focus on specific personality traits as risk factors for alcohol and substance use have recently been shown to be more effective than universal prevention programmes aiming at increase general knowledge about the harms of alcohol and substance misuse (see, for example, Conrod *et al.*, 2010; Foxcroft and Tsertsvadze, 2012; Conrod *et al.*, 2013). The PreVenture programme was implemented for children between 13 and 15 years old in Canada and the UK since 2001 and included tailored interventions based on screening results for four personality dimensions that have been linked to increased risk for alcohol and drug use. Subsequent evaluations showed that students in the intervention groups showed significantly lower use of alcohol and drugs than their peers in the control groups (Conrod *et al.*, 2006; Conrod *et al.*, 2010; O'Leary-Barrett *et al.*, 2010).

Almlund *et al.* (2011) discuss the importance of parental investments, education and interventions to promote positive changes in personality. Their work shows the effectiveness of interventions targeting younger children and specifically focusing on improving self-control and positive behaviour (Bierman *et al.*, 2010)

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and building up self-esteem and self-efficacy (Social and Character Development Research Consortium, 2010, as well as interventions targeting adults and focusing on openness to experience (Jackson *et al*., 2010). The well-known Perry Preschool programme, consisting of preschool sessions and home visits did improve important later-life outcomes through personality and is thought to have worked primarily through socio-economic channels.

In the UK, an example of these policies is the Social and Emotional Aspects of Learning (SEAL), a voluntary programme designed to develop the social and emotional skills of all school pupils in the areas of self-awareness, managing feelings, empathy, motivation and social skills. SEAL is currently being implemented in around 90% of primary schools and 70% of secondary schools. Various evaluations of SEAL have been conducted. Hallam *et al*. (2006) concluded that primary SEAL 'had a major impact on children's well-being, confidence, social and communication skills, relationships, including bullying, playtime behaviour, prosocial behaviour and attitudes towards schools'.

In the USA, the programme 'second step' focuses on core social-emotional skills such as empathy and communication, emotion management and problem solving and has been implemented for students from kindergarten to middle school. Evaluations of middle school second step have shown positive effect of the programme on social competence, prosocial skills and behaviours and decrease in depression and anxious behaviours (Taub, 2002).

The evaluations of a number of existing policies have shown that changing personality is possible, and interventions are useful, especially when they target young children and adolescents. We believe that our study shows some of the ultimate benefits of these programmes, which span a wide range of health behaviours, which might have important long-lasting consequences on individuals' lives and society as a whole.

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