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The roles of non-cognitive and cognitive skills in the life course development of adult health inequalities

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Abstract

Previous research has suggested that greater cognitive skill is protective against the development of socio-economic health inequalities across the life course, but the relative role of non-cognitive skills has been less investigated in this context. Using the prospective UK 1958 National Child Development Study (N = 18,558), higher factor scores for adolescent non-cognitive skills (NCS; i.e. a combination of work habits and pro-social behaviours) and mean cognitive skill (CS) at age 16 were examined with a path analysis model in relation to socioeconomic status (SES) across the life course (at ages 16, 33 and 50) and poor self-reported health at age 50. Adjusting for adolescent NCS explained over a third of the association between education and health, but the path between social class at age 50 and health was unaffected. Adjustment for CS explained larger proportions of the paths to adult health inequalities; and paths between CS and SES across the life course were stronger than the same paths with NCS. However, NCS was still independently associated with paths to later health inequalities in fully adjusted models, and both types of skill had equivalent inverse direct effects with poor health (OR: 0.82 [95% CI 0.73,0.93] vs 0.83 [0.72,0.96], respectively). Since NCS retained independent associations with SES and health across the life course, they could be a target for policies aimed at ameliorating the production of health inequalities for a wide range of children, regardless of their cognitive skill.

Keywords

UK; Health inequalities; Non-cognitive skills; Cognitive skill; Self-reported health; Socioeconomic status; Personality; Intelligence

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Declaration of interest
None.

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1 Introduction

A wide range of research has shown there are inequalities in general health by levels of socioeconomic status, but the debate continues around the mechanisms underlying these socioeconomic health inequalities (Kondo et al., 2009; Kunst et al., 2004; Power et al., 1998). Popular explanations for the production of health inequalities focus on the stratification of material resources at individual and societal levels (Lynch et al., 2000; Smith et al., 1994), social patterns of healthy lifestyles, and the impact of psychosocial mechanisms such as increased exposure to stress and psychological distress (Adler and Snibbe, 2003; Marmot, 2004). Some researchers have suggested that child cognitive ability may have an important role in the production of health inequalities due to its robust association with adult socioeconomic attainment, physical health, mental health and mortality (Deary et al., 2008; Gottfredson, 2004; Hatch et al., 2007b). One meta-analysis reported that cognitive skill had correlations in the range of 0.40–0.55 with education and occupational attainment, with other research suggesting that intelligence might explain between 20 and 50% of the socioeconomic gradient in health (Mackenbach, 2010; Strenze, 2007).

However, cognitive skill alone is unlikely to explain inequalities in health, particularly as research has shown that educational attainment still independently predicts later health even taking account of cognitive ability (Hatch et al., 2007b; Link et al., 2008; Richards and Deary, 2010). Furthermore, emphasising the importance of cognitive skill for education, work and health may seem disheartening for individuals with lower than average cognitive skill, leading to disengagement particularly in school. As such, the field of health inequality research needs to elucidate targets for interventions that are applicable to a wider range of individuals. Recent years have seen an increased focus on the potential of non-cognitive skills (NCS) to impact similar socio-economic trajectories as cognitive skill, suggesting these skills may be linked to socioeconomic inequalities in health as well.

1.1 What are non-cognitive skills (NCS)?

A review by the sociologist Farkas (2003) described NCS as a set of behaviours and traits that accrued rewards in the labour market but were distinct from traditional cognitive skills like literacy and numeracy. Farkas (2003) specifically described NCS in a review as:

> What characteristics do employers want in their workers? … They are the same characteristics that teachers want in their students. [Besides cognitive skill] they also include work habits that facilitate efficient individual and organisational functioning. … At all skill levels, they include appropriate focus on the task at hand, combined with the habit of energetic and efficient work (p 541).

Farkas (2003) summarised that these traits included conscientious work habits (such as effort and task persistence) and positive psychosocial characteristics such as sociability and obedience, but that they precluded antisocial behaviours like aggression and disruptiveness. There is some overlap between NCS and aspects of other commonly studied personality traits and attributes like self-control, executive function, self-regulation and conscientiousness, although these attributes all lack the pro-social element of agreeableness that research has highlighted receives additional rewards in education and work (Farkas, 2003; Witt et al., 2002). Higher-order personality constructs like conscientiousness and agreeableness also contain lower-order constructs that are not necessarily related to Farkas' (2003) review of the conceptualisation of NCS, in the sense that they may not be important for success in education and work (e.g. the facet of 'traditionalism' in conscientiousness) (Roberts et al., 2005a). Second, one of the justifications for studying the importance of cognitive and non-cognitive *skills* is that these characteristics, despite some temporal stability, are malleable with training and experience. This is a key distinction from the heritable stability often inferred from research on personality *traits* and intelligence (Algan et al., 2014; Hatch et al., 2007a; Heckman and Kautz, 2012; Roberts et al., 2005b, 2006).

1.2 The association of non-cognitive skills with health inequalities

Economists began examining the importance of NCS in the labour market when researchers acknowledged that cognitive ability, in addition to family background characteristics, did not fully explain the variance in academic and occupational attainment (Bowles and Gintis, 1976; Jencks, 1979). Narrative reviews of the research on NCS by Bowles and Gintis (Bowles and Gintis, 1976, 2002) cited several studies where personality traits socialised in school were more important than cognitive skill for economic success; and one meta-analysis of 117 studies reported conscientiousness was the strongest trait related to job performance (Barrick and Mount, 1991). Numerous other studies have supported these findings by demonstrating that characteristics related to organisation, self-determination, persistence, positive social adjustment, antisocial behaviour, self-control and conscientiousness have predicted years of schooling and educational dropout (Carneiro et al., 2007; Coneus et al., 2009; Cunha et al., 2010; Fergusson and Horwood, 1998; Goldberg et al., 1998; Rumberger and Lim, 2008); college grade point average (Credé and Kuncel, 2008; Wolfe and Johnson, 1995); wages, unemployment, illicit drug use, incarceration (Carneiro et al., 2007; Heckman et al., 2006; Moffitt et al., 2011); and course grades and standardised test scores (Blair and Razza, 2007; Duckworth and Seligman, 2005; Duncan et al., 2007; Farkas et al., 1990; Valiente et al., 2010).

Previous research suggests that NCS could therefore impact the production of health inequalities through their multifaceted relationship with socioeconomic attainment. A few studies that examined concepts related to NCS in relation to health inequalities reported that approximately 20–25% of the gradient in all-cause mortality by education, occupation and income in mid-adulthood was explained by adjustment for these non-cognitive characteristics (Chapman et al., 2010; Falkstedt et al., 2013; Nabi et al., 2008). Importantly, the one study that compared cognitive and non-cognitive skills reported that the associations were of similar strength (Falkstedt et al., 2013). However, these studies on mortality were limited in that associations were not examined with other forms of morbidity, only socioeconomic attainment at one point in the life course was examined and there was insufficient examination of early life social and health factors that could confound the later associations (Chapman et al., 2010; Falkstedt et al., 2013; Nabi et al., 2008).

The current study aims to extend this research by using a life course approach (1) to examine the upstream association of NCS with downstream trajectories linking SES to general morbidity, and (2) to compare the strength and independence of the pathways linking NCS to health inequalities with the same pathways for cognitive skill. We anticipate that adolescent NCS will explain downstream associations relating SES to health, and that the effects of NCS will be comparable to those of cognitive skill.

2 Method

2.1 Data

Data came from the National Child Development Survey (NCDS), also known as the 1958 British birth cohort. The NCDS began as the Perinatal Mortality Survey of all infants born in England, Wales and Scotland during the week of March 3rd-9th in 1958. Of 17,634 eligible births, 17,415 were sampled (98.8%) at the delivery of the infant by midwives. The sample later added 1,141 immigrants born in the same week to the cohort, resulting in a total sample of 18,558. Ongoing follow up over the last 50 years has collected information from mothers and their children on health, development, socioeconomic factors, parenting and cognitive function (Ferri et al., 2003; Power and Elliott, 2006).

The estimated response rate for the cohort declined over time from 98.8% at birth to 80.4% of the eligible participants by age 50 (Bhamra et al., 2010; Plewis, 2004). Of the 9,790 participants that completed the age 50 survey, 99.4% had information on the self-reported health outcome, which was 52.4% of the original sample.

3 Measurement

3.1 Non-cognitive skills

When the cohort members were 16 years of age, their teachers completed a modified version of the Rutter behavioural scale B (Rutter, 1967; NCDS, 1981) and six items pertaining to general behaviour and temperament. The cohort members at this age also completed an academic motivation scale assessing their attitudes towards school and schoolwork. Items from teacher and self-reports were selected for a confirmatory factor analysis if they corresponded to facets of NCS as reviewed by Farkas (2003).

Nine items from the teacher reports of behaviour were selected for inclusion in the factor analysis and were coded so that higher scores indicated more positive behaviour. Five items were chosen from the modified Rutter behaviour scale with responses of “does not apply/ applies somewhat/certainly applies”: truanting in the past year; school absences for trivial reasons; frequent disobedience; being unresponsive, inert or apathetic; and being resentful or aggressive when corrected (Rutter, 1967; NCDS, 1981). Four items of behaviour ranking cohort members on a five point spectrum were also selected from teacher reports: cautious to impulsive, flexible to rigid, sociable to withdrawn, and lazy to hardworking. The NCS factor from self-reported school attitudes included four Likert scale items (“school is a waste of time”, “homework is a bore”, “I never take work seriously” and “there is no point planning for the future”) and one binary item (truanted this year, 1 = yes). Factor analysis was conducted in Mplus version 7.1 (Muthén and Muthén, 2012) and factor scores were saved for analyses.

3.2 Cognitive skill

Cognitive skill (CS) was indicated by continuous measures of the reading and mathematics comprehension tests constructed by the National Foundation for Educational Research in England and Wales for use in the NCDS at age 16. Mathematics and reading scores were strongly correlated (r = 0.65), and the mean of both scores was used to indicate overall skill. Mean scores were standardised to a mean of 0 and standard deviation of 1.

3.3 Socioeconomic status

Socioeconomic status (SES) was coded at ages 16, 33 and 50. Either the mother's husband's current occupation (age 16) or the participants' current occupation was used to indicate social class using the Registrar General's classifications of I (professional), II (intermediate), IIINM (skilled non-manual), IIIM (skilled manual), IV (partly skilled) and V (unskilled). To decrease complexity in the life course models and since preliminary analyses suggested non-linear associations with NCS (data not shown), social class was dichotomised at all ages into manual or non-manual; education was likewise collapsed into those who stayed on after the minimum leaving age and those who did not (1 = A level+ [i.e. high school equivalency]) (Morgan et al., 2012; Power et al., 1998). The mother's social class was not assessed in adolescence, so mothers without partners were assigned a manual social class as both single mothers and fathers with manual occupations displayed similar associations with NCS and health outcomes.

3.4 Health

The outcome was self-reported health at age 50, which has been widely examined as an overall assessment of health status and morbidity due to its strong associations with physical functioning and mortality (Idler and Benyamini, 1997; Manor et al., 2001). Participants were asked to provide a general health assessment ("In general, how would you say your health is?") on a five point scale ranging from poor, fair, good, very good to excellent. Responses were dichotomised to indicate the presence of fair/poor health (18.5%, N = 1,796).

3.5 Life Course Covariates

Several covariates were controlled to isolate the life course trajectories from risk that may confound the development of NCS and later SES or health (Barker, 1998; Hatch, 2005; Huaqing Qi and Kaiser, 2003; Mensah and Hobcraft, 2008; Richards and Hatch, 2011). Measures at birth assessed gender (1 = male), birth weight, parity, maternal age at delivery, any smoking during pregnancy (1 = yes) and maternal marital status (1 = married). Binary items measured concurrently with NCS at age 16 indicated if the child had ever been in local authority care, had a disability and if they had missed more than a month of school for ill health in the last year.

3.6 Statistical analysis

Univariable associations were first examined between NCS, SES and health by linear and logistic regressions for each point in the life course. A life course model with progressive adjustment then examined if the adult social gradient in health at age 50 was explained by the earlier, upstream variables of SES, NCS and CS. This was done using path analysis (employing a logit link to provide point estimates in terms of odds ratios), a type of multivariate structural equation modelling that estimates the population covariance matrix by modelling the structural pathways between observed (instead of latent or factor) covariates. In the first model, adult health inequalities were estimated by regressing self-reported health at age 50 on SES at ages 33 and 50. Adolescent NCS were added in Model 2 to examine their impact on downstream health inequalities. Adolescent CS was then added (Model 3), followed by adolescent SES (Model 4), before adjusting for the remaining life course covariates in Model 5. All models were adjusted for gender, and changes in effect sizes (as % change) with the addition of upstream exposures were calculated using the following equation:

$$\left[(\mathrm{Logit}_{\mathrm{model\ 1}} - \mathrm{Logit}_{\mathrm{model\ 1\ +\ upstream\ predictor}})/(\mathrm{Logit}_{\mathrm{model\ 1}})\right] * 100$$

Path models were estimated in Stata v 13 (StataCorp, 2013b) using the gsem procedure. This procedure uses equation-wise deletion for cases with missing data to maximise the use of participant information across the life course (so participants missing indicators of social class are still used when estimating pathways between NCS and education). As variables earlier in the life course are added to the model, cases missing information later in life can then be brought into the overall model (increasing the overall N) as they are able to provide information on equations earlier in the life course (e.g. for paths between adolescent variables) (StataCorp, 2013a). While missing data accrued over the long term follow up of the cohort, with about half of the participants missing data on social class and health at age 50 (Table 1), preliminary analyses suggested there were only small differences in the social class of the father at birth and school absences due to ill health at age 16 between the analysis sample at age 50 and the entire baseline sample. However, scores of CS and NCS at age 16 were higher for participants remaining in the analytic sample at age 50. A sensitivity analysis coded all the missing participants at age 50 as either having poor or good health to see a range for how missing data may have affected the results.

4 Results

4.1 Factor analysis of non-cognitive skills

For the confirmatory factor analysis of NCS, a higher-order general factor of NCS was constructed with lower-order teacher-reported and self-reported NCS factors; lower-order factors were also included to capture residual covariance among items with similar content that was outside the concept of NCS (see Fig. 1). Six of the nine factor loadings in the teacher NCS factor were between 0.70 and 0.83, although there were low loadings for the sociable and cautious/impulsive items (0.27 and 0.34, respectively). Loadings in the self-reported NCS factor ranged from 0.40 to 0.73, with the lowest loading for the “future planning” item and the highest loadings for the “working seriously” and “school is not a waste of time” items. Both the teacher and self-reported NCS factors loaded highly on a higher-order factor of overall NCS at 0.70 and 0.93 respectively. Gender was modestly associated with overall NCS at −0.12, indicating that males displayed lower levels of NCS; but tests confirmed that the NCS factor structure was invariant across males and females. Model fit was good, as indicated by the RMSEA value of 0.05 and the CFI value of 0.98.

Factor scores for the overall NCS factor (without a gender covariate) were normally distributed, and standardised to a mean of 0 and a standard deviation of 1 for analyses.

4.2 Sample characteristics and univariable analysis

Table 1 displays the characteristics of the NCDS sample over the life course and their total effects on poor health. Participants with poor health at age 50 had lower NCS and cognitive skills (CS) at age 16. The majority of NCDS participants had fathers in manual occupations at age 16 and did not stay on in education past the minimum leaving age; but by age 50 the majority of the cohort was in a non-manual occupation themselves. As expected, participants born to fathers with non-manual occupations and with higher SES in adult life were less likely to report poor health. There was a strong association with school absences due to ill health at age 16 and later poor health, and the total effect of a one SD increase in NCS at age 16 on the odds of poor health was 0.65 (95% CI 0.61–0.69, $p < 0.001$).

Table 2 shows the associations of covariates with NCS. A 1 SD increase in CS was associated with nearly a 0.5 SD increase in NCS, while being male and missing more than a month of school for poor health in adolescence were associated with a decrease in NCS (0.18 and 0.41 SD, respectively, $p < 0.001$). A one SD increase in NCS at age 16 was also associated with a doubling of the odds for high SES across adulthood ($p < 0.001$).

4.3 Upstream path analysis of adult health inequalities

The first path model documented adult health inequalities (Table 3, Model 1). Both non-manual social class at age 50 and further education were associated with moderate reductions in the odds of poor health. The addition of NCS at age 16 in Model 2 did not explain the association between social class at 50 and poor health, as expected, but it did explain 38% of the direct effect between further education and health. Meanwhile, adult SES mediated 53% of the association between NCS health and health, as the direct effect of NCS on health reduced from 0.65 in unadjusted models (see Table 1) to 0.81 (95% CI 0.74–0.89, $p < 0.001$) in Model 2.

When CS was added in Model 3 (Table 3), the direct effect between social class at 50 and health was only reduced by 15%, but the association between education and poor self-reported health was reduced 76% and fully explained. The addition of CS explained 33% of the association between NCS and health, but paths with adult SES and NCS explained 61% of the direct effect between CS and health (see Table 1; note: adult SES mediated 51% of CS' direct effect on health without the addition of NCS). Interrelationships between other measures of SES and NCS were all reduced when adjusted for CS, with paths to and from education particularly reduced by approximately 40%.

Adding father's social class at age 16 in Model 4 (Table 3) explained less than approximately 10% of paths in the model, with no notable exceptions. The final path model was then fully adjusted for other life course covariates in Fig. 2; and associations between NCS, CS and health inequalities were generally not affected. All paths linking CS with SES across the life course were stronger than those linked with NCS, but there were still independent paths from NCS to health inequalities through adult SES and health. The remaining direct effect of both NCS and CS on health was also equivalent, with a one SD increase in both types of

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skill independently reducing the odds of poor health by about 18% (OR 0.82, 95% CI 0.73–0.93; 0.83, 0.72–0.96; $p < 0.01$, respectively). Lastly, a sensitivity analysis indicated that adjusting for externalising and internalising behaviours at age 16 negligibly affected the results (data not shown). Coding all missing participants at age 50 as having either poor or good health did not affect the model estimates either.

5 Discussion

This study compared associations of adolescent non-cognitive skills (NCS) and cognitive skills (CS) with paths linking adult socioeconomic status (SES) and self-reported health at age 50. Adjusting for adolescent NCS explained over a third of the association between education and health, but the path between social class at age 50 and health was unaffected. Adjustment for CS explained larger proportions of the paths to adult health inequalities; and paths between CS and SES across the life course were stronger than the same paths with NCS. However, NCS was still independently associated with paths to later health inequalities, and both types of skill had equivalent inverse direct effects with poor health.

5.1 Strengths and limitations

An important strength of the prospective birth cohort data used in this study was the availability of prospective life course data in an agehomogenous population-representative cohort. However, the use of observational data prohibits the inference of any causal effects from the pathways under examination, as there may have been unmeasured confounders. For example, the measure of adolescent health was crude (i.e. missing school due to ill health). Social selection may have therefore confounded the models, with worse health in adolescence inhibiting status attainment, entailing that health may have predicted SES rather than vice versa. However, evidence for the social selection model is mixed and may only contribute weak effects across the life course (Manor et al., 2003; Smith et al., 1994). Residual confounding may have also been present within the dichotomous measures of SES, with the trajectories between NCS and SES potentially underestimated given the strong non-linear associations between higher NCS and the highest level of education (not shown). While future research will need to explore the effect of NCS on more sensitive measures of SES and health in more detail, the use of this strategy enabled complex and novel path models to be constructed with easily interpretable results. There may have also been attrition bias since the analytic sample at age 50 had significantly higher scores on NCS and CS than those with missing data. The total N in each model also changed as additional variables were added to the model, decreasing comparability across models. However, an analysis on the NCDS cohort at age 45 suggested that the remaining cohort was generally representative of the original sample despite small differences in non-missing participant characteristics, and a sensitivity analysis on missing outcome data here did not affect the model estimates (Atherton et al., 2008). Lastly, there may have been some effects of reporting bias in the measurement of NCS as some of the items were self-reported, and teacher reports could have been biased by student characteristics (such as SES).

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5.2 The role of non-cognitive skills on the life course development of adult health inequalities

While the negligible effect of NCS on the path linking adult social class to health was unexpected, NCS attenuated the association between education and health by over a third. The strong association between NCS and educational attainment reported in previous research therefore appears to have further implications with this relationship extending to health inequalities as well (Carneiro et al., 2007; Duckworth and Seligman, 2005; Duckworth et al., 2009). About half of the direct effect of NCS on health was mediated by adult SES, suggesting that the association of NCS with health is largely through the mediation of SES and the production of health inequalities. However, a large proportion of the association between NCS and health is still due to other mechanisms outside SES that could be explored. Furthermore, the independent association of NCS with SES at both ages 33 and 50 was robust and remained after full adjustment for other covariates across the life course. This may suggest that the positive effects of NCS accumulate over adulthood, independently affecting different stages of an individual's trajectory through the labour market. As such, the benefit of NCS for health inequalities may accumulate through multiple independent processes across the life course as well. With other research suggesting that facets of NCS and CS can be fostered in education and work (Roberts et al., 2005b; Hatch et al., 2007a), future research should also examine the importance of both adolescent and adult levels of NCS and CS on labour market trajectories and their relationship to health inequalities.

The results presented here are consistent with the few previous examinations of personality (which included traits like conscientiousness akin to NCS) and socioeconomic health inequalities. While none of the previous research employed techniques that would allow the examination of mediational effects of SES across the life course, the effect size in the current study was similar to those reported in previous research, where 20–30% of the SES gradient on mortality was explained by traits related to NCS (Chapman et al., 2010; Falkstedt et al., 2013; Nabi et al., 2008). The analysis here further demonstrated that early life SES did not explain the association between later NCS and health, nor did it significantly affect the associations between NCS and adult SES. This finding may indicate that the association between NCS and later social gradients in health is largely independent of early social environments.

5.3 Comparative roles of non-cognitive and cognitive skills on health inequalities

While adjustment for earlier cognitive skill (CS) explained a larger percentage of adult health inequalities than NCS, NCS still had independent associations with SES and had direct effects on health equivalent to CS. This comparison with CS is particularly important since past research has consistently highlighted the key role of cognition in the production of socioeconomic attainment and health inequalities (Gottfredson, 2004; Hatch et al., 2007b; Singh-Manoux et al., 2005), and policy often targets interventions at improving CS formation (Carneiro and Heckman, 2003; Heckman and Rubinstein, 2001). The one other study that examined psychosocial functioning (a concept with similar facets to NCS) and intelligence together found generally equivalent inverse associations with all-cause mortality. However, CS had stronger effects on cardiovascular disease mortality and injuryrelated mortality, while psychosocial functioning contributed more to alcohol-related mortality (Falkstedt et al., 2013). Thus, while the results in this study suggest comparative effect sizes for NCS and CS with general morbidity, this result may depend on the health outcome under investigation. Future research will need to compare the socioeconomic processes linking NCS and CS to more specific forms of morbidity such as diabetes or depression in order to decipher which health outcomes are most strongly associated with each characteristic.

Considering that independent paths from NCS to health inequalities remained in fully adjusted models, it appears that the relationship between NCS, education and health is distinct from the relationship of CS with the same educational gradients. For example, it has been proposed that experiences in education may build separate processes of effort (which maps onto NCS) and ability (i.e. CS) (Mirowsky and Ross, 2003), and pathways from these separate skills to health may therefore travel via different mechanisms through education. For example, one of the proposed pathways from education to health is through increased social support and likelihood of stable adult relationships including marriage. This in turn may lead to greater economic resources and supportive relationships protective of health-damaging stress (Mirowsky and Ross, 2003). It could be that the effortful pro-social behaviours in NCS help to build and maintain these supportive relationships (Roberts et al., 2007). In contrast, there is weaker theoretical reasoning linking CS to these social processes, and it may be that CS relates more closely to health through the additional material resources that often accompany higher SES (especially as CS retained stronger associations with SES in the current study than NCS) or since cognition may be a marker of better longstanding physiological processes underlying health (Richards et al., 2010). Since non-manual social class at age 50 remained associated with lower odds of poor health in fully adjusted models and was less affected by adjustment for either NCS or CS, future work should consider the additional mechanisms that could explain this relationship besides the range of covariates already included in the model here.

Furthermore, the effortful behaviours in NCS that are associated with education may also relate to an individual being more proactive in terms of seeking out health-promoting knowledge or maintaining a healthy lifestyle. Greater CS may be associated with more knowledge about health promoting behaviours (i.e. health literacy), but without NCS, CS on its own may not relate to the maintenance of healthy behaviours. For example, a meta-analysis indicated that conscientiousness-related traits were negatively related to all deleterious health behaviours and positively related to all beneficial behaviours (Bogg and Roberts, 2004). Since life course research has also found that selfcontrol predicts financial planning and money management better than child intelligence (Moffitt et al., 2011), this may indicate that the effortful behaviours in NCS generally relate to the ability to restrain from short-term gratification to persist with healthy lifestyles and other longer-term gains. It would be interesting for future research to compare NCS and CS with additional pathways related to the maintenance of long term goals and health behaviours, and how these pathways link to the production of health inequalities.

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6 Conclusion

The production of socioeconomic health inequalities is a complex and lifelong process. This analysis showed that adolescent NCS remained associated with adult measures of SES and health independently of CS and early life demographic and socioeconomic risk factors. NCS may therefore be an important protective characteristic across the life course and a potentially valuable target for policies aiming to ameliorate the production of health inequalities. As such, the emerging research on the multifaceted benefits of characteristics related to NCS has prompted the implementation of policies targeting the development of these characteristics, such as the Tools of the Mind programme directed at self-regulation or the range of Social and Emotional Learning (SEL) programmes in school (Bodrova and Leong, 2007; Durlak et al., 2011). While translatable results from such policy interventions have been mixed (likely due to heterogeneity in implementation) (Humphrey et al., 2010), meta analyses of SEL programmes have suggested a moderate effect size for the ability of these programmes to increase positive school behaviours and attitudes (Durlak et al., 2010, 2011). Together, the findings in the current analysis and the consideration that NCS can be fostered with school programmes indicates a powerful message for students: regardless of cognitive skill, the proactive development of work habits and positive classroom behaviours is likely to be of substantial importance for long term prospects in employment and health.

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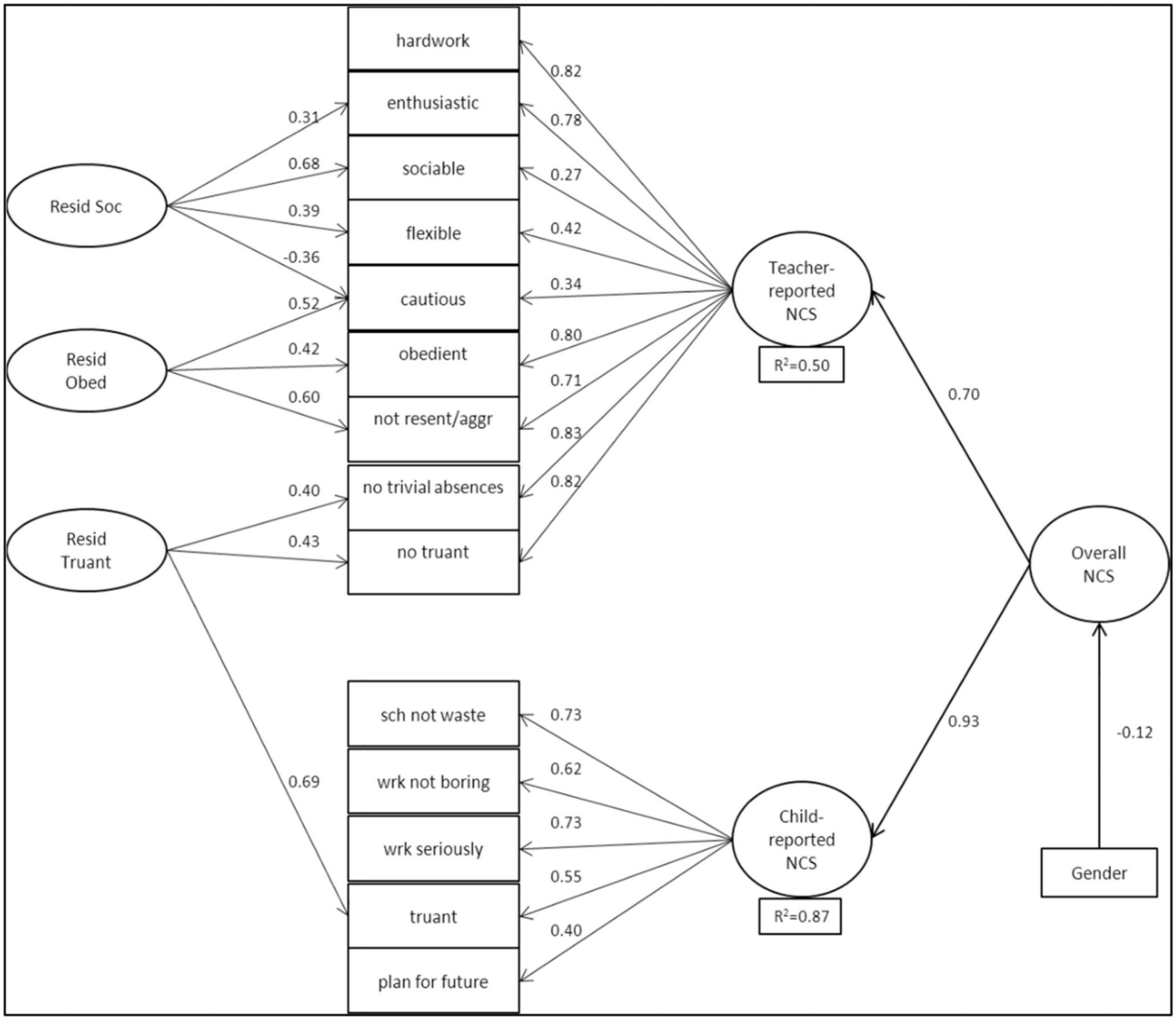

Fig. 1.

Final confirmatory factor analysis for non-cognitive skills (NCS) at age 16 in the National Child Development Survey (NCDS). All pathways are significant ($p < 0.001$).

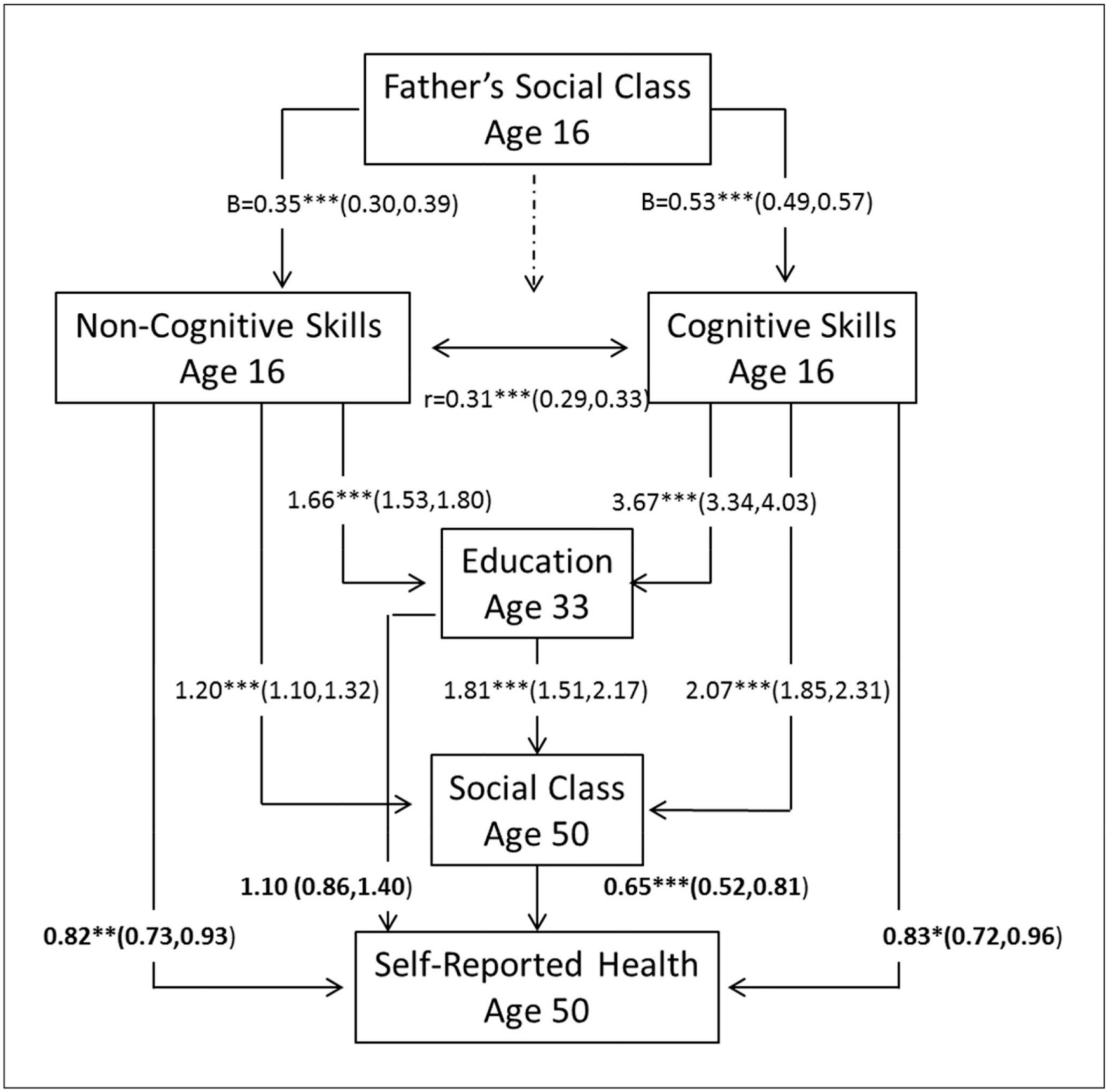

Fig. 2.

Path diagram of life course pathways linking non-cognitive skills and cognitive skills to self-reported health at age 50, with pathways to health labelled in bold. All parameters are odds ratios except for pathways labelled as “B”, which are unstandardised linear coefficients. For clarity of presentation, pathways linking father's social class at age 16 across the life course are partially displayed with an unlabelled dashed arrow. All pathways are fully adjusted for gender, maternal age at delivery, birth weight, parity, smoking during pregnancy, maternal marital status at birth, disability by age 16, ever in local authority care by 16, and missing more than a month of school at age 16 for ill health. ***$p < 0.001$, **$p < 0.01$, *$p < 0.05$.

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Table 1

Baseline sample characteristics and associations with poor self-reported health at age 50 in the National Child Development Survey.

	NCDS Cohort (N = 18558)		Poor Health at age 50 (N = 1796)		
	N	**(%)**	**N**	**(%)**	**Odds Ratio 95% CI p**
Gender					
Female	9595	(51.7)	932	(18.8)	1.00
Male	8959	(48.3)	864	(18.1)	0.95 [0.86, 1.05] 0.33
Binary Socioeconomic Status					
Non Manual Father Social Class Age 16	3980	(27.2)	350	(13.4)	0.60 [0.52,0.68] < 0.001
Stayed on in Education	4548	(40.8)	427	(11.8)	0.48 [0.42,0.54] < 0.001
Non Manual Social Class Age 50	5550	(67.4)	591	(10.7)	0.57 [0.50,0.65] < 0.001
School Absences due to Ill Health Age 16 (> 1 month)	1083	(5.8)	190	(32.4)	2.44 [2.03,2.94] < 0.001
Non-Cognitive Skills Age 16, mean(SD)	0	(1)	−0.23	(0.98)	0.65 [0.61,0.69] < 0.001
Cognitive Skills Age 16, mean(SD)	0	(1)	−0.26	(0.97)	0.59 [0.56,0.63] < 0.001

[a]Missing data N(%): gender = 4 (0.02); social class age 16 = 3,905 (21.0); education = 7,416 (40.0); social class 50 = 10,321 (55.6); school absences = 7,200 (38.8), non-cognitive skills = 5,754 (31.0); cognitive skills = 6,639 (35.8); poor health = 8,825 (47.6).

Table 2

Unadjusted association between sample characteristics, socioeconomic status and non-cognitive skills (NCS).[a]

	Non-Cognitive Skills	
	Mean (SD)	**Coefficient [95% CI][a] p**
Gender		
Female	0.09 (0.99)	1.00
Male	−0.09 (1.00)	−0.18 [-0.21, −0.14] < 0.001
Binary Socioeconomic Status		
Non Manual Father Social Class Age 16	0.36 (0.91)	0.50 [0.46,0.54] < 0.001
Stayed on in Education	0.55 (0.84)	2.68 [2.54,2.83] < 0.001
Non Manual Social Class Age 50	0.35 (0.90)	1.98 [1.87,2.10] < 0.001
School Absences due to Ill Health Age 16 (> 1 month)	−0.65(0.94)	−0.41 [-0.44,-0.38] < 0.001
Cognitive Skills Age 16[b]	0.34 (0.94)	0.45 [0.44,0.47] < 0.001

[a]Coefficients for gender, social class at age 16, child cognitive ability and school absences are linear coefficients from a linear regression of NCS regressed on these covariates. Coefficients for education and social class at age 50 are odds ratios for these items regressed on NCS.

[b]Mean(SD) for cognitive skill is for participants > mean for NCS scores, and the coefficients refer to a 1 unit change in continuous standardised math and reading scores.

Table 3

Progressive adjustment of upstream of non-cognitive skills (NCS) and cognitive skills at age 16 on downstream health and socioeconomic status (SES).

Odds ratios [95% Confidence Interval], p values are presented unless otherwise indicated.[a]

	Paths to Poor Self-Reported Health at Age 50	Paths to Social Class at Age 50	Paths to Education at Age 33	Paths to NCS at Age 16	Paths to Cognitive Skills at Age 16
Model 1: Health at 50 + Adult SES (N = 7071)					
Social Class at 50	0.60 [0.51,0.70] < 0.001				
Education at 33	0.69 [0.59,0.81] < 0.001	4.45 [3.96,5.00] < 0.001			
Model 2: +NCS at Age 16 (N = 8898)					
Social Class at 50	0.59 [0.49,0.70] < 0.001				
Education at 33	0.80 [0.66,0.96] 0.017	3.21 [2.79,3.68] < 0.001			
NCS at 16	0.81 [0.74,0.89] < 0.001	1.56 [1.45,1.67] < 0.001	2.85 [2.69,3.02] < 0.001		
Model 3: +Cognitive Skills at Age 16 (N = 12810)					
Social Class at 50	0.64 [0.53,0.77] < 0.001				
Education at 33	0.95 [0.77,1.16] 0.601	1.96 [1.68,2.28] < 0.001			
NCS at 16	0.87 [0.79,0.96] 0.008	1.25 [1.15,1.35] < 0.001	1.82 [1.70,1.95] < 0.001		
Cognitive Skills at 16	0.82 [0.73,0.91] < 0.001	2.13 [1.95,2.33] < 0.001	3.84 [3.57,4.14] < 0.001	r = 0.49 [0.47,0.51] < 0.001	
Model 4: +Early Life SES (N = 12810)					
Social Class at 50	0.64 [0.53,0.77] < 0.001				
Education at 33	0.95 [0.78,1.17] 0.646	1.93 [1.65,2.24] < 0.001			
NCS at 16	0.87 [0.79,0.97] 0.009	1.24 [1.15,1.34] < 0.001	1.80 [1.69,1.93] < 0.001		
Cognitive Skills at 16	0.82 [0.73,0.92] 0.001	2.08 [1.90,2.27] < 0.001	3.66 [3.40,3.95] < 0.001	r = 0.42 [0.40,0.44] < 0.001	
Father's Social Class at 16	0.92 [0.76,1.12] 0.397	1.28 [1.11,1.49] 0.001	1.45 [1.29,1.62] < 0.001	B = 0.50 [0.46,0.54] < 0.001	B = 0.72 [0.68,0.75] < 0.001

[a]All models are adjusted for gender. Pathways to poor self-reported health and SES are odds ratios, pathways to NCS and cognitive skills are linear coefficients, and the association between NCS and cognitive skills is Pearson's correlation coefficient between errors.