

# The Impact of Early Life Skills on Later Outcomes

Report for the OECD (Early Childhood Education and Care).

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# The impact of early life skills on later outcomes

## Executive Summary

In this report we assess the evidence on the long-run associations between early social, emotional and cognitive skills (focusing on measures before age six) and a range of later outcomes. We summarize these skills under the umbrella term of ‘life skills’ and provide a taxonomy, or descriptive model, of specific skill sets. Regarding outcomes, we focus on educational attainment, employment, income, health, and wellbeing.

There are three elements to this report:

1. A definition and taxonomy of key social, emotional, and cognitive skills
2. A literature review of evidence on the relationship between childhood social, emotional and cognitive skills and a range of later outcomes
3. New analysis of the British Cohort Study (BCS) on the long-run benefits and predictive power of early skills, using assessments made at age five and linking them to outcomes later in life, up to age 42.

## Key Findings

The evidence of both the literature analysis and our own analysis has to be interpreted against the background of the available data. Existing data had been collected often many years ago according to the research knowledge and interests at the time, is characterised by varying quality of the skill assessments, and focus on specific skills or specific outcomes. Moreover for some skills, such as childhood creativity and motivation there is limited longitudinal evidence linking early assessments to adult outcomes across domains. Although the findings presented here control for a range of other skills as well as additional factors and circumstances that may give rise to both the acquisition of skills and the outcome (e.g. socio-economic family background, gender, ethnicity, birth weight), the observed associations could still be the result of a common unobserved cause, and we have not established causality.

Given these caveats, the literature review suggests that:

- Key social, emotional and cognitive skills can be reliably assessed through standardised assessments by age 3 to 5 years, involving direct tests or reports from parents, teachers, or trained specialists.

- There is medium to strong evidence for the long-term predictive power of indicators of self-regulation, and also self-awareness (locus of control) for outcomes across domains. This effect is independent of cognitive ability.
- There is less strong evidence regarding the role of emotional stability, motivation, and interpersonal skills. After controlling for cognitive ability their impact is small, yet remains significant. In particular, there are significant associations between childhood emotional stability and adult mental and physical health; and between interpersonal skills and later mental health, suggesting domain specific effects.
- Verbal skills are important predictors across domains (socio-economic attainment, mental and physical health, crime), while for numeric skills we only found evidence regarding educational achievement, socio-economic status and physical health. Executive function was primarily associated with educational attainment and behaviour in school.

Our own analysis of early skills assessed at age 5 in BCS suggests that:

- Self-regulation is an important predictor across all domains, independent of cognitive ability
- Verbal and visual-motor skills are also important predictors across all domains
- Emotional health (indicated through a measure of internalizing problems) shows unexpected negative results across a number of domains
- Early social skills appear to be only relevant regarding family formation (becoming a parent) and are a risk factor regarding harmful alcohol consumption, pointing to a potential 'dark' side of early social skills.

Our analysis showed significant associations between the different early skill indicators at age five. Moreover, we controlled for later educational attainment, and the findings suggest the effect of early self-regulation, verbal and visual-motor skills is not fully mediated by later educational attainment. Early skills or competences can thus be understood to act as a 'reserve capacity' (Staudinger et al., 1993) enabling positive concurrent development as well as positive outcomes in later life.

**In conclusion**, what a child has learnt in the early years, such as by age 5, is predictive of a range of life outcomes, i.e. educational and socio-economic attainment, health and wellbeing. Later outcomes are not solely predicted by a single domain of early learning or skill development. Rather, several domains need to be considered to better predict a child's likely later outcomes. Each of the early cognitive, social and emotional competences are necessary,

but not sufficient to predictors of later outcomes. What is required for adaptive development is a balance of cognitive, social and emotional competences.

The findings of this report suggest a crucial role for early indicators of self-regulation (conduct and attention), verbal, numeric and visual-motor skills as predictors across a range of later outcomes. Self-awareness, in particular locus of control, also plays a significant role across domains, although children have different speeds in their maturation. Indicators of early interpersonal skills and emotional stability appear to be less prominent in their influence across domains, yet seem to be particularly associated with later mental health and wellbeing.

To obtain a comprehensive measure of early childhood competencies we would recommend to capture a set of core skills comprising verbal and numeric (ideally also visual-motor) skills, indicators of self-regulation, self-awareness (locus of control), emotional stability, as well as social skills, in particular approach. Such a more comprehensive approach takes into account that the formation of life skills and the development of a fully functioning individual depends on the interaction of social, emotional and cognitive skills which cross-fertilize each other.

Important developmental pre-cursors of these skills comprise gross and fine motor development, as well as early indicators of attention regulation and secure attachment. There is an overlap between indicators of self-regulation and executive function – both involving attention regulation which sometimes is considered to be a more ‘pure’ form of self-regulation.

## 1. Introduction

In this report we assess the evidence on the predictive power of early social, emotional and cognitive skills regarding later outcomes assessed during adolescence and adulthood. We summarize these skills under the umbrella term 'life skills'. We report on what these skills are, develop a taxonomy, i.e. a definition of overarching domains within which a large number of specific skills can be described, and provide evidence to what extent they predict later outcomes. We make this assessment through a literature review, and from new research using longitudinal data undertaken for this report. We find that social and emotional skills developed in childhood help to shape and determine a range of later life outcomes in addition to the influence of cognitive skills. In particular self-regulation and to a lesser extent also self-awareness (especially locus of control) show an independent effect across a range of outcomes. The evidence regarding the role of social skills and emotional stability is less strong after controlling for cognitive ability and family background. There are however significant associations between interpersonal skills and emotional stability and later mental health and wellbeing (even after controlling for cognitive skills), suggesting domain specific effects.

The purpose of this study is to provide empirical evidence regarding the long reach of early social, emotional and cognitive skills to inform policies and practices aiming to improve Early Childhood Education and Care (ECEC). In particular we aim to inform the decision-making of the scoping group regarding domains to be covered by an international assessment of early learning. Which early skills are especially important as predictors of later outcomes, and are there specific skill sets that are beneficial for distinct outcomes, such as educational attainment or health?

The study builds on a recent OECD report assessing the power of social and emotional skills as predictors for wellbeing and social progress (OECD, 2015). The report highlighted the importance of social and emotional skills in addition to cognitive skills for achieving positive life outcomes and the need to 'develop the 'whole child' with a balanced set of cognitive, social and emotional skills so that they can better face the challenges of the 21<sup>st</sup> century'. Children are not born with a fixed skill set. There is consistent empirical evidence that skills develop and grow depending on supportive learning environments in the family, school or out-of school context (Gutman and Schoon, 2013, in press; OECD, 2015). Skills are malleable and they can be learned and developed through practice and reinforcement in daily experiences. This applies to cognitive as well as social and emotional skills, although the mechanisms of skill acquisition vary across different skill sets.

The concept of cognitive skills, referring to a set of skills which enable the use of language, numbers and reasoning, is often contrasted with the notion of social and emotional skills

(sometimes also referred to as 'non-cognitive', 'soft', 'personality' or 'character' skills), referring to a broad range of capabilities that enable individuals to regulate their thoughts, emotions, behaviour and interactions with others. Cognitive, social and emotional skills interact and cross-fertilise each other, empowering individuals to adjust to an ever changing context, and there is no clear cut differentiation between these skills. For example, children who can sit still and are not constantly distracted by new stimuli are more likely to concentrate on completing learning tasks in the pre-school or school environment. Learning is a continuous interaction between cognitive and other skills and competences, and developmental progression is unlikely to happen in the absence of this interaction (Bowles and Gintis, 2002, Farkas, 2003, Kautz et al., 2014, Jencks, 1979).

Early social and emotional skills are associated with later outcomes, such as educational and occupational attainment, health and wellbeing independent of cognitive skills; indeed their predictive power can equal that of cognitive skills (see also Heckman et al., 2014). There is however still a lack of understanding on the specific type of skills that predict later outcomes and whether the most important early skills vary according to the outcome under consideration.

### **Gaps in the evidence base**

1. Many of the social, emotional and cognitive skills are inter-linked, yet most studies examine specific skill sets in isolation and few studies simultaneously assess multiple distinct skill sets. Moreover, most studies explore the effect on a single outcome. There is thus no conclusive evidence which of the diverse characteristics are crucial to improve or facilitate attainment across domains, and whether specific skills might be more important as predictors of specific outcomes than others.
2. There is less evidence on the long-term outcomes of early skills (measured before school entry) compared to skills measured during the school years.
3. There is little agreement about how different skill sets should be defined and measured, and terms are not used consistently. Moreover, assessment instruments with the same name might measure concepts that are quite different, and measures with different names might measure concepts that are quite similar (e.g. the use of composite measures versus stand-alone indicators to assess self-control or emotional stability). There is thus a need for a descriptive model, or taxonomy, to define the overarching domains within which a broad range of skills can be conceptualized.

## **The purpose of this report**

In this report we assess which early skills (focusing on measures before age six) are predictive of later life outcomes (taking into account interlinkages between different social, emotional and cognitive skills), and whether the most important early skills vary according to the outcome under consideration.

To conceptualise the diverse skill sets comprising social, emotional and cognitive skills we use the umbrella term ‘life skills’ and develop a taxonomy to describe the basic characteristics underlying distinct skill sets. We conduct a literature review to assess existing empirical evidence on the role of early childhood skills as predictors of later outcomes, focusing on evidence from longitudinal studies. We furthermore conduct new analysis of the 1970 British Birth Cohort Study to assess the role of early childhood skills as predictors of a range of adult outcomes, including educational attainment, employment and socio-economic status, health and wellbeing and other indicators of adult status.

## **Research Aims**

The specific research aims of this study are to:

- Review the literature to establish the strength of the evidence regarding the long-term predictive power of early social and emotional skills across a range of outcomes (educational attainment, employment, health, and wellbeing) independent of cognitive attainment
- Provide new empirical evidence using data collected for the 1970 British Cohort Study (BCS) regarding the role of early social, emotional and cognitive skills, measured at age 5, as predictors of adult outcomes at age 42
- Identify which cognitive and socio-emotional skills provide the strongest evidence regarding longer-term outcomes and suggest robust measurement.

We start with providing a definition of life skills and a descriptive model (taxonomy) providing an overview of relevant skills and competences that are expected to have a role in shaping later outcomes. The next section gives a literature review of existing evidence from longitudinal studies assessing the role of early social, emotional and cognitive skills associated with a) later educational attainment, and b) long-term outcomes (e.g. employment, health, well-being, civic engagement) irrespective of cognitive outcomes. Following this, specific evidence using the British cohort Study is considered, linking early skills measured at age 5 to later outcomes. A final conclusion provides a summative evaluation of the evidence and provides an outlook to future research challenges.



## 2. What are Life Skills?

The term 'life skills' has gained recognition across different domains, and is used in programmes aiming to improve health, education and social policy across countries (UNICEF, 2012). There is however no common definition of life skills and the concept refers to a range of skills and knowledge - and sometimes is also referred to by the broader term of competences or resources. The WHO (1997) has offered a definition referring to life skills as 'abilities for adaptive and positive behaviour that enable individuals to deal effectively with the demands and challenges of everyday life'. The nature and definition of life skills generally comprises a composite of multiple skills, which are likely to differ across cultures and settings. There appears however to be a core set of skills that are, for example, at the heart of the WHO skills-based initiatives for the promotion of health and wellbeing of children and adolescents. These skills include: decision making, problem solving, creative thinking, critical thinking, effective communication, interpersonal relationship skills, self-awareness, empathy, coping with emotions and coping with stress. Similar skills are reflected in the Global Evaluation of Life Skills Education Programmes by UNICEF (2012) which summarizes various sets of core life skills comprising the three broad categories of cognitive (critical thinking and problem solving skills); personal (self-awareness, motivation, and self-management); and interpersonal or social skills (communication, negotiation, cooperation and teamwork, as well as empathy).

The key message that comes across is the importance of a skill set comprising personal, interpersonal, and cognitive skills that enable individuals to manage their own emotional states, to interact appropriately, and to make decisions and choices for a healthy and productive life (Kautz et al., 2014, OECD, 2012, 2013, 2015).

The three core dimensions of personal, interpersonal and cognitive skills are helpful to construct a taxonomy, or descriptive model, that enables us to provide a definition of overarching domains within which a range of specific skill sets can be understood in a simplified way. Such a taxonomy of life skills would permit researchers to study specific skill sets, rather than examining separately a range of particular characteristics or skills. Moreover, a generally accepted taxonomy would facilitate the accumulation of communication of empirical evidence across disciplines.

Previous research establishing a comprehensive taxonomy of social and emotional skills has focused on the classification of personality characteristics, such as the Big Five (openness, conscientiousness, extraversion, agreeableness, neuroticism) or the 21<sup>st</sup> Century skills

comprising a broad set of knowledge, skills, work habits, and character traits that are believed by educators and employers to be critically important to success in today's world (John and De Fruyt, 2015). Although the Big Five characteristics offer a useful framework for conceptualising key social-emotional skills, they need to be supplemented with an assessment of positive core self-evaluation (i.e. self-esteem and locus of control) to provide a comprehensive taxonomy. Moreover, they do not encompass cognitive skills. A wider range of crucial children's learning outcomes has been specified in the conceptual framework for the assessment of early learning outcomes (OECD, 2015). That framework does however not specify the super-ordinate core skill domains. We thus adopt the broad UNICEF life skill framework to develop a taxonomy of key skills to characterize different competencies within the personal, interpersonal and cognitive domains.

### **A taxonomy of life skills**

Based on the literature and previous reports from WHO, UNICEF and OECD we have derived a taxonomy of life skills comprising personal, interpersonal and cognitive skills (Box 1).

#### **Box 1: Taxonomy of Life Skills**

##### *Personal skills*

- Self-regulation: self-control, grit, self-management, conscientiousness
- Self-awareness: self-confidence, self-esteem, self-efficacy, self-concept, locus of control
- Emotional stability (opposite of neuroticism), stress management, coping
- Motivation: goal setting, expectancy-value, intrinsic/extrinsic motives

##### *Interpersonal skills*

- Approach: extraversion, assertiveness, leadership, trust in others (attachment)
- Collaboration and taking the perspective of the other: prosocial behaviour, agreeableness, sociability, empathy

##### *Cognitive skills*

- Verbal skills: oral, language, literacy
- Numerical skills: numeracy, early concepts and other non-verbal skills
- Executive functioning: working memory, inhibitory control, attention shifting
- Openness, creativity, play

The three core skills (personal, interpersonal and cognitive skills) represent the superordinate-factor level skills, which are characterised through a number of more specific skills at a lower

level. For example, interpersonal skills comprise a set of competences, such as taking the perspective of other, the way in which one approaches others and trust in others. Each of these 'lower level' skills is distinct of each other and important in themselves. They reflect the essence or communality of various specific skills that can be measured through specific tasks or questions asked of the persons themselves, their parents or teachers. While there is convergence on the broad groups of three core skills, the list of sub skills given above is not a definitive list or categorization, but is an attempt to create an overview to guide our literature search. The list of subskills includes the five personality dimensions openness (which is conceptualized as a cognitive skill), conscientiousness (self-regulation), extraversion (approach), agreeableness (taking perspective of others), and neuroticism (emotional stability), as well as self-awareness, motivation and cognitive skills. A short summary description of the three skill domains guiding our literature review is given in Appendix 1.

### 3. Predictive Power of early Life Skills – Literature Review

In this section we first give an outline of how we conducted our literature review. We then present a summary of findings on the role of social, emotional, and cognitive skills as predictors of later outcomes, guided by the taxonomy of skills presented in Box 1 (see Appendix 2 for a description of the review process). In a next step, we give a more detailed description of how the different skills have been defined and operationalised in early childhood and the evidence from the literature regarding their longer term outcomes.

The review cannot aspire to being completely exhaustive. However we aim to provide a thorough overview of the evidence in this area, accessible to academics and non-academics alike, by presenting a balanced and contemporary survey of the relevant literature. We incorporate the breadth of the topic area, a variety of disciplines and empirical methodologies, and a wide range of different outlets, with the focus on peer-reviewed journals and academic working papers. We focus on evidence from longitudinal studies, linking early childhood skills assessed before age six to later outcomes. Where we do not find sufficient evidence we expand our search to skills assessed before age ten.

Many of the most influential studies on these topics have originated in the U.S. and also in Britain, which benefits greatly from the availability of rich longitudinal data from national and sub-national birth cohort studies, and other long-term panels, which follow individuals from childhood into adult life. The review, however, also includes studies using data from across Europe and Australasia.

The studies ultimately reviewed were chosen to provide, where possible, a similar number of papers relating to each of the three broad groups of skills defined in Chapter 2. Within each broad group of skills, studies were chosen so that the review covered, where possible, each of the different types of measures that fall within that particular skill group. By far the largest number of papers identified within our search relate to self-regulation, followed by papers on emotional stability, social skills (approach in particular) and self-awareness. There were hardly any publications on motivation and goal setting among this age group. Finally, studies were chosen so that they provided balanced coverage across a number of adult outcomes, including education, labour market, physical health, mental health, well-being, crime and others, where possible.

### 3.1. The empirical evidence based on the literature review

A number of social, emotional and cognitive skills can be reliably measured before age 6 and they predict later outcomes. Assessments of very young children, below the age of 3 are however less reliable, and often have to rely on parental report or other external assessors such as teachers. While for some skills, such as verbal and numerical skills and self-regulation, we found extensive literature for young children below the age of 5, other characteristics, such as motivation of very young children are not well covered in the literature.

Tables 3.1 highlights, separately for each broad skill group, the outcomes found in the literature. Regarding outcomes we focus on educational attainment (assessed at the individual level and reflecting school grades and highest academic achievement), attained socio-economic status and income, mental health, physical health and other outcomes reflecting social integration (relationship status, crime, civic engagement). The plus and minus in parenthesis indicate whether the skill is positively or negatively associated with the different outcomes. For example, in the literature reviewed, indicators of self-regulation are negatively associated with mental illness, clinical problems, unhealthy behaviours, obesity, experience of unemployment, crime involvement; and positively with educational attainment, adult socio-economic status and income. An asterisk indicates where skills measurements took place before the age of six.

We use bold to indicate the strongest evidence. The strongest evidence is where associations remain significant after controlling for confounding factors, are drawn from several long term longitudinal studies, and use skills measures taken before the age of six.

**Table 3.1. Predictive power of early social, emotional and cognitive skills from the literature review**

<b>Evidence category 1</b>				
	<b>Education/Socio-economic/Employment</b>	<b>Mental Health</b>	<b>Physical Health</b>	<b>Other</b>
<b>Self-regulation</b>  Self-control, delay of gratification	<b>*Educational attainment (+)</b> <b>*Socio-economic status (+)</b> <b>*Income (+)</b> <b>*Unemployment (-)</b>	<b>*Mental illness (-)</b> Stress management (+)	<b>*Clinical problems (-)</b> <b>*Obesity (-)</b>	<b>*Crime (-)</b>

<b>Verbal skills</b>	<b>*Educational attainment (+)</b> Income (+) Socio-economic status (+) Unemployment (-)	*Mental illness (-)	*Unhealthy behaviours (-) *Self-rated health *Clinical problems (-)	*Crime (-)
<b>Numerical skills</b>	<b>*Educational attainment (+)</b> Income (+) Socio-economic status (+)		Unhealthy behaviours (-) Clinical problems (-)	
<b>Evidence category 2</b>				
<b>Emotional stability</b>  <i>Absence of internalising behaviour</i>		*Life satisfaction (+) <b>*Mental illness (-)</b>	Obesity(-)	Partnership quality (+)
<b>Executive function</b>  <i>Attention regulation, working memory, inhibitory control, motor skills</i>	<b>*Educational attainment (+) (attention)</b> *Mathematical ability (+) *General cognitive ability *College completion		Obesity (-)	Classroom behaviour (+) Conduct problems (-)
<b>Evidence category 3</b>				
<b>Self-awareness</b>  <i>Self-esteem, internal locus of control</i>	Educational attainment (+) Continuing education (+) Unemployment (-)	Mental illness (-)	Self-rated health (-) Obesity (-) Clinical problems (-)	Crime (-)
<b>Collaboration</b>  <i>Prosocial behaviour, empathy</i>	Educational attainment (+) Work competence (+) Entrepreneurship (+)	Conduct problems (-)	Unhealthy behaviours (-)	Crime (-) *Social justice beliefs (+)

<b>Approach</b>  <i>Being extroverted, assertive, securely attached</i>	*School engagement (+) *Unemployment (-) Entrepreneurship (+)	*Mental illness (-) Life satisfaction (+)	Self-rated health (+) Unhealthy behaviours (-/+) *Clinical problems (-) *Obesity (-)	Crime (+) Leadership (+)
<b>Evidence category 4</b>				
<b>Openness, creativity, play</b>	Creativity (+) Divergent thinking (+)	Mental ill health (+/-) (men/women)		
<b>Motivation</b>  <i>Interest, engagement, persistence</i>	Educational attainment (+)			

**Table Note: Evaluating the strength of evidence**

We define four evidence categories with category 1 being the strongest evidence and category 4 the weakest:

**Evidence category 1:** Evidence is mainly drawn from several large scale long term longitudinal studies accounting for a number of control variables. We found evidence of associations across a range of outcome domains.

**Evidence category 2:** Evidence is drawn from several large scale long term longitudinal studies accounting for relevant control variables. Associations tend to be concentrated in particular domains.

**Evidence category 3:** Evidence is drawn from a single large scale longitudinal study, a number of small-scale studies, or a combination of both. We found evidence of associations across a range of outcome domains.

**Evidence category 4:** Evidence is drawn from a small number of small-scale longitudinal studies. Associations tend to be concentrated in particular domains.

We find significant evidence across domains regarding the predictive power of **self-regulation** (referring to constructs such as self-control, delay of gratification, good conduct and conscientiousness) as well as **verbal and numerical skills**. These skill sets can reliably be measured by age three, and there is evidence from several large scale longitudinal studies from different countries using appropriate control variables confirming their role as predictors of educational attainment, adult socio-economic status, mental and physical health, health behaviours and lack of crime involvement.

There is also significant evidence regarding the role of **emotional stability** (often defined as the absence of internalising problems or coping) as a predictor of mental health in adulthood, pointing to domain specific effects. Domain specific effects from several large scale and long-term longitudinal studies are also evident for indicators of **executive functioning**, especially regarding early attention regulation as a predictor of later educational attainment. The evidence concerning executive function highlights the interlinkages between different skill sets. For example early indicators of executive function are associated with later class room behaviour and conduct problems as well as educational attainment. These findings lend support to the assumption that executive function, especially attention regulation, is a developmental precursor of later self-regulation and that there is a conceptual overlap between the two constructs. The exact nature of the underlying developmental processes are however not yet fully understood.

Weaker evidence of predictive power (based on single large scale longitudinal studies or a number of small-scale studies) across domains is apparent for early indicators of **social skills** (comprising collaboration and approach) and **self-awareness** (beliefs that one's own actions can make a difference - captured by concepts such as locus of control, self-confidence and self-efficacy). Educational attainment is predicted by self-awareness (in particular locus of control) and collaboration (pro-social behaviour). Employment outcomes are associated with self-awareness, collaboration and approach. Social approach (in particular being assertive and outgoing) is also associated with entrepreneurship and leadership. Mental health, self-rated health, obesity and clinical problems are predicted by self-awareness and approach. Lack of crime involvement is predicted by indicators of self-awareness (internal control) and collaboration (pro-social behaviour). Being outgoing however, has been associated with involvement in crime, suggesting that high levels of extraversion can have a dark side (it is also associated with more unhealthy behaviours such as smoking and cannabis use) – although the evidence is not equivocal.

Domain specific evidence from only a small number of small-scale or relative short term longitudinal studies is available for indicators of **openness, creativity and motivation**. There is a limited literature linking measures of **motivation** in childhood to later life outcomes. For example, while there is evidence for the importance of 'intrinsic motivation' (defined as



enjoyment of an activity, such as learning, for its own sake) for positive schooling outcomes we found no studies linking early measures of intrinsic motivations to longer term outcomes in adult life. We also found no evidence on the importance of *resilience* and *coping* demonstrated in early childhood and outcomes in later life.

### **Box 2. Causation - A note of caution**

Studies in which links are found between childhood skills and later outcomes (during adolescence or adulthood) are often interpreted as evidence of a causal influence. Identifying causal relationships is important for identifying drivers of change and therefore levers of policy.

In most of the studies covered in our literature review, and in our own analysis, associations between later outcomes and the childhood characteristics are presented controlling ('adjusting') for other factors and circumstances which may have given rise both to the outcome and the skill (the 'predictor'). The more it is possible to control for other factors that may play a role, the stronger is the case for thinking of the relationship as causal. However, even with an extensive set of controls, as included in our own analysis, the childhood skills and outcomes could both still be the product of a common unobserved cause, and hence be superficial manifestations of 'true' unobserved causes in an underlying mechanism rather than causal in their own right. Indeed, it is also possible that the omission of relevant controls could obscure (rather than exaggerate) the existence of an underlying relationship.

## 3.2. Evidence regarding the role of specific personal skills

Personal skills relate to an individual's beliefs and perceptions about themselves, the ability to regulate one's impulses, desires and emotions, and the capacity for goal directed action and behaviour. These skills are conceptualized by the notions of self-awareness (beliefs and perceptions of oneself), self-regulation (the ability to control impulses and behaviour), emotional stability (ability to regulate emotions), and motivation (goal directed action and behaviour).

### 3.2.1. Self-regulation (controlling impulses and behaviour)

*Definition:* Self-regulation is conceptualised and measured differently across disciplines, and includes reference to terms such as impulsivity (Kagan, 1965), conscientiousness, delay of gratification, inattention-hyperactivity, willpower, inter-temporal choice, perseverance or persistence, and self-discipline, to name but a few (Duckworth, 2011). Essentially, young children who possess skills of self-control or self-regulation are characterised by an ability to persist in achieving goals (often termed, conscientiousness), inhibit impulsive behaviours and delay gratification (Mischel et al., 1989).

*Measurement:* Methods used to assess aspects of self-control in young children tend to rely on parent and teacher reports of children's behaviour, although experimental methods are sometimes incorporated (see Kautz, et al. 2014 for a review). Examples of indicators include 'the child fails to finish tasks' (lack of conscientiousness), and 'acts before thinking' (impulsivity). Delay of gratification is commonly assessed using an experimental method, the basic self-imposed delay waiting paradigm (Mischel, 1974), often referred to as the Marshmallow test. Children who can delay gratification are those able to wait for a short period (approximately 15 minutes) to receive a preferred reward. Studies also often use standardised screening tools of behavioural adjustment to assess self-control, as externalising behaviours may indicate an inability to control or inhibit actions in order to achieve a goal. Examples include the Rutter Child Scale (RCS) (Rutter, 1967), the Strengths and Difficulties Questionnaire (SDQ) (Goodman, 1997) and the Child Behaviour Checklist (CBCL) (Achenbach and Edelbrock, 1983).

#### Longer-term predictive power of self-regulation

##### *Educational attainment*

In a series of studies examining self-control amongst a sample of US pre-schoolers from a university community, delay of gratification at age 4 was associated with higher levels of cognitive and self-regulatory competence and coping at age 16, including higher scores on the standardized college entrance exams (SAT) (Shoda et al., 1990). Other studies also show that self-control predicts attainment even after adjusting for previous attainment. For instance, ten year olds in a US study who exhibited high levels of self-control (assessed using a scale with items such as 'I do not have a hard time breaking bad habits'), were shown to have higher academic attainment four years later (Duckworth et al., 2010).

Evidence from the Avon Longitudinal Study of Parents and Children (ALSPAC) suggests that parent-reported hyperactivity and attention problems at age 47 months were strongly related to the total score on the General Certificate of Secondary Education (GCSE)<sup>1</sup> at age 16 - among boys in particular. This association reduced substantially when controlling for childhood IQ measured at age eight, suggesting that attention problems and hyperactivity are related to childhood IQ. In boys, inattention problems predicted a failure to attain five GCSEs at A\*-C grade (a basic threshold for progression in education), even after adjusting for childhood IQ, parental education, parental social class and early maternal depression (Washbrook et al., 2013).

### *Employment, income and socioeconomic status*

A number of studies show that aspects of self-control during childhood are important in explaining later labour market outcomes. These studies use composite measures of self-control, incorporating both positive and negative indicators of self-control. For instance, in the excellent study by Moffitt and colleagues using the Dunedin cohort, lack of self-control was indicated by nine measures comprising observational ratings of self-control at ages three and five, as well as reports from parents, teachers and the young people themselves at ages five, seven, nine and eleven regarding indicators of hyperactivity, impulsive aggression, lack of persistence, inattention and impulsivity (Moffitt et al., 2011). This study linked early self-control to a range of later outcomes. They found that lack of self-control at age 3 was almost as strongly associated with different indicators of socio-economic attainment at age 32 as early cognitive ability, including lower income, low socioeconomic status and more self-reported financial difficulties. A study using another New Zealand cohort (The Christchurch cohort) found that the same measure of self-control at age six was related to a range of adult outcomes including

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<sup>1</sup> The General Certificate of Secondary Education (GCSE) is an academically rigorous, internationally recognised qualification awarded in a specified subject. It is generally taken in a number of subjects by pupils in secondary education.

violent offending, welfare dependence, educational attainment and income (controlling for socioeconomic status, child conduct disorders, IQ and gender) (Fergusson et al., 2013).

Similarly, externalizing conduct problems at age 8 were associated with a risk of leaving school without qualifications and unemployment by age 18 (Fergusson and Horwood, 1998).

A parent-reported measure akin to conscientiousness, including assessment of concentration and perseverance, was used to assess self-control in the BCS cohort at age ten. Higher scores on this measure were associated with higher incomes at age 30, independent to factors such as educational attainment and employment (Blanden et al., 2007). Evidence from BCS as well as the National Child Development Study (NCDS) also suggests that childhood self-control is negatively associated with unemployment throughout the adult years (Daly et al., 2015). Evidence from Finnish and Swedish longitudinal studies (The Jyväskylä Longitudinal Study of Personality and Social Development (JYLS) and the Individual Development and Adaptation study) confirms this finding; however, most of the association operated via low academic attainment (Kokko et al., 2003). Using the same measure, Pulkkinen and colleagues (1999) found that high self-control of emotions, including exhibiting constructive and compliant behaviours, was indirectly associated with higher career orientation at age 36. Career orientation was indicated by occupational status, education, current work situation and stability (i.e. few periods of worklessness).

### *Health*

Aspects of self-control in childhood are also associated with adult health outcomes. In the aforementioned study by Moffitt and colleagues, early self-control (age three) was associated with better adult physical health (e.g. absence of metabolic abnormality, periodontal disease, airflow limitation etc.). Children who exhibited self-control were also less likely to be dependent on substances in adulthood, including tobacco, alcohol, cannabis, street or prescription drugs. These associations were independent of factors such as intelligence and socioeconomic status.

Studies using stand-alone indicators of self-control support the findings of Moffitt and colleagues' study, which uses a composite measure. For instance, more externalising behaviours at age 5 predicted greater likelihood of obesity at age 30 in the BCS, after adjusting for factors including childhood and paternal BMI (White et al., 2012). Furthermore, conduct difficulties in 7-year-old children in the NCDS were associated with increased risk of mortality by the age of 42 (Jokela et al., 2009). Although there is relatively less evidence linking delay of gratification to health outcomes than for other self-control measures, a small US study (N=164)

showed that the ability to delay gratification at age 4 was correlated with lower BMI at age 34 (Schlam et al., 2013).

There is less evidence explicitly examining the relationship between aspects of self-awareness and later mental health outcomes. However, several studies find convincing evidence for the role of early externalising behaviour in predicting psychological disorders. In the Dunedin cohort, children classified as 'undercontrolled' at age 3 were more likely to show negative emotionality at age 26 (Caspi et al., 2003). Similarly, using the NCDS, Buchanan, Flouri and Ten Brinke (2002) found that externalising behaviour at age 7 was associated with poor mental health at age 33, even after adjusting for factors including childhood emotional health, gender, parental socioeconomic status, socioeconomic disadvantage and family structure.

### *Other*

Moffitt and colleagues' study indicated that early self-control was associated with fewer criminal convictions at age 32. Using the same data, lack of self-control at ages 3 and 5 predicted an increased number of violent offences committed by the age of 18 (Henry et al., 1996, see also Caspi et al., 1996), a greater variety of self-reported offences committed in the last 12 months and a greater number of conviction records by the age of 21 (Henry et al., 1999). Further evidence from the Dunedin cohort suggests that individuals with 'undercontrolled temperament' at age 3 were more than twice as likely to engage in gambling at ages 21 and 32 than children who were well-adjusted (Slutske et al., 2012).

Delay of gratification has been associated with adolescent coping competencies. In Schlam and colleagues' study (2013), pre-schoolers who could delay gratification for a longer period of time at age four were better able to cope with frustration in stress in adolescence, according to parent's reports (e.g. 'child is less likely to be side-tracked by minor setbacks').

Table 3.2.1. Summary: Longer-term predictive power of self-regulation

<b>Outcome</b>	<i>Education/ Socio-economic/employment</i>	<i>Mental health</i>	<i>Physical Health</i>	<i>Other</i>
<b>Indicators of Self-Regulation</b>				
<i>Self-control</i>	Socio-economic status (+) Income (+) Unemployment (-)	Mental illness (-)	Clinical problems (-) Unhealthy behaviours (-) Obesity (-)	Crime (-)
<i>Delay of gratification</i>	Educational attainment (+)	Stress management (+)	Obesity (-)	Coping competencies (+)
<i>Conscientiousness</i>	Income (+)			

### 3.2.2. Self-awareness (Beliefs and perceptions of oneself)

**Definition:** Self-awareness broadly refers to children’s own beliefs about whether they possess the ability to complete tasks, and encompasses several aspects including self-esteem or self-confidence, self-efficacy and locus of control (John and De Fruyt, 2015). Although it has been argued that self-concept may be evaluative, it is largely considered to be descriptive and to represent self-perceptions of ability based on past experiences (Harter, 1982). On the other hand, terms such as self-efficacy, self-esteem or self-confidence, and locus of control are considered to be evaluative components of the self.

Self-efficacy refers to children’s beliefs about their perceived ability to perform in future tasks (Bandura, 1986), whereas self-esteem is the overall affective evaluation of one’s own value or worth (Blascovich and Tomaka, 1991). So, an individual’s self-concept may include ‘I am good at mathematics’ and they may have high self-efficacy in performing well in mathematical tasks, but the perceived ability in this specific domain may not necessarily influence their feelings regarding their overall self-esteem (Marsh, 1990). Locus of control refers to whether a person believes their performance is based on external factors (i.e. perceiving that the action of other people or luck determines an outcome), or internal factors (i.e. perceiving that they have

control over an outcome) (Rotter, 1966, Bandura, 1977). This attribution style relates to having either a 'fixed mindset' (believing that capabilities are inborn and unchangeable) or a 'growth mindset' (believing that capabilities, including intelligence can be developed; increased), each of which leads to different school behaviours and attainment (Dweck, 1999, Dweck, 2008).

*Measurement:* Researchers commonly use self-report measures to measure aspects of self-awareness, although the use of non-verbal methods is encouraged amongst young children, for example, using puppets in role-plays (Eder, 1990). An example of a typical self-esteem measure is the Rosenberg Self-Esteem scale (1967), a 10-item scale asking children to either disagree or agree with statements such as 'I feel that I have a number of good qualities'. Rotter's scale is commonly used to assess whether an individual tends to have an external or internal locus of control (Rotter, 1966), as is the Stanford Pre-School Internal-External Control Scale (Mischel et al., 1974), or the CARALOC pupil questionnaire (Gammage, 1975). The latter assesses perceived achievement control, including items assessing school experiences (e.g. 'Do you feel that wishing can make good things happen?'). Overall, assessments tend to be less reliable for children under the age of five, due to their developmental and language limitations (Eccles et al., 1993).

### **Longer-term predictive power of self-awareness**

#### *Educational attainment*

The evidence suggests that early self-awareness skills are associated with educational attainment throughout childhood, adolescence and in to early adulthood. However, few studies have assessed self-awareness skills at the age of six or below. One exception is a study which found that US children who expressed higher self-efficacy in their overall academic ability at age six had higher reading and mathematics scores at age nine (Liew et al., 2008).

Two studies using the data from the 1970 British Cohort Study (BCS) have analysed the long-term educational outcomes associated with measures of locus of control (the CARALOC questionnaire, Gammage, 1982) and self-esteem (The LAWSEC questionnaire; Lawrence, 1981) at age ten. Flouri (2006) showed that although both locus of control and self-esteem were associated with educational attainment by age 26, the predictive power of self-esteem disappeared when accounting for birth weight, parental social class, socioeconomic disadvantage, emotional behavioural problems, cognitive ability and mother's educational attainment. Similarly, Murasko (2007) found that locus of control but not self-esteem was significantly associated with increased probability of continuing education beyond age 16 and obtaining a degree by age 30, after controlling for parental background, cognitive ability and

physical health at age 10. Murasko also showed that both locus of control and self-esteem were associated with self-rated health at age 30, suggesting differential impacts of the two indicators on later outcomes.

### *Employment, income and socioeconomic status*

In another study using the BCS, children with an internal locus of control at age 10 experienced fewer spells of worklessness (of one year or more) between the ages of 16 and 29. However, this association was largely mediated by behavioural adjustment and academic attainment at age 16 (Macmillan, 2013).

### *Health*

As already mentioned, both locus of control and self-esteem measured at age ten were associated with later health outcomes in a study using the BCS (Murasko, 2007). In a further BCS study, children with an internal locus of control had a lower risk of being overweight or obese, reporting fair or poor health, or having high blood pressure (in women only) at age 30 (Gale et al., 2008). Internal locus of control was independently predictive of health outcomes in addition to childhood IQ, and partially explained the association between childhood IQ and being overweight or obese. Further evidence from the BCS suggests that both low self-esteem and having an external locus of control at age 10 are associated with increased weight gain at age 30 (Ternouth et al., 2009). A US study using the National Longitudinal Survey of Youth (NLSY) also found that children who were obese adolescents and showed unhealthy behaviours (e.g. smoke and drink alcohol) at age 13-14 had low academic and global self-esteem at age nine or ten (Strauss, 2000).

Low self-esteem and external locus of control at a young age is also an antecedent of later mental health problems. Children in the BCS who had an external locus of control at age 10 were more susceptible to anxiety, depression and emotional distress at age 30, as measured by Rutter's Malaise Inventory (Rutter et al., 1970) (Berrington et al., 2010). A US study following 385 children from age five to 18 showed that females with major depression at age 18 had lower self-esteem at age nine, than those with no depression at age 18 (Reinherz et al., 1993).

### *Other*

A study using the New Zealand Dunedin cohort found an association between low self-esteem and later criminal activity. Assessed at age 11, low self-esteem was shown to be associated with higher levels of criminal behaviour at age 26, even after controlling for adolescent depression, gender and socioeconomic status. Children with low self-esteem were 1.48 times more likely to



commit a violent crime and 1.32 times more likely to be convicted of any crime in adulthood (Trzesniewski et al., 2006).

Table 3.2.2. Summary: Longer-term predictive power of self-awareness

<b>Outcome</b>	<i>Education/Socio-Education/ economic status/employment</i>	<i>Mental health</i>	<i>Physical Health</i>	<i>Other</i>
<b>Indicators of Self Awareness</b>				
<i>Self-esteem/self-confidence</i>		Mental illness (-)	Obesity (-) Clinical problems (-) Unhealthy behaviours (-)	Criminal activity (-)
<i>Internal locus of control</i>	Educational attainment (+) Continuing education (+) Income (+) Unemployment (-)	Mental illness (-)	Obesity (-) Clinical problems (-) Unhealthy behaviours (-)	
<i>Self-efficacy</i>	Educational attainment (+)			

### 3.2.3 Emotional stability

**Definition:** Childhood emotional stability can be defined as the absence of internalising or externalizing behaviours (Goodman et al., 2015), coping, or the manifestation of a calm, balanced mood. However many studies focus on the presence of disorders involving such behaviours, such as anxiety, depression and volatility, which can be grouped under the Big Five personality trait ‘Neuroticism’.

**Measurement:** Childhood emotional stability is assessed through parent or teacher report of a child’s general disposition and the absence of emotional problems. Widely used tools include the Rutter scale (Elander and Rutter, 1996) and the Strength and Difficulties Questionnaire (Goodman and Goodman, 2009, Goodman et al., 2010). The Child Behaviour Checklist (Achenbach and Ruffle, 2000, Ivanova et al., 2007, Achenbach and Edelbrock, 1983) also

includes items assessing an absence of emotional wellbeing or the presence of internalising behaviours (such as appearing shy, withdrawn, or nervous).

### Longer term predictive power of emotional stability

#### *Educational attainment*

The evidence suggests that early emotional stability is not directly related to later educational attainment. A meta-analysis of six large longitudinal studies from different countries examined the influence of pre-school socio-emotional indicators on later academic attainment (Duncan et al., 2007). This impressive study<sup>2</sup> found that **internalising behaviours (measured before age five) were not significant predictors when controlling for prior cognitive skills, attention regulation and family background factors.** This result remains after various robustness checks. This finding has been subsequently repeated in a non-representative<sup>3</sup> study, the Fragile Families and Child wellbeing project (Turney and McLanahan, 2015). Children's socio-emotional skills can however affect both individual learning behaviour and classroom dynamics, such as child-teacher conflict and social exclusion, which in turn can impact on academic attainment (Pianta and Stuhlman, 2004).

#### *Employment, income and socioeconomic status*

There is mixed evidence regarding the role of early emotional stability in predicting later socioeconomic outcomes. Evidence from the Finnish JYLS suggests that teacher-rated anxiety at age 8 was predictive of low career orientation at age 36 for women, while extraversion promoted high career aspirations. For men, an 'unstable career' was also predicted by anxiety and passivity at age eight, but these effects were 'rooted in family socio-economic status (SES) (Pulkkinen et al., 1999). Another study using Finnish and Swedish data (Kokko et al., 2003) showed that 'timidity' at age eight was related to adult unemployment. These effects however mainly operate via SES, school achievement and earlier emotional problems

In a study by Layard and colleagues (Layard et al., 2014), which focused on emotional health rather than disorder, **childhood emotional wellbeing was not strongly related to economic outcomes such as adult educational attainment or income**<sup>4</sup>. Unexpectedly, Goodman et al.

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<sup>2</sup> This study examined the predictive effect of several core social, emotional and cognitive childhood skills measured between ages 4.5 to 6 years on subsequent educational attainment, assessing their relative importance across different cultural contexts, controlling for parental socio-economic background.

<sup>3</sup> The sample was predominantly drawn from large U.S. cities and includes an oversample of children born to unmarried parents who are disproportionately Hispanic and African American.

<sup>4</sup> In this study emotional health was operationalised through a composite score comprising 28 items on mixed measurement level, assessing symptoms of distress as well as physical symptoms such as headache, stomach ache, biliousness, temper tantrums, eating problems, bed wetting, etc.

(2015) found that better emotional health at age 10 was associated with a higher likelihood of living in social housing and with having a larger number of children (this latter outcome in the low income subgroup only).

### *Mental health*

There is a substantial body of evidence linking childhood emotional stability to mental health in later life. Not only do 'positive children become positive adults' (Richards and Huppert, 2011), the roots of several psychological disorders are thought to be detectable through emotional states in early childhood. In a review article Rutter and colleagues (2006) provide an overview of this research area and discuss possible behavioural, social and physiological mechanisms.

Evidence based on the BCS and NCDS shows associations between childhood emotional stability and various measures of adult wellbeing. Layard et al. (2014) found that the most important childhood predictor of self-perceived health, emotional health at age 26 and life satisfaction at age 34 was age 5 emotional health. As already mentioned this analysis used a composite measure of mother-rated emotional health throughout childhood; however, concentrating on age five predictors only, emotional health exerted the greatest influence - more than family economic resources, family psychosocial resources, and cognitive ability. About half of this was a direct effect, unmediated by other factors in adulthood. Similarly, Goodman et al. (2015) found that emotional health at age 10 predicted well-being at age 42.

There are links between early childhood and adulthood psychological disorders. Analyses using the BCS show that parent-reported emotional difficulties as early as age five are predictive of midlife psychological disorders such as depression and anxiety through their association with emotional problems at ages ten and 16 (Flouri and Malmberg, 2011). In the study by Clark and colleagues (2007), the association between internalising and externalising behaviours at age seven and midlife disorders was particularly strong for men. In the Dunedin cohort, parent-reported anxiousness and withdrawal at age 8 were found to be predictive of a range of mood, anxiety and phobic disorders between the ages of 16 and 21, controlling for social, childhood and family factors (Goodwin et al., 2004). A follow-back study of adults with depression found that three quarters had received a diagnosis before the age of 18 (Kim-Cohen et al., 2003), and results from the Christchurch Health and Development Study show early anxiety/withdrawal were associated with an increased risk of later anxiety and depression (Jakobsen et al., 2012). Similarly, in a sample drawn from the Mater-University of Queensland Study of Pregnancy (MUSP), Katz et al. (2011) found that social withdrawal at age five predicted depression in young adulthood.

A Dutch general population study shows associations between mood and anxiety disorders assessed between age 6 and 14 years through parental reports (using a Behaviour Checklist) and the existence of psychological disorders 14 years later (Roza et al., 2014). Later mood disorders were predicted by high scores on the anxious/depressed scale and on an internalizing composite (being withdrawn, somatic complaints, and anxious/depressed) during childhood and adolescence. Anxiety disorders were significantly predicted by a social problems scale and composite scale indicating externalizing problems (delinquent behaviour and aggressive behaviour). Anxiety disorders predominantly started in childhood and early adolescence, whereas the incidence of mood disorders increased sharply in adolescence and young adulthood.

### *Physical health*

For physical health outcomes, the evidence is mixed. In a study using the BCS, self-reported worrying and nervousness at age ten were significantly related to weight gain for females, controlling for childhood SES and parental BMI. The association seemed to operate through self-esteem and locus of control (Ternouth et al., 2009). However, in White and colleagues' (2012) BCS study, childhood emotional problems were not predictive of adult obesity. As for broader health outcomes, a study based on the Hawaii Personality and Health cohort, which tracked the influence of teacher-rated Big Five personality traits (assessed in grades 1 to 5) on health behaviours and health status in mid-life (aged 41-50), found that teacher-rated emotional stability was not predictive of later outcomes (Hampson et al., 2007). Findings in relation to substance abuse are few and mixed. A study using the same data found an association between lower levels of emotional stability in childhood (measured in grades one to five) and alcohol use in adulthood (Hampson et al., 2006). However, in the Finnish JYLS, emotional stability at age eight, including indicators of anxiety, did not predict problem drinking in adulthood after accounting for adverse factors in adolescence (Pitkänen et al., 2008).

### *Other*

In Layard and colleagues' (2014) study, childhood emotional stability was not associated with relationship outcomes in adulthood. However, other studies suggest some specific associations with partnership and family outcomes. Goodman and colleagues (2015) found that poorer emotional health at age 10 was associated with having children at age 42 (among women only), and in the JYLS, childhood anxiety was associated with poor quality marriages at age 36 (Kinnunen and Pulkkinen, 2003).

Table 3.2.3. Summary: Longer-term predictive power of emotional stability

<b>Outcome</b>	<i>Education/ Socio-economic/employment</i>	<i>Mental health</i>	<i>Physical Health</i>	<i>Other</i>
<b>Emotional Stability</b>	Career development (+) Employment (+) Wealth (+)	Mental illness (-) Life satisfaction (+)	Clinical problems (-) Unhealthy behaviours (-) Obesity (-)	Crime (-) Relationship quality (+)

### 3.2.4. Motivation

*Definition:* Motivation relates to why individuals think and behave as they do. A range of motivational theories have focused on understanding the values placed on achieving a task, goal orientation, interest and enjoyment (Wigfield and Cambria, 2010). These include the theory of intrinsic/extrinsic motivation (Deci, 1971), achievement goal theory (Dweck and Leggett, 1988, Ames, 1992); attribution theory (Weiner, 1979); expectancy-value theory (Eccles et al., 1983). Among younger children motivation can be conceptualized as school motivation, i.e. feeling towards school (e.g. liking school or school is boring), expectations for success (i.e. expected grades), preferences for challenge, and engaged behaviour in school.

The distinction between intrinsic/extrinsic motivation is derived from self-determination theory (Deci and Ryan, 1985) and refers to whether goals for action are set internally or externally to the individual. An individual with intrinsic motivation performs a task for its own sake, without seeking reward. Intrinsic motivation may be perceived in terms of children’s enjoyment of tasks, interest in novelty, curiosity, persistence, and perceptions of competence (Gottfried, 1983). A related concept is ‘mastery motivation’. This is where the goal of completing a task is to improve skills, master new material or learn new things (Wigfield and Cambria, 2010). By contrast, when motivation is extrinsic, goals may be more competitive or demonstrative in nature (sometimes termed ‘performance goals’).

The expectancy-value theory of motivation suggests that an individual’s motivation to perform tasks and the choice of which tasks to pursue are driven by expectancies for success (how well a child believes s/he will do on a task) and the extent to which they value the task (Wigfield and

Eccles, 2000, Eccles et al., 1983). Motivation is also linked to interest, enjoyment and engagement. Current research differentiates between three different types of engagement (Fredricks et al., 2004): behavioural engagement includes engagement in school activities as well as effort, persistence, concentration, attention; emotional engagement encompasses affective reactions to teachers, classmates, academics, and school; and cognitive engagement includes thoughtfulness and willingness to exert effort to understand complex ideas and master skills.

*Measurement:* The assessment of motivation is often included within broad scales of learning-related behaviour, in terms of traits such as persistence with tasks and interest/eagerness to learn (Barnett et al., forthcoming). Examples include:

- The Preschool Learning Behaviours Scale (PLBS) (McDermott et al., 2000) which is a broad assessment of approaches to learning including both motivation and executive function. This assessment has four subscales: Competence Motivation, Attitude Toward Learning, Attention/Persistence, Strategy/Flexibility and includes items accessing attentiveness, responses to novelty and correction, problem solving strategies and initiative. The Teacher Rating Scales of Early Academic Competence (TRS-EAC) (Reid et al., 2014) includes an Early Academic Enablers scale that comprises engagement, motivation, self-regulation, motor, interpersonal, and emotional competence, and the Approaches to Learning scale (ATL) captures teacher ratings of eagerness to learn, attentiveness, persistence, learning independence, flexibility and organization.
- Bayley Scales of Infant Development (Bayley, 1993) includes items measuring interest and persistence towards novel tasks among infants.

Emotional and behavioural responses to challenging tasks, which may indicate motivation and persistence, have also be measured by observing facial expressions and verbal cues (Berhenke et al., 2011).

### **Longer term predictive power of motivation**

#### *Educational attainment*

Although there is a large body of research on the role of motivation in learning, there are relatively few longitudinal studies measuring the longer term impact of early childhood motivation. In studies using data from the US Early Childhood Longitudinal Study, Kindergarten Class (ECLS-K), scores on the **Approaches to Learning scale (which includes items accessing motivation) at school entry were positively associated with achievement in mathematics and reading throughout elementary school** (Li-Grining et al., 2010, Duncan et al., 2007, DiPerna et

al., 2007) . However, researchers did not evaluate the specific contribution of motivation. In a small-scale study of the impact of pre-school factors on age eight to nine academic attainment, a scale of learning-related behaviour including motivation items predicted both the level and growth of Letter-Word identification and speed of reading processing, controlling for executive function and IQ (Sasser et al., 2015). The study also found that children with better learning-related behaviour in preschool had higher teacher-rated social competence and lower aggression in the third grade.

Studies using more specific measures of early motivation tend to be relatively short-term, and mainly suggest that motivation is a less important predictor of later attainment than self-regulation. Evidence based on small-scale studies conducted with preschoolers and kindergartners in the US suggests that children generally like school, that their grade expectations are unrealistic high (regardless of social class background) and unrelated to school success (Alexander and Entwisle, 1988, Stipek and Ryan, 1997). These studies controlled for the children's cognitive skills which were by far better predictors of later attainment than the motivational variables. A more recent small-scale, short term longitudinal study, which assessed the independent effect of motivation and self-regulation on school achievement among economically disadvantaged kindergartners, confirms the previous findings (Howse et al., 2003). However, another small scale longitudinal study conducted with 35 pre-schoolers in the US showed that early indicators of motivation are positively associated with initial adjustment in kindergarten (Daniels, 2014).

More specific aspects of motivation have also been considered in relation to academic attainment. Martin and colleagues (2013) studied the relationships between interest (interest in a new task), persistence and attainment between the ages of three and five in a low income sample. They found that both interest and persistence at age three were related to early academic skills at age five. In another small study, persistence (assessed through task observation) at age three was related to academic skills manifested two years later - independent of demographic factors and early cognitive-linguistic skills (Mokrova et al., 2013). A small Finnish study (Nurmi and Aunola, 2005) showed that 'task motivation' (motivation and interest towards mathematics) at age six was linked to mathematics attainment one year later. A small Australian study showed that task persistence was at age two predicted the same construct at age eight (Gilmore et al., 2003).

In a longer term longitudinal study , Shiner and colleagues (2003) found that, for 205 individuals involved in the US Project Competence Longitudinal Study, those who rated higher on a scale of

Mastery Motivation (derived from a combination of self-, parent- and teacher-report) between the ages of 8 and 12 had higher academic achievement 10 years later.

*Employment, income and socio-economic status*

This review found no evidence linking motivation assessed before age ten to later employment, income or socio-economic outcomes.

*Health*

This review found no evidence linking early motivation to later physical or mental health outcomes. However, Shiner and colleagues (2003) found that individuals high on Mastery Motivation in childhood were positively involved in their work and social environments and better able to deal with stress in adulthood. However, the authors conclude that some of the positive long-term effects of this trait may be due to its covariance with IQ.

*3.2.4. Summary: Longer-term predictive power of motivation*

<b>Outcome</b>	<i>Education/Socio-economic/employment</i>	<i>Physical Health</i>	<i>Mental health</i>	<i>Other</i>
<b>Indicators of motivation</b>				
<i>Learning related behaviours (including motivation)</i>	Maths attainment (+) Reading attainment (+)			
<i>Task persistence</i>				
<i>Task motivation</i>	Maths attainment (+)			
<i>Mastery motivation</i>	Academic attainment (+)		Stress management (+)	



### 3.3. Evidence regarding the role of interpersonal skills

Interpersonal or social skills comprise a set of characteristics that enable a child to interact with others. In our review we focus on the abilities to collaborate with others and ways of approaching others (see also John and de Fruyt, 2015). Collaboration requires the ability to take the perspective of another, to demonstrate prosocial behaviour (i.e. show kindness, sharing, cooperation, and respect for others), agreeableness and empathy. Ways of approaching others have been conceptualised in terms of extraversion, assertiveness or leadership, sociability, popularity and likability, as well as the capability of developing trust in others and the ability to communicate effectively.

#### 3.3.1. Approach

*Definition:* The term ‘approach’ includes several child characteristics which reflect early temperament or personality traits, including extraversion, assertiveness as well as approach-withdrawal. Markers of extraversion in early childhood include approach to novel situations, heightened activity, and excitement-seeking. Extroverts are also characterised by warm, gregarious and assertive behaviour within their interpersonal relationships (Costa and McCrae, 1989). Assertiveness is defined as ‘the direct, non-hostile, non-coercive expression of one’s thoughts, feelings, beliefs or desires’ (Alberti and Emmons, 2008). Approach-withdrawal reflects the nature of children’s responses to new stimuli (e.g. people, places, food etc.). Uninhibited (or outgoing/extroverted) children are quicker to approach and respond more positively to unfamiliar situations, than inhibited or shy children (Kagan et al., 1989).

Another important aspect of approach is attachment. Research in this area draws on attachment theory (Bowlby, 1969, Bowlby, 1958), which suggests that a child’s ties to its principal caregiver are central to development and have a long term impact. A child’s attachment style can be described as ‘secure’, characterised by a supportive, mutual, positive and stimulating relationship with the caregiver, or ‘insecure’. Ainsworth and Bell (1970) further characterised insecure styles as avoidant, resistant or disorganised.

*Measurement:* Multi-informant approaches are commonly used to assess temperament. Examples of inventories suitable for young children include the Toddler Temperament Scale (Fullard et al., 1984) and the California Child Q-set (Block and Block, 1980). Items on these inventories assessed children’s interaction with their peers in order to identify extraversion, e.g.

'He is shy; he has a hard time getting to know people'. Items also include an assessment of how children interact with novel situations to assess approach-withdrawal traits, e.g., 'Do your children fuss when trying new foods or new clothes?'. Assertiveness is sometimes assessed using discourse analysis of conversations, breaking down abilities into turn-taking, topic management and conversational repair (Brinton and Fujiki, 1989).

Attachment styles are principally measured using two assessments: the Strange Situation Procedure (SSP) (Ainsworth and Bell, 1970) and the Separation Anxiety Test (Klagsbrun and Bowlby, 1976). In the SSP, a child is exposed to a series of separations from and reunions with the caregiver. A securely attached child explores happily in the presence of the caregiver and is easily reassured after the separation, whereas an insecure child does not notice the caregiver's absence or seek comfort on their return (Ranson and Urichuk, 2008). In the Separation Anxiety Test, the subject is shown images depicting a child being separated from their caregivers and asked to interpret the child's feelings. Other assessments of the parent-child relationship include the parent-rated Parenting Stress Index (Abidin, 1983).

### **Longer-term predictive power of approach**

#### *Educational attainment*

While we did not find any research specifically linking extraversion and assertiveness to later academic outcomes, some studies suggest that early attachment style can structure later school behaviour and engagement. In a meta-analysis of the association between infant attachment (at 12-24 months) and intelligence, van Ijzendoorn and colleagues (1995) conclude that, while the direction of causality is unclear, secure attachment is related to both language development and IQ. However, this topic does not appear to have been studied extensively using longer-term longitudinal data. An analysis based on the US Study of Early Child Care and Youth Development (SECCYD) (Drake et al., 2014) suggests that early attachment relationships aid the development of self-regulation and the ability to navigate the school environment. **Early attachment styles (at 15 and 36 months) were related to later social self-control, and attentional impulsivity, but not other measures such as task persistence.** The study also suggests that early attachment has an impact on school engagement in Grade 5, via social self-control. Hamre and Pianta (2001) suggest that early relationships between teachers and children are predictive of later school behavior and attitudes towards work, controlling for gender, IQ, ethnicity and other aspects of behavior.

#### *Employment, income and socioeconomic status*

Several studies examine the link between temperament or personality traits and later labour market outcomes. Males in the BCS who were more extroverted at age 10 had lower levels of unemployment over the ages 16 to 29, after controlling for cognitive ability (Macmillan, 2013). Furthermore, evidence from the Dunedin study suggests that children classified as inhibited at age 3 were more likely to experience unemployment between the ages of 15 and 21 and left school earlier, than well-adjusted children. However, it should be noted that inhibited children were less likely to be unemployed or leave school due to being expelled, than those children who were classified as 'uncontrolled' (e.g. restless, impulsive and distractible) (Caspi, 2000). Evidence from BCS also shows that indicators of extraversion (being outgoing and extrovert) at age 10 are associated with becoming an entrepreneur by age 34 after controlling for general cognitive ability, locus of control and self-esteem (Schoon and Duckworth, 2012).

This rapid review found no evidence linking attachment to later employment, income and socio-economic status outcomes.

### Health

Variations in degree of extraversion and assertiveness in childhood are shown to be associated with adult physical health outcomes, although the evidence is equivocal, especially regarding health behaviours. Children from the Dunedin study classified as 'inhibited' at age 3 (showing signs of social withdrawal and shyness) were less likely to be socially engaged at age 26 and were prone to depression, suicidal feelings and substance abuse at age 21 (Caspi et al., 1996). Children in the BCS who were extroverts at age 10 were more likely to engage in unhealthy behaviours at age 34 such as smoking and using cannabis (ter Weel and Prevo, 2013). However, children in the Hawaii Personality and Health cohort who exhibited assertiveness at age 6 were shown to have better self-reported health at ages 41 to 51, through the mechanism of higher educational attainment, healthier eating habits, and being less likely to smoke (Hampson et al., 2007).

While a large body of research documents the relationships between social relationships and health, there are relatively few longitudinal studies linking early attachment styles to later health outcomes. Puig *et al.* (2013) used data from the Minnesota study<sup>5</sup> to show that those who were insecurely attached at 18 months (resistant or avoidant) were more likely to report an inflammation-based illness in adulthood than those classified as securely attached during

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<sup>5</sup> The Minnesota study was a long term longitudinal study of attachment over the life course and its relationship to other aspects of development. Review of findings from the study can be found in Sroufe (2005).

infancy. This result was controlling for other well-known health predictors such gender, SES, current BMI, life stress, negative emotional style, and perceived social support. Another study using data from the ECLS (Anderson and Whitaker, 2011) suggests that insecure attachment may be related to the development of childhood obesity. The authors found that insecure attachment at age 2 were at increased risk of obesity at 4.5 years, taking into account mother-child interaction during play, parenting practices related to obesity, maternal BMI and SES.

Several studies find evidence linking several aspects of temperament or personality in childhood with later mental health outcomes. Evidence from ter Weel and Prevoos (2013) study showed that extraversion at age 10 was related to positive life satisfaction at age 34. And, those in the Dunedin study who were classified as being inhibited at age 3 were shown to have greater internalising problems at age 18 and were more likely to be diagnosed with depression at age 21, than well-adjusted children (Caspi, 2000). Similarly, in a small sample of 167 German children, low assertiveness at age 5 was linked to increased emotional symptoms at age 9 (Groebe et al., 2011).

A number of studies show that early attachment is related to later personal and interpersonal competences (see review by Ranson and Urichuk, 2008). For example, Steele et al. (1999) showed that maternal attachment at one year predicts emotional understanding at age six. A Swedish study of 96 children showed that by age 8 or 9, securely attached infants reported less social anxiety and were generally more positive and popular than their insecurely attached peers (Bohlin et al., 2000).

There are a number of studies linking early attachment relationships to the development of psychological disorders. The majority of these are small-scale but some are relatively long term. For example, anxious or resistant early attachment style has been linked to the development of anxiety disorders in adolescence (Warren et al., 1997). Disorganised attachment has been linked to the development of affective disorders by the age of 17 (Carlson, 1998). For a recent review suggesting mechanisms linking attachment to mental health outcomes, see Morley and Moran (2011).

### *Other*

There is some evidence linking inhibition in childhood to criminal activity in adulthood. Although inhibition was associated with less positive health and labour market outcomes in Caspi's (2000) study, children did not differ from well-adjusted children in the extent to which they engaged in criminal activity at age 21. However, it should be noted that inhibited children

(age three) were less likely to have been convicted of multiple crimes (two or more crimes by the age of 21) than the aforementioned ‘uncontrolled’ children.

Extraversion, assertiveness and lack of inhibition during early childhood may be early indicators of future leadership potential. For instance, a study of US children derived from the Fullerton Longitudinal Study showed that those classified as uninhibited at age two were more likely to be extroverts in adolescence, and subsequently to possess leadership skills at age 29 (Guerin et al., 2011).

Table 3.3.2. Summary: Longer-term predictive power of approach

<b>Outcome</b> <i>Indicators of social approach</i>	<i>Education/Socio-economic/ labour market</i>	<i>Mental health</i>	<i>Physical Health</i>	<i>Other</i>
<i>Agreeableness</i>	Educational Attainment (+)			Friendship quality (+)
<i>Assertiveness</i>	Educational Attainment (+)	Depression (-)	Self-reported health (+) Unhealthy behaviours (-)	
<i>Extraversion</i>	Employment (+) Entrepreneurship (+)	Life satisfaction (+)	Self-reported health (+) Unhealthy behaviours (-/+)	Crime (+) Leadership (+)
<i>Secure attachment</i>	Maths attainment (+) Reading attainment (+) Self-regulation (+)	Social competence (+) Anxiety (-)	Inflammatory illness (-) Childhood obesity (-)	
<i>Disorganised attachment</i>		Affective disorders (+)		

### 3.3.2. Collaboration (Taking the perspective of others)

*Definition:* Within the category collaboration, we assess those social skills involved in interacting with others and maintaining positive relationships with others. These skills include empathy (i.e. understanding another person's perspective) and prosocial behaviours, including kindness, caring, sharing, cooperating and being helpful - constructs which also comprise the personality trait known as agreeableness (Pursell et al., 2008, John and De Fruyt, 2015). Sociability refers to a tendency to seek out interaction and forge relationships with others (Cheek and Buss, 1981).

*Measurement:* Measures tend to rely on parent and teacher reports of the nature of children's interaction with peers. Some measures seek to assess skills directly, including the Strengths and Difficulties Questionnaire (Goodman, 1997), which includes items measuring prosocial behaviour (e.g. 'Is kind to younger children'). Others assess an absence of a particular skill, including items on the Child Behaviour Checklist (Achenbach and Edelbrock, 1983) which assess lack of sociability or social withdrawal (e.g. 'likes to be alone'). Aggressive or antisocial behaviour towards others may also be evidence of a lack of prosocial behaviours. Scenarios are often used to assess empathy in young children, or their ability to infer range of mental states such as beliefs, desires, intentions and emotions of others (sometimes also referred to as theory of mind). For example, in the "Unexpected contents", or "Smarties" task, experimenters ask children what they believe to be the contents of a box that looks as though it holds a sweet called "Smarties". After the child guesses (usually) "Smarties", it is shown that the box in fact contained pencils. The experimenter then re-closes the box and asks the child what she thinks another person, who has not been shown the true contents of the box, will think is inside. The child passes the task if he/she responds that another person will think that there are "Smarties" in the box, but fails the task if she responds that another person will think that the box contains pencils.

#### Long-term predictive power of collaboration

##### *Educational attainment*

Several studies find evidence linking early agreeableness and later educational attainment. For example, in Hampson and colleagues' study (2007) of the Hawaii Personality and Health cohort, agreeableness at age six was associated with higher academic attainment. Similarly, in the Project Competence study, childhood agreeableness at age 8 was associated with higher academic attainment alongside rule-abiding conduct and better quality friendships at age 30, even after adjustment for earlier cognitive ability (Shiner et al., 2003). Two small studies show

that prosocial behaviour is a factor in shaping attainment in adolescence and adulthood. We could not find evidence of this using measures before the age of six. In a study of 294 children drawn from schools in Rome, early pro-socialness at age 8 was associated with better attainment at age 13, even after controlling for previous attainment levels (Caprara et al., 2000). Furthermore, early prosocial behaviour at age eight was shown to be equally important as early cognitive ability in predicting attainment at age 30, in a sample of US children from a semi-rural area of New York state (Eron and Huesmann, 1984).

### *Employment, income and socioeconomic status*

In the Project Competence study, social competence measured at age 8 was associated with better work competence (i.e. a record of holding down a job successfully and carrying out responsibilities well) at age 20. Furthermore, work competence was shown to be stable over a 10-year period throughout early adulthood (Masten et al., 2010). Evidence from the BCS suggests that social competence in childhood (i.e., social skills and peer popularity measured at age 10) predict entrepreneurial status at age 34, continuity in entrepreneurial activity (age 30 and 34) as well as earnings among the self-employed at age 34 (Obschonka et al., 2012).

### *Health*

There is some evidence for the association between early social skills and health outcomes. For example, agreeableness at age six among children in the Hawaii Personality and Health cohort study was indirectly associated with better self-reported physical health, through the mechanism of better educational attainment, healthier eating habits and being less likely to smoke (Hampson et al., 2007).

There is relatively less evidence explicitly examining children who exhibit early empathy and later health outcomes, although a *lack* of empathy is associated with negative outcomes in adolescents. British children in the Twins Early Development Study who exhibited callous-unemotional (CU) traits (in part indicated by a lack of empathy) at age 7 reported more antisocial and delinquent behaviours at age 12, characterised by hyperactivity, peer and emotional problems, as well as negative parental feelings (Fontaine et al., 2011). The study notes that children and adolescents with high CU traits, and associated antisocial and delinquent behaviours, are at increased risk of adult psychopathology.

### *Other*

There is some evidence linking early prosocial behaviour to criminal activity in retrospective studies examining precursors of criminality amongst convicts. Convicted men at age 32 in the

JYLS exhibited more aggressive and lower prosocial behaviours at age 8. Furthermore, those with earlier convictions (between the ages of 15 and 16) were shown to have been more aggressive at age 8 than those convicted in later adolescence (17 to 20 years) (Hämäläinen and Pulkkinen, 1995).

A Swiss longitudinal study found that sympathy (example item: ‘When I see another child who is hurt or upset, I feel sorry for him or her’) and moral reasoning at 6 and 9 were associated with social justice values, such as the belief in treating others fairly and minimizing inequalities, at age 12. This association was found when controlling for SES and cognitive ability (Daniel et al., 2014).

Table 3.3.1. Summary: Longer-term predictive power of collaboration

<b>Outcome</b>	<i>Education/Socio-economic/ labour market</i>	<i>Mental health</i>	<i>Physical Health</i>	
<b>Indicators of social collaboration</b>				
<i>Sociability</i>	Work competence (+) Entrepreneurship (+)	Mental illness (-)	Unhealthy behaviours (-)	
<i>Prosocial behaviour</i>	Educational attainment (+)			Crime (-)
<i>Agreeableness</i>	Educational attainment (+)		Clinical problems (-) Unhealthy behaviours (-)	
<i>Empathy/sympathy</i>		Mental illness (-)		Social justice values (+)



### 3. 4. Evidence regarding the role of cognitive skills

Cognitive skills are an umbrella term for several skills which enable the use of language, numbers and reasoning. They comprise verbal and non-verbal skills, executive functioning and problem solving.

#### 3.4.1. Verbal skills

*Definition:* Verbal skills are a vital asset in our global communication society, enabling individuals to achieve their ambitions for themselves, their families and their communities. According to the UNESCO Global Monitoring Report inadequate levels of literacy continue to represent a major problem in developed countries, such as the United States or the United Kingdom (UNESCO, 2006).

Verbal cognitive skills comprise the set of skills required to facilitate speaking, listening, reading and writing. Oral language skills (also known as emergent literacy) comprise those skills required to speak and understand (Honig, 2007). There are several domains of oral language, including the sounds produced while speaking (phonemes), the rules a given language requires to construct sentences (syntax) and the understanding that concepts have meaning (semantics). Literacy skills are those skills required to read and write, building upon oral language skills (Whitehurst and Lonigan, 1998). Receptive language refers to the ability to understand or comprehend spoken or written language. Expressive language means being able to put thoughts into words and sentences, in a way that makes sense and is grammatically accurate.

*Measurement:* Numerous measures assess oral language and literacy skills in children, including standardised assessments of verbal cognitive ability as well as formal assessments used in mainstream education. Examples of robust assessments typically used to assess verbal cognitive ability include the Naming subscale of the British Ability Scale (BAS) (Elliott et al., 1996) and the Verbal subscale of the revised Wechsler Preschool and Primary Scale of Intelligence (WPPSI-R) (Wechsler, 1967). Both assessments have a measure of verbal ability/expressive language whereby children are asked to verbally name pictures of objects. Measures of receptive language include the American Peabody Picture Vocabulary Test (Brimer and Dunn, 1962), and its adaptation the English Picture Vocabulary Test (EPVT) (Brimer and Dunn, 1973), in which the child is asked to indicate a picture that corresponds to a given word.

## Longer-term predictive power of verbal skills

### *Educational attainment*

Early literacy is strongly associated with educational attainment during childhood and adolescence. In the 2007 meta-analysis by Duncan and colleagues as well as in a subsequent study of the ECLS-K (Claessens et al., 2009), reading skills at the beginning of kindergarten were strongly related to reading achievement at age 10 to 11, net of background controls. Likewise in BCS receptive language skills at age five are associated with competent reading by age ten (Parsons et al., 2011). This result is also replicated in smaller, more selective samples. For example, a study of Israeli low-socioeconomic status children showed that early oral language skills at age five were associated with better school literacy achievements two years later, independent of family measures (Aram, 2005). Similarly, in a small sample of US children (N=121), emergent literacy skills in both Spanish and English at age 5 were associated with better reading levels in both languages at ages 12-13 (Reese et al., 2000). Early literacy skills are also associated with later academic attainment in adulthood. For instance, literacy skills at age 10 predicted educational and vocational achievement in early adulthood (early 20s) in the 1970 Youth Transition study in Australia (Athanasou, 2011).

### *Employment, income and socioeconomic status*

Studies show that early literacy skills are associated with several labour market outcomes, including employment, income and socioeconomic status. Evidence from the BCS shows that early literacy skills at age 10 were associated with significant increases in income in both gross hourly wages and weekly earnings, particularly from the ages of 38 to 42. Although results were not as convincing, children with high literacy levels were also more likely to be employed (Crawford and Cribb, 2015). Similarly, in an analysis using the NCDS, early reading ability at age 7 was associated with higher attained socioeconomic status at age 42, as indicated by higher income, home ownership, and having a non-manual occupation (Ritchie and Bates, 2013). Evidence from the BCS shows that competent readers at age 10 were also more likely to have higher incomes and fewer periods of worklessness by the age of 34 (Parsons et al., 2011).

### *Health*

Early literacy skills are significantly associated with health outcomes, both in physical and mental domains. Children in the BCS with better receptive language skills (listening and reading) at age 5 were more likely to have positive mental health outcomes at age 32 (Schoon et al., 2010b). Regarding physical health, low literacy levels among children in the BCS at age 5 were indirectly associated (via lower literacy levels in adulthood) with poor self-rated health, and

worsening health-limiting conditions by the age of 38. Another study also using the BCS showed that low early literacy levels were associated with more unhealthy behaviours (smoking) in adult men (Sabates and Parsons, 2012).

### Other

Variation in early language skills is associated with criminal activity in adulthood, although there is relatively less evidence than for health, education and labour market domains. For instance, in a sample of at-risk children from Hawaii in the Kauai Longitudinal Study, age-appropriate language development at ages 2 and 10 was associated with reduced likelihood of engaging in criminal delinquency by the age of 32 (Werner, 1989).

Table 3.4.1. Summary: Longer-term predictive power of verbal skills

<b>Outcome</b>	<i>Education/Socio-economic/employment</i>	<i>Mental health</i>	<i>Physical Health</i>	<i>Other</i>
<b>Indicators of Verbal Skills</b>				
<i>Oral language</i>	Educational attainment (+)			Crime (-)
<i>Literacy</i>	Income (+) Unemployment (-) Educational attainment (+)	Mental illness (-)	Clinical problems (-) Unhealthy behaviours (-)	

### 3.4.2. Numerical and other ‘non-verbal’ skills

**Definition:** Numeracy is the ability to reason and apply simple numerical concepts. It comprises the ability to identify and understand numbers as well as computational skills, i.e. the ability to perform simple arithmetical operations such as addition, subtraction, multiplication, division, and compare numerical magnitudes. For example, numeracy in infants’ refers to sensitivity to small changes in quantities, including understanding basic additions by counting on their fingers (e.g. 1+1=2) (Mandler and Shebo, 1982). Young children’s ability to identify quantities without the use of language is thought to indicate early evidence of numerical or mathematical ability, sometimes referred to as ‘number sense’ (Starr et al., 2013).

In addition to numerical skills there is also a range of other, so-called 'non-verbal', abilities which are sometimes included in general intelligence tests, comprising skills that do not necessarily require the use of language, such as demonstrating understanding of shapes, sizes, positions directions, colours as well as visual-spatial skills (e.g. recognising relationships between visual concepts).

*Measurement:* A variety of tests have been developed for assessing numeracy. For example, the Number Knowledge Test (Griffin, 2003) was developed as an index of conceptual and procedural understanding of the number system, requiring the child to count a small array of objects which increase in complexity. The Early Numeracy Test (Wright et al., 2006) for children aged four to nine years assesses skills on a continuum from facile to skilful. It consists of three parts: single-digit arithmetic, forward and background number word sequences and numerical identification, and simultaneous numerical processes, like spatial and finger patterns. For example children are asked: which is bigger, 6 or 8? Which number is closer to 3: 2 or 5? How many spots are on this show card? Other well-known tests are the Woodcock-Johnson test (Woodcock et al., 2001/2007) or the KeyMath (Connelly, 2007).

Other assessment instruments, such as the Wechsler Preschool and Primary Scale of Intelligence-Revised (WPPSI-R) (Wechsler, 1989) or the Bracken Basic Concept Scale (Bracken, 1998, 2002) include a range of measures to indicate early cognitive ability. For example the Bracken scale is a brief and easily administered scale to measure school readiness among children from 2 years 4 months through to 7 years 11 months of age. It captures 11 distinct areas including numbers/counting, comparisons, shapes, colours, direction/position, letter identification, size, texture, quantity, time/sequence, and social/emotional understanding. Although these assessments are considered to be culture free involving visual and pictorial stimuli, they rely on verbal instruction. For instance, children are asked to point to the missing section of a set of pictures (e.g. 'Look at each picture carefully and tell me what is missing').

### **Longer-term predictive power of numerical and other non-verbal skills**

The following section outlines evidence on numeracy and mathematical ability. There is less evidence on long-term outcomes of specific non-verbal skills, such as visuo-spatial ability.

### *Educational attainment*

Early numeracy is shown to be associated with educational attainment in childhood, adolescence and adulthood. In Duncan et al.'s (2007) meta-analysis of large scale longitudinal studies, and in subsequent ECLS-K analysis (Claessens et al., 2009), **kindergarten numeracy skills were related to mathematics achievement up to age ten.** In Ritchie and Bates' (2013) study

using the NCDS, numeracy ability at age 7 was associated with higher global intelligence scores at age 16 and higher rates of school completion. Furthermore, low mathematical scores at age 10 were highly predictive of poor numeracy levels at age 32 in Sabates and Parson's 2012 study using the BCS.

### *Employment, income and socioeconomic status*

Early numeracy skills in childhood are shown to be associated with several labour market outcomes in adulthood. In Ritchie and Bates' (2013) study, age seven numeracy was assessed using the Problem Arithmetic Test and teacher ratings of ability. Children with better numeracy were more likely to have attained higher socioeconomic status by age 42. Generally, the association between childhood IQ and educational attainment and socio-economic success is well established (Jencks et al., 1979; Sternberg et al., 2002).

### *Health*

Lower early numeracy levels are shown to be indirectly associated with poor physical health outcomes. As mentioned, low mathematical ability at age ten was highly predictive of adult numeracy in Sabates and Parson's study (2012), which was in turn associated with worsening health limiting conditions and deteriorating self-reported health in the BCS sample. Although associations were not as strong, low early numeracy was associated with increased smoking in men.

There are few studies explicitly examining the link between early numeracy and later mental health outcomes. However, several studies find an association using global assessments of cognitive ability. For example, in a study using the National Survey of Health and Development (the British 1946 birth cohort), higher cognitive ability at age 8 was associated with fewer self-reported symptoms of anxiety and depression (in women) at age 53, yet it places both men and women at higher risk for potential alcohol abuse (Hatch et al., 2007). The association between higher general cognitive ability (measured at age 10) and higher alcohol use in adulthood (age 30) is also observed in BCS (Batty et al, 2008). High levels of IQ (measured at age ten) are however also associated with a more active life style (regular exercise), eating fruits and vegetables (Batty, 2007a), a lower risk of premature mortality (Batty et al., 2007b) and a lower risk of psychiatric disorder (Batty et al, 2005).

Table 3.4.2. Summary: Longer-term predictive power of numerical and other non-verbal skills

<b>Outcome Skill</b>	<i>Education/Socio-economic/employment</i>	<i>Mental health</i>	<i>Physical Health</i>	<i>Other</i>
<i>Numeracy</i>	School completion (+) Educational attainment (+) Income (+) Socioeconomic status (+)		Clinical problems (-) Unhealthy behaviours (-)	
<i>General cognitive ability</i>	Educational attainment (+) Socio-economic attainment (+)	Depression (-) Psychiatric Disorder (-)	Premature Mortality (-)	Alcohol use (+) Smoking (-) Exercise (+) Healthy eating (+)

### 3.4.3. Executive Function

**Definition:** Executive function is an umbrella term covering a range of cognitive processes pertaining to purposeful behaviour. Executive function is ‘responsible for the planning, initiation, sequencing, and monitoring of complex goal-directed behaviour’ (Royall et al., 2002). It is sometimes referred to as a more ‘pure’ form of self-regulation (Rothbart et al., 2011) that can help to support effortful control and modulate reactivity to new stimuli.

Developmental psychologists distinguish between ‘hot’ and ‘cool’ executive function. ‘Cool executive function’ is thought to operate in ‘affectively neutral contexts’ while ‘hot executive function’ involves an emotional component (e.g., delay of gratification, tasks involving rewards and punishments) (Zelazo and Carlson, 2012). In our review we focus on the role of:

- *Working memory:* The active use of information held in memory.
- *Attention shifting:* Switching from one task or set of rules to another.
- *Sustained attention:* (or vigilance) the ability to remain focused on a task over time.
- *Attention regulation:* The ability to ignore irrelevant stimuli.

- *Inhibitory control*: The ability to override habitual behaviour responses.

‘Hot’ aspects of executive function are covered separately in the earlier section on self-regulation (personal skills). However, the capacity to regulate attention can be understood as a developmental precursor for self-regulation, i.e. the ability to effectively regulate behaviours and emotions in order to achieve goals (Barkley, 1997). It is thus important to keep in mind that there is no clear cut differentiation of social, emotional and cognitive skills, as these skills interact and build on each other in the process of skill acquisition.

*Measurement*: There is some debate in the literature on how to effectively measure executive function, particularly as tasks often simultaneously assess non-executive skills, a problem for the ‘purity’ of measurement. Several studies suggest that executive function is a single construct in young children (Willoughby et al., 2010, Allan et al., 2015) while others have identified differentiated domains (Howard et al., 2015). These mixed results may be the result of assessment in differently aged samples – and Howard, Okely and Ellis (2015: 5) suggest that ‘pre-schoolers’ executive functioning may initially present as unrelated processes, yet undergo a period of integration in the preschool years’. However, these developmental processes are not yet fully understood.

Researchers typically assess executive function using standardised tasks involving novel problem-solving situations. ‘Cool’ executive function tasks should not involve obvious reward or punishment. There are many examples and the development of appropriate tasks to assess executive function in young children is an active research area - Carlson (2005) provides a review of 24 tasks; see also Willoughby et al. (2012) for evidence on a recently developed battery of executive function tasks in a 5 year old sample.

The Wisconsin card sorting test (Grant and Berg, 1948) is a prototypical executive function task. Participants are asked to sort cards according to different criteria (shape, colour and number). A variant is the Dimensional Card Change Sort, where children have to switch between sorting on different dimensions (Frye et al., 1995). An example of a task assessing working memory is the Backward Word Span task, where children are asked to repeat a list of words in backward order (Davis and Pratt, 1995). The Continuous Performance Test is used to simultaneously assess attention and inhibitory control (Allan et al., 2015, Rosvold et al., 1956, Conners, 1985). During this task, children view a stimulus sequence on a screen, respond to target stimuli, and withhold responses to non-target stimuli. Attention and inattention have also been measured using teacher and parent report, for example using the Strengths and Difficulties questionnaire.

### 3.4.3.1 Longer term predictive power of executive function

#### *Educational attainment*

The most studied aspect of early childhood executive function in relation to later achievement is attention. The aforementioned meta-analysis of six large longitudinal studies by Duncan et al. (2007) found moderate strength predictive power of childhood attention regulation (measured before age five years) on later academic attainment independent of early reading and math skills as well as indicators of self-regulation and emotional stability<sup>6</sup>. Similarly, Claessens and colleagues' (2009) ECLS-K study found that a pre-school measure including indicators of attention and the teacher-rated 'Approach to Learning' scale, predicted reading and mathematics achievement at age ten, net of a comprehensive set of background controls and classroom clustering. While these studies are high quality, using large sample longitudinal data, they use broad measures of attention. For example, the Approaches to Learning scale includes 'attentiveness, task persistence, eagerness to learn, learning independence, flexibility and organization' (Claessens et al., 2009: 9). These are qualities that may be more related to behaviour and disposition rather than cognitive function per se, and may access both 'hot' and 'cool' aspects of executive function. Nonetheless, the findings are supported by consistent evidence linking the ability to regulate and sustain attention to educational achievement (Alexander et al., 1997, Yen et al., 2004, Howse et al., 2003, Turney and McLanahan, 2015).

Studies using task-based measures of executive function tend to be smaller scale and shorter term. There is a proliferation of small-scale evidence showing that attention regulation and composite measures of executive function are associated with early academic achievement in both reading and mathematics (e.g. Nesbitt et al., 2013; Sasser et al., 2015, Neuenschwander et al., 2012) and in mathematics specifically (Clark et al., 2010, Fuhs et al., 2014, Toll et al., 2011). Clark and colleagues (2013) had particularly early measures – their study used a task battery measuring different aspects of executive function at age three which was predictive of mathematics achievement two years later, after controlling for intervening attainment as well as SES, language and processing speed. However this study comprised a convenience sample of only 228 children. Other small-scale longitudinal studies have found that early executive function (parent rated or task-assessed) is related to later teacher-reported measures of school adjustment and classroom behaviour (Davies et al., 2008, Brock et al., 2009, Neuenschwander et al., 2012).

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<sup>6</sup> In this comparative study childhood attention regulation was assessed with different measures involving directly assessed performance tasks, behavior checklists, and parental and teacher ratings of hyperactivity and attention control.



A number of studies (Razza et al., 2012, Blair et al., 2015, Nesbitt et al., 2013) are focused on low-income or at-risk groups and they suggest that early executive function could be a 'protective factor' mediating the relationship between family socio-economic status and later academic outcomes. It is however difficult to attribute causality in these short term studies, since executive function and academic skills develop simultaneously.

Two smaller studies have analysed the predictive role of early working memory and inhibitory control. A study of 124 children in Scotland (Bull et al., 2008) found that children with higher scores on a test measuring visual working memory at age 4 had higher maths ability at age 7. Other executive functions skills (inhibition and planning) predicted achievement in both maths and reading. Pre-school inhibitory control may also contribute to academic development, as demonstrated in a US ethnic minority sample (Ng et al., 2015).

Longer term evidence is less abundant, however Richland and Burchinal (2013) found that children with higher scores on a composite measure of executive function in early elementary school displayed higher scores on a verbal analogies task at age 15, even after adjusting for a range of background factors. However, early measures of short term memory and sustained attention were not related to the later outcome.

In a study using data from the Colorado Adoption Project (McClelland et al., 2013) children's attention span-persistence (reported by parents at age 4) significantly predicted mathematics and reading test scores at age 21, even after controlling for achievement levels at age 7, adopted status, child vocabulary skills, gender, and maternal education level. After testing for mediation using structural equation models, the authors conclude that an individual's attention span persistence was a stronger predictor of college completion by age 25 than reading or math score at age seven or age 21.

### *Employment, income and socioeconomic status*

This rapid review provided no evidence relating executive function to later employment, income or socioeconomic outcomes.

### *Physical health*

One recent German study suggests that lower levels of early executive function (measured in primary school) could be related to the development of childhood obesity. The authors found that executive function predicts particular eating styles that may be associated with the development of weight problems (Groppe and Elsner, 2015).

### *Mental health*

A study using the Dunedin cohort found that individuals diagnosed with schizophrenia in adulthood exhibited developmental lags across the ages of 7 to 13 on tests indexing processing speed, attention, visual-spatial problem solving ability, and working memory (Reichenberg et al., 2009).

*Other*

While most studies examining the childhood antecedents of later criminal behaviour focus on ‘hot’ aspects such as self-control and delayed gratification, Moffitt (1990) suggests that hot and cool aspects could interact to predict later criminal behaviour. However there is no longitudinal study conclusively showing this. A study using the ECLS (Jackson and Beaver, 2013) found that fine and gross motor deficits (used as proxies for executive function) in kindergarten children were associated with parent-reported conduct problems in the eighth grade and teacher-reported self-control throughout primary school. Likewise, a study based on the UK Millennium Cohort shows that fine and gross motor development at age 9 months is associated with general cognitive ability (assessed with the British Ability Scales) and prosocial behaviour at age 5 years, after controlling for financial hardship in the family, parental mental health and an indicator of school readiness measured at age 3 years (Schoon, Cheng and Jones, 2010).

Table 3.4.3. Summary: Longer-term predictive power of executive function

<b>Outcome</b>	<i>Education/ Socio-economic/employment</i>	Mental Health	<i>Physical Health</i>	<i>Other</i>
<b>Indicators of executive function</b>				
Attention problems	Adolescent educational attainment (-)			Behaviour in the class room (-)
High fine and gross motor skills	General cognitive ability (+)			Pro-social behaviour (+) Adolescent conduct problems (-)
Working memory	Mathematical ability (+)			
High levels of executive function	Mathematical ability (+)	Mental illness (-)	Obesity (-)	

### 3.4.4. Creativity, openness, and play

*Definition:* Creativity has been referred to as the ability to produce ideas that are novel and useful (Harrington et al., 1983). Although creativity is a key concept of human innovation, there are ongoing debates regarding its conceptualisation and the recognition that the development of creativity depends on the combination of cognitive and social and emotional capabilities. In 1957 Guilford introduced a distinction between convergent and divergent thinking to describe processes that lead to single, correct solutions (convergent) versus processes that generate multiple solutions and possibilities (divergence). Both processes were considered to be part of his Structure of Intellect model (Guilford, 1957). Later research drew a sharper distinction between the two modes of thinking, linking convergent thinking with aspects of executive function and divergent thinking with association processes (Wallach and Kogan, 1965). Current research has reinterpreted divergent thinking as an executive function that is founded on managing interference (Gilhooly et al., 2007, Nusbaum and Silvia, 2011, Benedek et al., 2014). Recognizing that intelligence is a necessary but not sufficient factor for the development of creativity, researchers began to assess creativity from the perspective of personality theories and processes aiming to identify the general and specific abilities, motives, and traits that result in a person who is creative (Batey and Furnham, 2006). In particular associations to high level of openness were identified, the tendency to be curious, imaginative and being open to new experiences, as well as indicators of confidence and independence. In our review we also searched for studies examining the longitudinal benefit of play, which is considered to facilitate cognitive strategies, such as divergent thinking, problem solving and self-regulation (Bergen, 2002).

*Measurement:* Widely used approaches to assess creativity are based on divergent thinking tasks, especially those originally devised by Wallach and Kogan (1965). In the Alternate Uses Task, children are asked to give alternative uses for everyday objects; task responses are then summed and coded for fluency and originality. In the Instances Task, the facilitator asks, for example, 'Tell me all the things you can think of that are round'. Responses are coded for how closely they adhere to constraints (i.e. roundness of named objects). For more examples such as the Thinking Creatively in Action and Movement Task see (Barnett et al., forthcoming). There are strengths and weaknesses in these different assessments, in particular regarding the scoring of originality ratings which are strongly sample-dependent, and the fact that the naming tasks resemble verbal fluency tasks very closely and imply a strong confounding of fluency and originality scoring. These issues can however be overcome through the development of new

scoring methods focusing on the creative quality of the responses and use of executive and strategic processes (Nusbaum and Silvia, 2011).

Openness to Experience among preschool children can be assessed through rating scales, as described by John and colleagues (1994). Parents or teachers rate children on a number of statements, for example: 'Is curious and exploring, eager to learn, open to new experiences'.

Qualities of children's play can be measured using the Affect in Play scale (APS) (Russ, 1993). The APS is a standardized 5-minute task designed to measure various dimensions of children's pretend play. Children are filmed playing with puppets and their play is subsequently coded for organisation, imagination, comfort, frequency and variety of affect.

### **Longer term predictive power of creativity, openness and play**

#### *Educational attainment*

This review found no recent studies looking at longer term outcomes of divergent thinking in early childhood. However, an older study by Harrington and colleagues (1983) found that scores on **divergent thinking tasks at age 4 were linked to teacher rated creativity at age 11**. We found no longitudinal studies linking openness in early childhood to later academic attainment. Some researchers have theorised that play styles, in particular children's ability to engage in pretend play and role-play, could also be a developmental precursor to creative, versatile and symbolic thinking. There are a few small-scale longitudinal studies demonstrating this. Mullineaux and Dilalla (2009) reported that **realistic role-play at age 5 predicted performance on a divergent thinking task at ages 10 to 15**. Hanline and colleagues (2008) showed that **'symbolic substitution sociodramatic play' (where children use props or objects in pretence) at age 5 predicted reading and maths skills at age 8**. Similarly, in a small-scale study of 31 girls, Wallace and Russ (2015) found that **early pretend play predicted divergent thinking and maths achievement over a 4 year period**. Children whose pretend play was more imaginative and organized generated more alternate uses for common object four years later. For a review of studies linking pretend play to early (concurrent) developmental outcomes, see Lillard *et al.* (2013).

#### *Employment, income and socio-economic status*

This review found no evidence linking early creativity, openness or play to later employment, income or socio-economic status.

### Physical health

This review found no evidence linking early creativity, openness or play to later physical health outcomes.

### Mental health

Two small studies provide evidence for a relationship between openness to experience and later mental health. Gjerde and Cardilla (2009) studied emotional and cognitive outcomes in 102 individuals at the ages of 18 and 23, in relation to their scores on a pre-school scale of Openness to Experience (the John *et al* scale). They found that pre-school openness predicted later openness in both males and females. Males with higher Openness to Experience scores reported being more extroverted, conscientious, emotionally positive, and higher in self-esteem at age 23. However, females with higher Openness to Experience scores reported being significantly more neurotic, depressed, anxious, shy, susceptible to anger, and emotionally negative. In a small study by Abe (2005), openness to experience at age 3.5 was associated with sophisticated play behaviour at age 5 and self-confidence in adolescence (mean age 12 years).

Table 3.4.4. Summary: Longer-term predictive power of creativity, openness and play

<b>Outcome</b>	<i>Education/Socio-economic/employment</i>	<i>Mental health</i>	<i>Physical Health</i>	<i>Other</i>
<b>Indicators of motivation</b>				
<i>Divergent thinking</i>	Creativity (+)			
<i>Openness to experience</i>		Self esteem (+) Self confidence (+) Extraversion (male) (+) Anxiety + depression (female) (+)		
<i>Pretend play</i>	Divergent thinking (+) Reading attainment (+) Maths attainment (+)			

### 3.5. Conclusions from the Literature Review

In this review, we provided an assessment of the evidence concerning the links between early childhood personal, interpersonal and cognitive skills and later outcomes. Regarding outcomes, we focused in particular on educational attainment (assessed at the individual level and reflecting school grades and highest academic achievement), attained socio-economic status and income, mental health, physical health and other outcomes reflecting social integration (relationship status, crime, civic engagement). We concentrated on longitudinal studies where early skills were measured under the age of six, but evidence of skills assessed up to age ten was also considered. We first provide a short summary and evaluation of the findings from the literature review. Second, we discuss the quality of the evidence, and third we identify challenges and opportunities for future studies.

#### Predictive power of early skills

**We could identify a comprehensive set of core skills associated with a range of adult outcomes comprising verbal and numerical (as well as other non-verbal) skills as well as early indicators of self-regulation. Locus of control also is predictive across a range of outcomes - although the evidence is less strong than for self-regulation. Regarding domain specific influences, especially regarding educational attainment, executive function performs a significant role. Given that executive function also appears to be predictive of behaviour regulation, it is assumed that it is a developmental pre-cursor of self-regulation. Concerning mental health, the evidence suggests a significant role of early emotional stability as well as social approach (being assertive and securely attached).**

The strongest evidence we found relates to the predictive role of early self-regulation and cognitive skills. Specifically, young children's ability to control their behavior and emotions appears to be an important predictor of a range of adult outcomes. A lack of self-regulation as young as age three predicts a range of adverse adult outcomes including lower socioeconomic status, mental ill health and criminal behavior, independent of the influence of cognitive ability and family background. There is particularly strong evidence on this from prospective longitudinal studies conducted in New Zealand. There is however less evidence showing that self-control is related to children's later educational attainment, instead we find good evidence regarding the role of executive function as a predictor of educational attainment. Executive function (in particular attention regulation) is associated with later educational attainment and behavior control. Attention regulation is considered as a developmental precursor of self-

regulation, and is sometimes referred to as a more 'pure' form of self-regulation (Rothbart et al., 2011). There is potentially an overlap between these two constructs (executive function and self-regulation). Moreover, the evidence points to the existence of sensitive periods for the development of specific competencies and skills, and a better understanding of developmental processes and interlinkages in the formation of different skill sets is needed.

The evidence on the predictive power of cognitive skills is generally strong. In particular early verbal skills are strongly predictive of a broad range of outcomes, including educational attainment, socio-economic status, mental and physical health, health behaviour and crime. Also numerical skills measured before school entry are predictive of later school attainment. Later on in life, early numerical skills predict other outcomes, such as socio-economic status, income, engagement in unhealthy behaviours and clinical problems.

The evidence regarding early indicators of self-awareness is also significant. Indicators of self-awareness appear to be associated with a range of outcomes, yet this evidence mostly relates to age ten measures of locus of control from the British cohort studies. Few studies have assessed self-awareness before age six and it has been argued that accurate beliefs, perceptions and evaluations of one's abilities and competencies flourish only later.

Aspects of early executive function, in particular the ability to regulate and sustain attention appear to be strongly related to educational attainment as well as school engagement and good behaviour. Studies demonstrating this tend to be shorter term rather than tracking individuals into adulthood. As this is a relatively recent research area, evidence on other specific aspects of executive function is more scattered, although processes starting to be considered longitudinally include working memory, inhibitory control, and proxies such as motor skills.

A number of studies show that emotional instability, manifested as internalizing behavior, is associated with later mental health problems, pointing to domain specific effects.

The evidence on interpersonal skills is less conclusive and less strong. Evidence for early indicators of approach is somewhat more robust than regarding collaboration. In particular early attachment patterns and indicators of assertiveness appear to be related to later mental health and life satisfaction, and to fewer adverse socioeconomic circumstances.

### Quality of evidence

Evidence we rate as 'strong' is based on multiple indicators: involving skill measurements before age six, establishing associations while accounting for extensive potential confounding factors such as cognitive ability and socioeconomic status, and drawing on a number of large-

scale longitudinal studies across countries. Weaker evidence is drawn from small scale and short duration studies, providing evidence regarding one particular domain only (for more details see our ranking of evidence in Chapter 3).

The volume of evidence we found for each skill is dependent on a number of factors, not least the availability of high quality, large scale longitudinal data including appropriate measures. The majority of evidence is sourced from a relatively small pool of longitudinal studies from a select number of developed countries (e.g. the Dunedin study in New Zealand, the British cohort studies, the Jyväskylä study in Finland, and a number of US studies). Although there are several smaller-scale longitudinal studies in other developed countries (e.g. Germany, Sweden etc.), there is a scarcity of studies examining outcomes amongst children in developing countries. There is a Brazilian longitudinal study 'Pelotas' which follows up children from the age of three with good evidence on early developmental milestones, indicators of physical health and other competences, but we found no evidence regarding the outcomes we were interested in.

There is variability across studies regarding how the different skills are defined and measured and terms are not used consistently. While some studies use composite indicators, others focus on specific skills or functions. Moreover, assessment instruments with a similar name might measure concepts that are quite different, and measures with different names can measure concepts that are quite similar. There is thus a need to agree and develop a more consistent use of core concepts and agree on ways of how to operationalize them. Differences in operationalisations have implications regarding findings. For example, whether studies focus on the presence versus the absence of a skill matters for the evidence regarding later outcomes. For instance, empathy is not commonly directly measured, but a lack of empathy is shown to be associated with less positive outcomes. Variation in whether an absence or presence of a skill is identified may be because some skills are difficult to assess in very young children compared to others. For example, delay of gratification can be reliably assessed using standardised direct test appropriate for use in children as young as three years, whereas no questionnaire or test has been designed which systematically operationalizes empathy (although parent/teacher observations are commonly used).

Another concern is that the evidence depends on prevailing research interests and available knowledge. Some skills, for example executive function, have become an active research area only recently so there were not many longer term longitudinal studies. Other skills, such as self-esteem, do not seem highly suited to assessment in children younger than six, or at least were not thought to be historically. There have however been major advances in research on the development of childhood competences since, although long-term benefits of early skills are



less studied (often due to the lack of longitudinal data). Our review thus cannot claim to be exhaustive and, in common with all literature reviews, is subject to prevailing research interests and publication bias.

## Outlook

For future studies it is of note that the majority of available studies do not take steps to account for measurement error inherent in assessing skills. Measurement error refers to the difference between the measured value of a variable and its 'true' value, and may be attributable to the respondent (e.g. demand characteristics – parent not wanting to report their child has difficulties in a particular skill), the interviewer (unconscious biases, inadequate training), the questionnaire (e.g. wording), task characteristics etc. Future studies could use more robust statistical techniques (e.g. structural equation modeling or item response theory as opposed to typically used regression analyses) which better account for measurement error. Furthermore, not all studies include appropriate controls to account for possible alternative explanations of effects, and more attention is needed to identify key control variables that might give rise to both the outcome and the skill.

Regarding the conceptualisation and measurement of core skills it is important to reach consensus about the definition of key constructs and use of appropriate measures, also taking into account cultural variations and practices. Here we adopted a broad life skill framework to identify key overarching skill domains and their associated sub-ordinate specific skill components.

There are also concerns regarding potential problems of the 'purity' of measurement. For example, the use of assessment batteries as indicators of executive function often involve measures of non-executive skills, such as self-regulation and motivation (i.e. the Preschool Learning Behaviours Scale or the Approaches to Learning Scale). Not differentiating the role of specific skills or competencies, in turn, can mask their distinctive contributions, and thus not advance our understanding of which skills are especially important regarding distinct outcomes or general future development. Future studies need to pay more attention to the specific skills captured in broad assessment batteries and develop a more detailed understanding of different processes contributing to positive adjustment.

Generally, there is a need for a better understanding of the developmental and interactive processes underlying the formation of different skill sets. For example, indicators of gross- and fine motor development play a significant role, and there is evidence regarding the importance of early attachment styles. Moreover, early indicators of executive function are considered to

be pre-cursors of self-regulation. Yet, there is also evidence to suggest that early indicators of self-regulation or situational factors (such as stressful situations and adversity) might drive capabilities of executive function. It is thus important to explore in more detail developmental and reciprocal processes among early skills, their co-development and potential cascading effects (i.e. an inevitable and sometimes unforeseen chain of events), as well as potential risk and supportive factors in the children's environment that account for their advancement.

Moreover, we still don't know the longevity of effects of early skills on outcomes across the life course. One reason why is because the majority of birth cohort studies (tracking children from birth) were initiated in the last 50 years or so, meaning that data is only available for participants up to and including the earlier stages of adulthood (beginning at age 35 and ending at age 64). Another reason is that most studies do not concurrently examine outcomes at multiple time points across the lifecourse, meaning the relative importance of early skills at different stages of adulthood is not robustly assessed. Nevertheless, for certain skills, there appears to be relatively more evidence suggesting that early skills are important in predicting later outcomes in early adulthood (up to the age of 34) compared to in middle adulthood. For example, aspects of approach (including both temperament and attachment) are linked to mental health outcomes up to the age of 34 but there is less certainty about older ages.

## 4 Predictive Power of early Life Skills – New Evidence from BCS

### 4.1. Overview

In this chapter, we present new evidence on the association between social, emotional and cognitive skills measured at age 5 and adult outcomes in the 1970 British Birth Cohort Study (BCS). The measures include early indicators of self-regulation (non-hyperactivity and good conduct), emotional stability, social skills (peer relations), visual-motor and verbal skills as well as conceptual maturity. We examine the association between these multiple early skills and a range of outcomes at age 42, relating to different life domains including educational attainment, socio-economic status, labour market outcomes, health and health behaviours, partnership and children and political interests.

**Table 4.1: Evidence of predictive power of social, emotional and cognitive skills from our analysis using BCS70**

Early Competencies	Adult Outcome			
	Education/ Labour Market/ Socio-Economic	Mental Health & Well-being	Physical Health & Health Behaviours	Other
<b>Self—regulation (non hyper- activity)</b>	GCSE (+)	Well-being (+) Malaise (-)		Political Interest (+) Partnership (+)
<b>Self—regulation (good conduct)</b>	GCSE (+) Degree (+) Employment (+) Top Job (+) Job Satisfaction (+) Social Housing (-)	Life Satisfaction (+) Malaise (-) Well-being (+)	Smoking (-) Drinking (-) Self-rated Health (+)	Political Interest (+)
<b>Emotional stability*</b>	GCSE (-) Degree (-) Wage (-) Social Housing (+)		Smoking (+) Self-rated Health (- )	
<b>Social skills</b>			Drinking (+)	Parenthood (+)

<b>Visual motor skills</b>	GCSE (+) Degree (+) Employment (+) Top Job (+) Income (+) Wage (+) Wealth (+) Social Housing (-)	Malaise (-) Life Satisfaction (+)	Self-rated Health (+) Obesity (-) <i>Exercise (-)</i> Smoking (-)	Partnership (+)
<b>Verbal skills</b>	GCSE(+) Degree (+) Employment (+) Wage (+) Income (+) Top Job (+) Social Housing (-)	Well-being (+) Malaise (-) Life Satisfaction (+)	Self-rated Health (+) Drinking (-)	Partnership (+) Political Interest (+) Parenthood (-)
<b>Conceptual maturity</b>	Employment (+) Social Housing (-)			Political Interest (+)

Notes: Malaise = mental distress;

Table 4.1 above summarises findings from our analysis using the BCS70. Only the significant associations between adult outcomes and each skill group are reported, after controlling for a wide range of child, parent and family characteristics. The significant associations outlined in Table 4.1, are thus independent of a wide range background characteristics and the different skill sets included in the model. More details for the conditional model specification are given in Appendix 5. Appendix 6 shows the effect sizes of the skills for each individual outcome in Figures A6.1 to A6.21.

The outcomes are grouped using the same themes as those in the previous tables: Education/Labour Market/ Socio-Economic; Mental Health and Well-being, Physical Health and Health Behaviours, and Other. The plus and minus in parentheses correspond to whether the skill is positively or negatively associated with the outcome. For example, in our analysis, indicators of self-regulation are positively related to obtaining a degree (+), and negatively related to malaise (mental distress) (-). There are also some outcomes, highlighted in italics, for which the association found can be said to be in an ‘unexpected’ direction. For example, emotional health is associated with a *higher* likelihood of smoking.

We consider two separate measures relating to **self-regulation** – ‘*good conduct*’ and ‘*non hyperactivity*’. We find that both these indicators are important for outcomes across all of the life domains considered. For example, good conduct in childhood is associated with obtaining degree level qualifications, getting a top job, higher levels of life satisfaction and self-reported well-being, positive health behaviours and partnership outcomes, and civic engagement (interest in politics). We see independent effects for indicators of early non-hyperactivity and later educational attainment, mental health and wellbeing, political interest and partnership formation.

**Emotional stability** is unexpectedly associated with lower wages, a lower likelihood of obtaining a degree and fewer GCSEs, lower self-rated health, as well as a higher likelihood of smoking.

Our indicator of **social skills** (positive peer relations) is positively associated with parenthood by age 42, i.e. the number of children, but also positively associated with harmful drinking, suggesting a potential ‘dark’ side of strong peer relations.

Two of the **cognitive skills**: *verbal skills* and *visual motor skills* show significant associations across a wide range of outcomes. Both *verbal* and *visual motor skills* are positively associated with educational attainment, employment, income, wages, getting a top job, life satisfaction, self-rated health, low levels of mental distress, and being in a committed relationship by age 42. Both skills are also related to positive health behaviours. *Verbal skills* are also linked to political interest and having no or only few children by age 42. The indicator for early conceptual maturity is only associated with obtaining a degree.

**In summary**, early **self-regulation**, **verbal** and **visual motor skills** are the most consistent predictors of adult outcomes, across all outcome groups and show independent effects. In particular, **verbal** and **visual motor skills** are the strongest predictors of the socio-economic and labour market outcomes. Moreover, **good conduct** predicts a range of socio-economic and labour market outcomes and all but one of the mental wellbeing and physical health/health behaviour outcomes, independent of the cognitive skills and other control variables included in the model. **Emotional stability**, **peer relations** and **concept maturity** predict very few adult outcomes in the expected direction, after taking into account the other variables in the model.

## 4.2. Data, definitions and methods

Our analysis is based on data from the 1970 British Cohort Study (BCS70), a study that has followed a large, representative group of individuals born in 1970 since birth, and at regular intervals throughout their lives. Parents and teachers were interviewed a number of times and provided especially rich information about the social and emotional development of the study children. The children themselves also sat cognitive tests that give a detailed picture of their cognitive development, while parents provided detailed information about the family background. See the section 4.2.1. in this chapter and Appendix 4 on data and methods and the CLS website<sup>7</sup> for more details of the cohort and the assessments.

The study has continued into adulthood and we now have information about the lives of the cohort members across multiple domains, including their socioeconomic status and employment, family life, own life satisfaction and well-being, health and health behaviours and political interest, most recently when they were aged 42. We thus are able to assess the relative influence of the social, emotional and cognitive skills measured at age five to a wide range of outcomes in later life.

### What measures did we use?

The social and emotional skills that we consider are derived from data collection when the children were aged 5, and are related both to the framework of definitions that we set out in Box1 and those that we covered in our literature review in Section 3. Please note that the assessments do not cover all the skills covered in the literature review. Our measures include indicators of self-regulation, emotional stability, social skills and cognitive skills. The creation of measures is dependent on the data collected at the time. For a more detailed description of the measures used see Appendix 4.

#### 4.2.1. Early Socio-Emotional Skills

##### ***Self-Regulation***

*Non-hyperactivity* - our measure of hyperactivity addresses impulsivity and a lack of self-control, with questions relating to restlessness, fidgeting, being irritable and unsettled (Rutter Behaviour Questionnaire, 1970).

*Good conduct* –our measure addresses impulsivity and a lack of self-control, with questions relating to destroying things, fighting, stealing, lying and being disobedient (Rutter Behaviour Questionnaire, 1970).

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<sup>7</sup> [www.cls.ioe.ac.uk](http://www.cls.ioe.ac.uk)

### **Emotional health**

We use the emotional subscale of the mother-reported Rutter Behaviour Questionnaire (1970) to create a measure of emotional health. The emotional subscale includes questions relating to being worried, miserable, fearful and fussy.

### **Social relationships (Peer relations)**

Our measure of peer relations includes questions relating to not being liked, being solitary and bullying others.

#### **4.2.2. Early Cognitive Skills**

We utilize three measures of cognitive ability, based on assessments carried out as part of the age 5 sweep of the British Cohort Study.

**Verbal skills** – assessed with the English Picture Vocabulary Test (EPVT) requires the child to indicate the one picture that corresponds to the given word.

#### **Non-verbal skills**

We have two indicators of non-verbal skills: visual-motor ability and conceptual maturity (see Appendix 4 for more details).

*Visual-motor ability* - the copy-a-design test assesses the cohort member's perceptual-motor ability

*Conceptual maturity* - The child is asked to draw a human figure and this picture is scored by trained coders according to set criteria

#### **4.2.3. What adult outcomes do we consider?**

We examine the impact of social and emotional skills measured in childhood on 20 outcomes relating to different life domains, measured at age 42. These include well-being and mental health, education, socioeconomic status, labour market outcomes, partnerships and children, health, health behaviours and political interest. The full list of outcomes is given below. More detailed definitions of the outcome measures are provided in Appendix 4, as well as some basic descriptions of the binary (yes/no) outcome variables.

- |  |   |                                    |
|--|---|------------------------------------|
| <ol style="list-style-type: none"><li>1. Life Satisfaction</li><li>2. Wellbeing</li><li>3. Malaise (mental distress)</li></ol> | } | <b>Mental Health and Wellbeing</b> |
|--|---|------------------------------------|

4.	No. of GCSEs	}	<b>Education</b>
5.	Has a Degree		
6.	Net Family Income	}	<b>Socioeconomic Status</b>
7.	Net Wealth		
8.	In Social Housing		
9.	In Top Job	}	<b>Labour Market</b>
10.	In Employment		
11.	Hourly Pay		
12.	Job Satisfaction		
13.	In a Partnership	}	<b>Family</b>
14.	Has Children		
15.	No. of Children (if any)		
16.	Poor/Fair Health	}	<b>Health</b>
17.	Obesity		
18.	Exercise	}	<b>Health Behaviors</b>
19.	Smoking		
20.	Drinking		
21.	Interest in Politics		

#### **4.2.4. How we estimate the importance of social and emotional skills for later life?**

We use multivariate regressions to examine how the social and emotional, and cognitive skills of children at 5 years of age relate to a range of outcomes in later life, controlling for a set of possible confounding variables, including parental socio-economic situation and child characteristics (birth weight, gender, ethnicity). The methods we use are described in further detail in Appendix 5.



The full set of controls we use include child birth weight, gender, ethnicity, number of siblings, parental education and unemployment, gross family income, social housing tenure, mother's mental health and mother's age (see Appendix 4 for details).

We follow common practice of referring to the estimated associations as 'effects', but we urge caution in interpreting them as indicators of causal effects – what would happen to an outcome if one of the skills were increased. This is because we cannot be sure that there is not some common cause of both the childhood skills and adult outcome that is not measured or controlled for in our models. The inclusion of a large set of other variables (as potential 'confounders') available in the cohort study as controls should minimise this danger (see Appendix 5).

### 4.3. Research findings from analysis of BCS

In this section, we set out our findings addressing the following three questions:

1. How are children's social and emotional, and cognitive skills at age 5 interrelated?
2. How do early skills differ across children and their families?
3. How important are social and emotional, and cognitive skills at age 5 for mid-life outcomes across different domains?

#### 4.3.1. How are children's social and emotional, and cognitive skills at age 5 interrelated?

We first show how our measures of social and emotional, and cognitive skills are correlated with one another (Table 4.2. below). This table shows that there are positive correlations between different social and emotional, and cognitive skills, meaning that a child with higher skills in one dimension is likely to have higher skills in the other dimensions, too. Some skills are not correlated with one another (e.g. concept maturity and emotional health), whereas some show high degrees of association (e.g. non-hyperactive and good conduct). As a rough guide, a correlation above 0.3 is considered strong.

Within the social and emotional skills there appears to be moderate to strong correlations, with only good conduct and emotional health displaying a correlation below 0.2. Similarly, within the three cognitive skills there appears to be moderate to strong associations, although none of the correlations is above 0.42, suggesting a considerable degree of independence. Generally the correlations are weaker when considering the associations between social and emotional skills and cognitive skills. Emotional health appears to be weakly associated with all three cognitive

skills, and the strongest correlation between any social emotional and cognitive skill is 0.16 (good conduct with visual motor and verbal ability), which although not trivial, is modest.

**Table 4.2. Bi-variate correlations between social, emotional and cognitive skills**

	Social and emotional skills				Cognitive skills		
	Non-hyperactive	Good conduct	Emotional health	Peer relations	Visual-motor	Verbal	Concept
Non-hyperactive	1.00	<b>0.49***</b>	0.25***	0.28***	0.14***	0.12***	0.10***
Good conduct	<b>0.49***</b>	1.00	0.16***	<b>0.35***</b>	0.16***	0.16***	0.11***
Emotional health	0.25***	0.16***	1.00	0.27***	0.01	0.05***	-0.00
Peer relations	0.28***	<b>0.35***</b>	0.27***	1.00	0.08***	0.14***	0.05***
Visual-motor	0.14***	0.16***	0.01	0.08***	1.00	<b>0.32***</b>	<b>0.42***</b>
Verbal	0.12***	0.16***	0.05***	0.14***	<b>0.32***</b>	1.00	0.25***
Concept	0.10***	0.11***	-0.00	0.05***	<b>0.42***</b>	0.25***	1.00

Sample restricted to those with non-missing social, emotional and cognitive skills

N= 10,042, Correlations >.3 in bold

\* p<0.05      \*\* p<0.01      \*\*\* p<0.001"

#### 4.3.2. How do early skills differ across children and their families?

Table 4.3. shows the bivariate correlations between the social and emotional, and cognitive skills and other background characteristics of the child. Compared to the indicators of social and emotional skills, the cognitive skills are more strongly associated with almost all of the child, parent and family characteristics, with the notable exceptions of mother's malaise score (mental health) and whether the mother was young (age 20 and younger) when she gave birth to the cohort member.

Social and emotional skills are most strongly associated with mother's malaise score, and these associations, ranging from 0.23 to 0.32 across the four social and emotional skills, are the strongest found between any background characteristic and any skill. The three cognitive skills are most strongly associated with family social housing tenure, ranging from -0.14 to -0.22 - pointing to the important role of living conditions in supporting the development of cognitive skills.

**Table 4.3. Bi-variate correlations between social and emotional and cognitive skills and background characteristics**

	Social and emotional skills				Cognitive skills		
	Non-hyperactive	Good conduct	Emotional health	Peer relations	Visual-motor	Verbal	Concept
Male	-0.09***	-0.19***	0.05***	-0.06***	-0.00	0.07***	-0.15***
Birth Weight	0.06***	0.03**	0.04***	0.04***	0.12***	0.13***	0.05***
Non-white	-0.04***	-0.03*	-0.00	-0.07***	-0.04***	-0.16***	-0.01
Older Siblings	0.07***	-0.04***	0.16***	0.03**	-0.02*	-0.03**	-0.02*
Low Family Income	-0.09***	-0.09***	0.00	-0.08***	-0.15***	-0.17***	-0.10***
Mother Unemployed	-0.04***	-0.04***	-0.02*	-0.03**	-0.08***	-0.08***	-0.05***
Father Unemployed	-0.05***	-0.08***	-0.00	-0.07***	-0.09***	-0.13***	-0.06***
Mother Education 16+	0.10***	0.11***	0.03**	0.09***	0.16***	0.16***	0.09***
Father Education 16+	0.11***	0.12***	0.02	0.07***	0.20***	0.16***	0.11***
Social Housing	-0.12***	-0.18***	-0.02*	-0.13***	-0.22***	-0.22***	-0.14***
Mother Malaise	<b>-0.32***</b>	<b>-0.30***</b>	-0.28***	-0.23***	-0.12***	-0.15***	-0.06***
Mother Young at Birth	-0.12***	-0.13***	-0.07***	-0.08***	-0.08***	-0.11***	-0.04***

Sample restricted to those with non-missing social and emotional, and cognitive skills; N=10,042; Correlations >.3 in bold

\* p<0.05

\*\* p<0.01

\*\*\* p<0.001"

### 4.3.3. How important are social and emotional, and cognitive skills at age 5 for mid-life outcomes across different domains?

We now consider the associations between the skills at age 5 and adult outcomes. Table 4.4 below shows the raw bivariate correlations between the social and emotional, and cognitive skills at age 5, and the adult outcomes across the range outcome groups.

**Table 4.4. Correlations between social and emotional and cognitive skills and a range of outcome variables**

	Social and emotional skills				Cognitive skills		
	Non-hyperactive	Good conduct	Emotional health	Peer relations	Visual-motor	Verbal	Concept
<b>Education</b>							
No. of GCSEs obtained (age 16)	0.14***	0.19***	-0.00	0.11***	<b>0.32***</b>	0.24***	0.17***
Obtained Degree (age 30)	0.10***	0.13***	0.00	0.06***	0.22***	0.17***	0.12***
<b>Socio-economic/ Labour Market</b>							
Family Income (age 42)	0.05**	0.06***	-0.00	0.02	0.12***	0.12***	0.08***
Net Wealth (age 42)	0.03*	0.04**	0.00	0.03*	0.08***	0.07***	0.04**
Social Housing Tenure (age 42)	-0.10***	-0.13***	0.01	-0.06***	-0.18***	-0.17***	-0.13***
Ever in Top Job (age 26-42)	0.06***	0.08***	0.03*	0.04***	0.17***	0.16***	0.09***
Employed (age 42)	0.05***	0.05***	0.01	0.03*	0.11***	0.11***	0.07***
Gross Wage (age 42)	0.02	0.03*	-0.01	0.03	0.15***	0.17***	0.06***
Job Satisfaction (age 42)	0.03*	0.05***	0.01	0.01	-0.02	-0.00	-0.02
<b>Mental Well-being</b>							
Life Satisfaction (age 42)	0.07***	0.10***	-0.00	0.05***	0.06***	0.06***	0.01
Well-being (age 42)	0.11***	0.11***	0.04**	0.06***	0.09***	0.11***	0.06***
Malaise (age 42)	-0.09***	-0.09***	-0.05***	-0.05***	-0.08***	-0.10***	-0.03*

<b>Health/Health Behaviours</b>								
Poor Health (age 42)	-0.08***	-0.10***	0.01	-0.05***	-0.11***	-0.12***	-0.06***	
Obese (age 42)	-0.06***	-0.06***	0.00	-0.02	-0.07***	-0.03*	-0.06***	
Exercise (age 42)	-0.01	-0.04**	0.01	-0.00	-0.04**	0.00	-0.01	
Whether Smokes Daily (age 42)	-0.09***	-0.14***	0.03	-0.06***	-0.10***	-0.08***	-0.07***	
Higher Risk Drinking (age 42)	-0.05***	-0.09***	0.01	-0.01	-0.03**	-0.05***	-0.02	
<b>Family</b>								
Whether Lives With Partner (age 42)	0.06***	0.07***	0.01	0.04***	0.09***	0.11***	0.05***	
Whether a Parent (age 42)	-0.00	-0.01	0.02	0.01	-0.00	-0.01	0.02	
No. of Own Children (age 42)	-0.02	-0.03**	0.00	0.01	-0.03*	-0.08***	-0.00	
<b>Other</b>								
Interest in Politics (age 42)	0.08***	0.07***	0.00	0.03	0.12***	0.14***	0.08***	
Observations	10042	10042	10042	10042	10042	10042	10042	
Sample restricted to those with non-missing social and emotional skills								
=* p<0.05      ** p<0.01      *** p<0.001								

Beginning with educational attainment, the findings suggest that cognitive skills, in particular visual-motor and verbal skills, are most strongly correlated with a range of outcomes. Good conduct, non-hyperactivity and positive peer relations show less strong associations. Emotional health is the only skill not correlated with the two educational outcomes. A similar pattern is observed for the socio-economic and labour market outcomes: cognitive skills are generally displaying stronger correlations, although the social and emotional skills are also correlated. Emotional health again appears the most weakly associated with these outcomes.

Regarding mental well-being outcomes, general health and health behaviours at age 42, we can see similar strength in the associations with the social and emotional, and cognitive skills. Raw correlations generally are low, ranging between 0.05 and 0.10. Of the social and emotional skills, the two pertaining to self-regulation, non-hyperactivity and good conduct, are most consistently correlated with the health and health behaviour outcomes. All three of the

cognitive skills are similarly correlated with the health and health behaviour outcomes. Emotional health and concept maturity appear to display the smallest raw correlations.

Regarding the family outcomes, whether the individual is in a cohabiting relationship is most consistently correlated with the range of skills, while the number of children is also weakly correlated with some of the skills. The size of the raw correlations is rather small, ranging from 0.03 to 0.11.

Finally cognitive skills in general are more strongly correlated with an interest in politics, although non-hyperactivity and good conduct display correlations also.

It can be seen from these bi-variate raw correlations that the social and emotional, and cognitive skills are associated with the outcomes. The correlations are generally modest. Strongest associations are observed for outcomes related to educational attainment and later socio-economic status, especially regarding early cognitive skills, and visual-motor and verbal skills in particular. From the social and emotional skills, non-hyperactivity and good conduct are the skills most consistently correlated with the range of outcomes, yet regarding educational and socio-economic attainment, the associations are lower than that of cognitive skills. Regarding mental health, physical health, health behaviours and family formation the correlations are of similar strength. Emotional health is in general the mostly weakly correlated indicator across the range of outcomes.

#### **4.3.4. Multivariate Analysis**

Moving beyond the raw correlations between skills and outcomes shown in Table 4.4, Table 4.5 below presents the findings of the multivariate regression analysis of each outcome on the full set of skills and background variables. Table 4.5 describes the relative importance of the different social, emotional and cognitive skills for the different outcomes, and highlights the skills found to be significantly associated with each outcome. The outcomes are grouped using the same domains as in previous tables.

The value in parentheses corresponds to the standardised effect size of the skill, on the outcome, taken from the 'conditional' specification, which controls for the child, parent and family characteristics and the other skill indicators included in the model (see Appendix 5 for more details). Presenting standardised effect sizes in this way allows the comparisons of the size of the effects across all of the outcomes, regardless of whether the outcome is continuous or binary (see Box 3 for details). Effect sizes of each of the skills separately and for each outcome are presented as individual charts in Appendix 6 (see Box 3 for explanation on how to read the charts and a description of effect sizes in terms of standard deviations, percentages and percentage points). It should be noted that there are a number of skills highlighted in

italics, for which the statistically significant association found can be said to be in an ‘unexpected’ direction, for example, emotional stability appears to be negatively associated with educational outcomes.

**Table 4.5. Multi-Variate Analysis: Predictive power of social, emotional and cognitive skills on adult outcomes from our analysis using BCS (including standardised effect sizes), controlling for child, parent and family background characteristics**

Outcome	Skills at age five that are associated with this outcome	
	Social and Emotional	Cognitive
<b>Educational Attainment</b>		
Number of GCSE obtained (age 30)	<b><i>Good conduct (0.058)</i></b> Non-hyperactivity (0.032) <i>Emotional health (-0.035)</i>	<b>Visual-motor (0.189)</b> <b>Verbal (0.111)</b>
Obtained Degree (age 30)	<b><i>Good conduct (0.056)</i></b> <i>Emotional health (-0.029)</i>	<b>Visual-motor (0.116)</b> <b>Verbal (0.083)</b>
<b>Socio-economic/Labour Market</b>		
Employed (age 42)	Good conduct (0.030)	<b><i>Visual-motor (0.051)</i></b> Conceptual maturity (0.048) Verbal (0.033)
Family income (age 42)		<b><i>Verbal (0.072)</i></b> <b><i>Visual-motor (0.059)</i></b>
Net wealth (age 42)		Visual-motor (0.042)
Gross wage (age 42)	<i>Emotional health (-0.045)</i>	<b>Verbal (0.100)</b> <b><i>Visual-motor (0.074)</i></b>
Job satisfaction (age 42)	Good conduct (0.027)	
Social Housing (age 42)	Good conduct (-0.049) <i>Emotional health (0.034)</i>	<b><i>Visual-motor (-0.071)</i></b> Verbal (-0.040) Conceptual maturity (-0.039)
<b>Mental Wellbeing</b>		
Life satisfaction (age 42)	<b><i>Good conduct (0.071)</i></b>	Visual-motor (0.032) Verbal (0.031)
Well-being (age 42)	<b><i>Non-hyperactivity (0.051)</i></b> Good conduct (0.049)	<b><i>Verbal (0.073)</i></b>
Malaise (age 42)	<b><i>Good conduct (-0.060)</i></b> Non-hyperactivity (-0.034)	Verbal (-0.047) Visual-motor (-0.038)
<b>Health/Health Behaviours</b>		
Poor health (age 42)	Good conduct (-0.040)	<b><i>Verbal (-0.063)</i></b>

	<i>Emotional health (0.039)</i>	Visual-motor (-0.044)
Obese (age 42)		Visual-motor (-0.042)
Exercise (age 42)		<i>Visual-motor (-0.040)</i>
Smokes daily (age 42)	<b>Good conduct (-0.071)</b> <i>Emotional health (0.063)</i>	Visual-motor (-0.036)
High risk drinking (age 42)	<b>Good conduct (-0.064)</b> <i>Social (0.032)</i>	Visual-motor (-0.048)
<b>Family</b>		
Whether lives with partner (age 42)	Non-hyperactivity (0.033)	<b>Verbal (0.078)</b> Visual-motor (0.041)
Whether a parent (age 42)	Emotional health (0.030)	
No. of children (age 42)	Social (0.040)	Verbal (-0.044)
<b>Other</b>		
Interest in politics (age 42)	<b>Non-hyperactivity (0.054)</b> Good conduct (0.034)	<b>Verbal (0.060)</b> Conceptual maturity (0.049)

Notes: Malaise = mental distress; Strong effects are marked in **bold** (>.1); and medium strength effects are indicated in **bold/italics** (>.05); unexpected results are given in *italics*

At a first glance it becomes obvious that the different outcomes are predicted by a combination of skills, each one having an independent effect, in addition to the other variables included in the model. For example, our indicators of self-regulation (good conduct and non-hyperactivity) and emotional health predict the number of GCSEs attained by age 16 independently from the cognitive skills included in the model and the control variables comprising indicators of parental socio-economic status and child characteristics (birth weight, gender and ethnicity). For most of the outcomes we find significant effects from the cognitive skills, in particular verbal and visual-motor skills. Some outcomes, such as family income, obesity, and regular exercise are predicted primarily by cognitive skills, while others, such as job satisfaction and well-being are primarily predicted by early social and emotional skills, pointing to domain specific effects.

Good conduct (one of our indicators of self-regulation) and visual-motor and verbal ability from the cognitive skills, represent the most consistent predictors of the adult outcomes. For socio-economic and labour market outcomes, these three competences are the most consistent predictors, with the two cognitive dimensions, visual-motor and verbal ability, most strongly predicting these outcomes, as shown by the largest effect sizes.



Our two measures of self-regulations consistently predict mental well-being outcomes, as do visual-motor and verbal ability although with marginally smaller effect sizes. Good conduct, visual motor and verbal ability are the most consistent predictors of health and health behaviours, although visual-motor skills are negatively associated with exercise, as shown by exercise highlighted in italics. Social skills predict greater likelihood of harmful drinking, which could point to a potential 'dark' side of early social skills. The relationships with outcomes related to family formation are mixed, while political interest, a proxy for civic engagement, is predicted by both measures of self-regulation, verbal skills and concept maturity.

Interestingly, emotional health is not associated with any of the adult outcomes, other than in an 'unexpected' direction. Emotional health is associated with lower wages and reduced likelihood of obtaining a degree, fewer GCSEs and poorer self-rated health, and with a higher likelihood of being in social housing tenure and smoking. From Table 4.4, however, it can be seen that emotional health exhibits no bivariate correlation with any of these outcomes. This suggests the inclusion of the other skills and background child, parent and family characteristics in the multivariate regressions lead to unexpected associations between emotional health and these outcomes. A closer examination shows that it is the inclusion of the other social and emotional skills, in particular those pertaining to self-regulation, good conduct and non-hyperactivity, which give rise to the unexpected direction of association between emotional health and the outcomes mentioned. This sensitivity of the effect of emotional health to the inclusion of other social and emotional skills could arise for a number of reasons, and further work would be required in this area to establish the mechanisms driving this relationship.

From Table 4.5 we can see that the size of many of the associations between the skills and the adult outcomes are broadly comparable; a 1 standard deviation increase in the skill is generally associated with around 0.05 standard deviations increase in the outcome (shown in parentheses). It should be noted that a 1 standard deviation increase in each skill will move the average individual approximately a third (33 percentiles) up the distribution, or ranking, of the skill. The estimated effect sizes are therefore in response to what can be considered a significant improvement in each of the skills.

Effects sizes of 0.05 standard deviations can be considered moderate, but not trivial. This can be illustrated with a few examples, in the case of good conduct. A 1 standard deviation increase in good conduct predicts an increase in the number of GCSEs obtained with an association of 0.058 standard deviations. This corresponds to just over an 8% increase in the median number of GCSEs obtained. Similarly, the effect of a 1 standard deviation increase in good conduct corresponds to a 10% (0.056 standard deviations) increase in the likelihood of obtaining a degree. Note, the percentage effect size is calculated by dividing the marginal effect size (percentage point) by the percentage of the sample that obtained a degree. Similarly, a 1 standard deviation increase in good conduct is associated with a, 13% (-0.049 standard

deviations) reduction in the likelihood of being in social housing, and a 10% (0.040 standard deviations) reduction in the likelihood of having poor health. This illustrates, that effect sizes around 0.05 can be considered modest but are nevertheless important.

For some outcomes, the effect sizes are significantly bigger than 0.05 standard deviations, in particular, the effects of visual-motor and verbal skills on the number of GCSEs obtained (0.111 to 0.189 standard deviations) and obtaining a degree (0.083 to 0.116 standard deviations). These effect sizes can be considered as large.

#### 4.4. Conclusion from the data analysis

In our analysis we were able to assess the independent effect of different social, emotional and cognitive skills on later outcomes, going beyond previous studies that mostly focused on the long-term benefits of single skills or specific skill compounds. Moreover, we were able to assess the relative contribution of different skill sets for a range of outcomes.

The data analysis partly confirms the conclusions from the literature review. The strongest evidence relates to the predictive power of verbal and visual-motor skills and early self-regulation, especially good conduct, which are important for a broad range of outcomes, including educational attainment, socio-economic attainment, mental and physical health, health behaviours and other indicators of social inclusion (family formation and political interest). Perhaps unsurprisingly, verbal and visual-motor skills show particularly strong effects on educational outcomes. Moreover, we controlled for later educational attainment, and the findings suggest a significant role of early self-regulation, verbal and visual-motor skills in addition to academic qualifications achieved later in life.

Compared with cognitive skills measured at age five, indicators of self-regulation matter as much regarding later mental health, physical health and health behaviours. Regarding education, socio-economic and labour market outcomes early indicators of self-regulation matter less than cognitive skills, but are nonetheless important. Importantly, the predictive power of measures of self-regulation and cognitive skills is independent of the other (as the skills are included jointly in the models) and also independent of a vast array of other child, parent and family characteristics. The size of the effects of these individual skills is generally moderate, but cannot be considered trivial. Moreover, there are additive effects by considering multiple skills simultaneously.

The findings show that many outcomes are predicted jointly by multiple skills involving social, emotional and cognitive competences. Through the combination of skills one can thus achieve better predictive power than by focusing on a single skill only, since the independent effects of different skills increase our ability to explain variations in a range of adult outcomes. Taking into account the simultaneous influence of multiple skills provides a better informed understanding of the underlying processes which in turn can inform social policies aiming to promote the positive development and wellbeing of children and the design of interventions.

The findings also suggest that early skills can potentially be understood to act as a 'reserve capacity' (Staudinger et al., 1993), enabling positive concurrent development as well as later outcomes. For example, early good conduct is strongly associated with other concurrent skills, such as social skills (peer relations), and shows moderate strength associations with later socio-economic attainment, mental and physical health in addition to cognitive ability and the other variables included in the model. Moreover, in our analysis we controlled for later educational attainment, and the findings suggest the effect of early self-regulation, verbal and visual-motor skills is not fully mediated by later educational attainment. Early skills or competences thus show an independent long-term effect in addition to later educational attainment.

In our analysis we could not confirm the role of early emotional health or social skills as predictors of adult mental health, as is found in the literature. This could be due to a number of reasons. First, it might be due to the quality of the assessment of these skills at age 5 (low internal consistency of the scales, especially regarding our measure of peer relations). Second, our assessment of social skills focused only on one aspect – the quality of peer relationships. Likewise our indicator of emotional health covered only one aspect of emotional health, that is the lack of internalizing problems. We thus had different indicators than those reported in the literature review. Another explanation is that we did not assess the sole effect of these skills on later outcomes (as in many previous studies), but controlled for the presence of other skill sets as well as a wide range of indicators of parental socio-economic background and child characteristics. The positive bivariate correlation between emotional health and positive adult mental health does not remain once these other explanatory factors are taken into account. Moreover, in the multivariate models our indicator of emotional health showed unexpected relationships with some of the outcomes. For example, early emotional health is associated with less likelihood of obtaining a degree and achieving a lower wage; it is also associated with lower self-rated general health and higher risk of daily smoking. Future research will have to delineate the combined effect of different social, emotional and cognitive skills in more detail, and also take into account possible combinations of skill sets, or skill profiles.

There is not one specific skill that is important regarding later outcomes, but rather the combination of different skill sets. A child with higher skills in one dimension is, in general, likely to have higher skills in other dimensions, too, pointing to cumulative effects and the process of developmental integration and cross-fertilisation. However, it could well be that if one skill is less developed, other skills might compensate for the deficit. It could also be that some children develop strengths in one domain, such as good conduct, but might suffer emotionally or socially under the pressure or expectation of always being well behaved. The latter interpretation is potentially supported by the observation that some of the skills (especially emotional health and indicators of cognitive skills) show relative low correlations between each other (see Table 4.2) pointing to a considerable degree of independence. To support positive development among young children it is thus important to support the development of multiple skill sets, and not to focus on just one skill.

The findings also indicate a strong association between early skills and family background factors. Children's social and emotional skills are most strongly associated with maternal mental health, highlighting the importance of a stable and consistent relationship with a parent which could be undermined by mental health problems. Social, emotional and cognitive skills are also strongly associated with the housing conditions of the family, pointing to the crucial role of the living environment in shaping children's development. Parental education also has a strong association with children's skill level, potentially being indicative of the quality of the home learning environment. In supporting the positive development of young children one should thus not forget to also address the quality of their living conditions and support parents in providing a stimulating and secure home.

## **5. Summary and Conclusions**

There is consistent evidence from the literature and our own analysis regarding the significant role of early skills (measured before age five) as predictors of later outcomes. In particular cognitive skills as well as indicators of self-regulation can reliably be measured before age five and are significantly associated with a range of later outcomes. Self-awareness, in particular locus of control also matters regarding later outcomes, yet appears to develop a bit later. Findings from our analysis of BCS data suggest that compared with cognitive skills measured at age five, indicators of self-regulation matter as much for later life satisfaction, job satisfaction,

mental health and health behaviours (smoking, drinking). Improvements in the wellbeing of adults, especially regarding mental health and job satisfaction, are desirable policy goals in their own right, and early interventions supporting self-regulation can be an effective route to achieve that. Regarding education, socio-economic and labour market outcomes early indicators of self-regulation matter less than cognitive skills, but are nonetheless important.

In the literature there is also evidence suggesting domain specific effects, especially regarding the role of early emotional stability in promoting later mental health and wellbeing. In our own analysis, we could however not confirm the significant role of early emotional health (measured by items indicating lack of internalizing problems) regarding later mental health. As already mentioned, this might be due to a number of reasons, i.e. the quality of the assessment and the fact that in our models we simultaneously controlled for a range of other social, emotional and cognitive skills as well as parental background and additional child characteristics. Taking into account these potential other explanatory factors, the association with later mental health was not significant. Likewise we found little evidence for the long-term predictive power of early social skills for different adult outcomes. Also in the literature the evidence regarding early social skills is less strong compared to that regarding the role of early cognitive skills and self-regulation, except for maybe indicators of early attachment styles. However, there is stronger evidence regarding the long-run predictive power of social and emotional skills measured later than age five, i.e. around age ten (OECD, 2015; Goodman et al., 2015).

### The combination of skills matters

In general the findings suggest that there is not one specific skill that is important regarding later outcomes. It is the combination of skills that matters. In particular a combination of early cognitive skills (with independent effects of verbal and non-verbal competencies) as well as indicators of self-regulation appear to play a significant role in shaping a range of later outcomes. There is less consistent evidence regarding the role of early social and emotional skills. Yet, focusing only on the skills with strong long-term benefits can mask a.) the importance of developmental interactions between different skill sets during early life, b. the importance of domain specific effects, and c. the fact that skills can develop or manifest with different speeds. Considering that different skill sets interact, cross-fertilize and build on each other, interventions directed at supporting the development of multiple skill domains are likely to be more effective than those directed solely at cognitive skill development among young children. For example, in our analysis of BCS we find that cognitive, social and emotional skills show moderate to strong associations with each other. A child with higher skills in one dimension is, in general, likely to have higher skills in another dimension also. Yet, some skills are less strongly associated with others. For example in our sample, emotional stability shows only weak associations with indicators of cognitive skills, suggesting a considerable degree of

independence. It could thus be the case that a child is performing well in school but also is worried or fearful, or less liked by others. It could however also be the case that if one skill is less developed at a particular age, other skills might compensate for the deficit. Interventions aiming to promote a diverse skill set are thus more likely to be effective in supporting positive development than those only focusing on single skills only.

### The role of context

Regarding the context in which skill development takes place our findings point towards a significant role of parental socio-economic background and maternal mental health. Growing up in a less privileged family is associated with lower levels of cognitive ability. In particular housing conditions are playing a significant role, pointing to the critical importance of the living environment encountered by small children and their families. Regarding the formation of social and emotional skills maternal mental health is a very strong correlate, highlighting the significance of a stable and supportive home environment.

### Developmental focus

The literature points to developmental pathways underlying the differentiation of key skills. For example, there is evidence to suggest that executive function (especially attention regulation) is a developmental precursor of self-regulation and later educational attainment. Moreover, indicators of gross- and fine motor development and early attachment styles, which (like attention regulation) can reliably be assessed before age three, have been identified as predictors of social, emotional as well as cognitive competences by age five. Yet, the underlying developmental processes are not yet fully understood, and more research into the developmental antecedents and progression of skill development is thus needed.

In addition, the findings suggest potentially sensitive periods for the development of key skills, which would have implications for the design and implementation of effective interventions. While cognitive skills and indicators of self-regulation are clearly manifest by age five, indicators of self-awareness as well as social and emotional skills might mature and advance at a different pace. Yet, children have different speeds in their maturation, and the formation of distinct capabilities such as self-regulation, depend on the combination of skills, where different skill sets interact and cross-fertilize each other. Moreover, it is argued that compared to cognitive skills, social and emotional skills are more readily malleable, especially during the mid/late childhood years, and the design of interventions has to take into account variations in developmental progression as well as the wider context in which children live (see also Gutman and Schoon, 2013, in press; Kautz et al., 2014).

### Definition and conceptualisation of skills

Regarding the conceptualisation and measurement of core skills it is important to reach consensus about the definition of key constructs and use of appropriate measures, also taking into account cultural variations and practices. Here we adopted a broad life skill framework to identify key overarching skill domains and their associated sub-ordinate specific skill components. Such an approach is helpful to construct a taxonomy of key skills and also to inform debates regarding the multi-dimensionality of core concepts. In addition, there is a need to develop more fine-grained and integrated assessments of different skill components, and a clearer understanding of how different skills develop over time, how they interact with other skills and competences, and how they cross-fertilise each other's development.

For example, the assessment of early executive function is often based on assessment batteries tapping into a range of competences, including motivation and self-regulation. Likewise the assessment of early emotional stability or social skills is sometimes based on compound measures comprising a range of indicators. More precision and clarity in the definition and operationalisation of key constructs, and a consensus about core elements would help to advance the debate and our understanding of vital developmental processes. It would also facilitate the communication and accumulation of empirical evidence across areas of specific expertise. Many of the social, emotional and cognitive skills are inter-linked, and exchange and communication between experts is necessary to advance our understanding of their complex interactions. Future research will have to delineate the relative and combined effect of different social, emotional and cognitive skills in more detail, and also examine possible combinations of skill sets and skill profiles, as well as patterns of co-development across time.

### Caveat

In interpreting the findings it is important to remember that the evidence we cite from the review of the literature and our own analysis is observational in nature (see also Box 2). While care is generally taken to control for potential confounders, only very few of the studies used strictly causal methods in examining the role of early social, emotional and cognitive skills in determining later outcomes. If they did these were general small scale, relative short-term studies focused on executive function. Thus, although the associations between early skills and later outcomes reported here are independent of a range of family, parent and child characteristics, confounding cannot be ruled out and we do not claim to have identified causal influences.

### Conclusion

The evidence presented in our report suggests that there are likely to be substantial benefits in providing effective and well informed interventions to enhance social, emotional and cognitive skills in early childhood. Many adult outcomes are predicted by multiple skill sets, and there is

not one silver bullet that can address positive adjustment across domains or regarding one specific domain. It is necessary to build up and support the development of different skill sets to facilitate the development of a fully rounded person. Moreover, the returns to policies which simultaneously improve multiple skills are potentially greater than regarding policies focusing on single skills only. Our recommendation is thus to focus on different cognitive capabilities (comprising verbal and non-verbal aspects) as well as indicators of self-regulation, self-concepts, social relationship and emotional stability. Early precursors of these skills include gross- and fine motor development and executive function.



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## Appendix 1: Description of the Three Core Skill Domains

### **Personal Skills**

Personal skills enable the child to manage and regulate their thoughts, emotions and behaviours. They comprise indicators of self-awareness, self-regulation, motivation and emotional stability. Self-awareness broadly refers to children's perceptions and beliefs about whether they possess the ability to complete tasks and comprise indicators of self-esteem, self-confidence, self-efficacy, ability concepts, and locus of control. Self-regulation refers to the ability to control impulses and behaviours and emotional stability refers to the ability to regulate emotions. Motivation concerns why individuals think and behave as they do. Key aspects of motivational constructs include intrinsic/extrinsic motivation; and individual values and expectations.

### **Interpersonal Skills**

Interpersonal or social skills comprise a set of characteristics that enable the child to interact with others and to forge and maintain relationships. In our conceptualization we differentiate two distinct skill sets: approach as well as collaboration and connection (see also John & de Fruyt, 2015). Collaboration involves taking the perspective of others and manifestation of prosocial behaviour (i.e. kindness, sharing, cooperation, and respect for others), agreeableness and empathy. Differences in approaching others assessed through indicators of extraversion, assertiveness or leadership as well as sociability, popularity and likability of the child (which are contrasted by behaviours indicating withdrawal, shyness and being solitary). Approach also involves developing trust in others and the ability to communicate effectively.

### **Cognitive Skills**

Cognitive skills are an umbrella term for several skills which enable the use of language, numbers and reasoning. They comprise verbal and nonverbal skills, executive functioning and problem solving, although the concept of 'intelligence' (or 'IQ') is thought to underlie these numerous cognitive skills (Barbey et al., 2012).

Several theoretical approaches attempt to conceptualise intelligence, and there is considerable debate regarding whether intelligence is composed of several independent abilities, or one underlying general ability or intellectual capacity. Those who consider that intelligence is a single construct often refer to a general intelligence factor ('g') (Spearman, 1927), which underlies all skills and abilities. Spearman found that scores on all mental tests tended to be interrelated, regardless of the domain assessed or mode of measurement. For instance, there is

a high correlation between the Wechsler Intelligence Scale for Children (WISC) (1949) and estimates of 'g'. However, it is important to note that 'g' does not take account of specific abilities and skills acquired through formal education or other environments (Estrada et al., 2015, Colom et al., 2002), which are reflected in conceptualisations of intelligence as involving two major domains: fluid and crystallised intelligence (e.g. Cattell, 1987). Fluid intelligence refers to inductive and deductive reasoning ability and is often considered to have a physiological basis, whereas crystallised intelligence refers to knowledge that is learnt. More recent theorists have proposed multifaceted models of intelligence, such as the triarchic theory of intelligence (Sternberg, 1988) proposing three aspects (componential, experiential and contextual intelligence), or Gardner's model identifying as many as eight independent domains of intelligence (Gardner, 1999). It should be noted that theories proposing that intelligence is multifaceted have been criticised (e.g. Gottfredson's critique of Sternberg's triarchic theory, (Gottfredson, 2003), and the robustness of empirical evidence supporting the existence of various abilities is inconsistent (Klein, 1997). Nevertheless, this approach continues to be important in informing current thinking on intelligence.

What is largely agreed in the literature investigating the role of cognitive skills in shaping later outcomes is that the majority of cognitive skills are malleable, and can be developed through appropriate training (Kautz et al., 2014a). It is however acknowledged that genetics may be in part responsible for certain skills and competencies (Plomin and DeFries, 1998, Plomin and Deary, 2015). It is also widely considered that skills are measurable, meaning that indicators of general intelligence (or independent skills) can be directly assessed and several robust standardised assessments exist.

## Appendix 2: How we conducted the Literature Review

### **Box 2: How we undertook our literature review**

For this review, three concurrent search strategies were used to secure a representative sample of studies. First, relevant studies were identified through search engines, including, but not restricted to, *ScienceDirect*, *Pyschinfo*, *Springerlink*, *ERIC*, *Web of Knowledge*, as well as *Google Scholar*, using a comprehensive set of search terms for childhood social, emotional and cognitive skills and adolescent and adult outcomes, largely focusing on studies published since 2000. Second, given the focus on long-run impacts of skills, manual searches were conducted on longitudinal data sets which exhibit the required properties of containing appropriate skills measures in early childhood and observing outcomes for the same individuals from early adulthood onwards (see Appendix 3). Finally we also found studies by examining the references and citations made within (and of) other studies included in the review.

Studies eligible for the review were (i) quantitative; (ii) examined measures of the social, emotional and cognitive skills of children between birth and the age of ten years – with a focus on skills assessed before age six; and (iii) examined the association between these measures and later life outcomes: the earliest being at ten/eleven years of age. In order to keep the searches manageable whilst remaining inclusive, a preference was given to more recent studies over earlier ones, in order to keep the review as contemporary as possible, but without losing vital evidence. Areas in which there was a lack of contemporary evidence, with respect to the social and emotional skill and/or adult outcome, older evidence was included. Again due to the large number of studies returned, we largely excluded working papers and unpublished literature, unless the study was of a particularly high quality and/or represented evidence in an area which was otherwise scarce.

We would note that research which fails to find relationships often fails to get published, and so our review will tend to share such ‘publication bias’ with the literature in general. However, many researchers have found associations of interest. Furthermore, our own findings in chapter four do report where associations are not significant as well as where they are.

The studies ultimately reviewed were not a representative sample of studies found, but were chosen to provide, where possible, a similar number of papers relating to each of the three broad groups of skills defined in Chapter 2. Within each broad group of skills, studies were chosen so that the review covered, where possible, each of the different types of measures that fall within that particular skill group. By far the largest number of papers identified within our search relate to self-regulation, followed by papers on emotional stability, social skills

(approach in particular) and self-awareness. There were hardly any publications on motivation and goal setting among this age group. Finally, studies were chosen so that they provided balanced coverage across a number of adult outcomes, including education, labour market, physical health, mental health, well-being, crime and others, where possible.

Note that a number of studies were excluded if they used constructs comprising measures belonging to more than one broad skill group. For example, many studies examined the role of the total score to the Rutter questionnaires. However, the Rutter questionnaire in its entirety captures dimensions of childhood social and emotional development applicable to conduct and hyperactivity, social skills and emotional health, with the independent role of each of these dimensions impossible to determine. Another ground for exclusion was whether the study relied on social and emotional skills or personality measured in adulthood as an indicator of those skills or traits in childhood.

## A.2.1. Search Terms for Literature Review

### Self-awareness:

- self-awareness
- self-perception
- self-esteem
- self-efficacy
- self-concept
- locus of control
- self-confidence

### Self-control/Self-regulation:

- self-regulation
- self-control
- perseverance
- self-direction
- metacognition
- self-discipline
- impulsivity
- engagement
- effort
- managing feelings
- conscientiousness
- grit

### Motivation:

- motivation
- goal orientation
- task value
- expectancy-value
- learning style
- persistence
- intrinsic motivation
- learning behaviour

### Emotional stability/Coping:

- emotional stability
- internalizing
- externalizing
- neuroticism
- resilience
- coping

### Social Skills – Approach

- extraversion
- assertiveness
- leadership
- temperament
- approach/withdrawal
- gregariousness
- excitement-seeing

### Taking Perspective of others:

- empathy
- pro-social behaviour
- social skills
- kindness
- cooperation
- helpfulness
- social competencies
- forging relationships / relationship skills
- communication
- openness
- agreeableness
- extraversion



## Cognitive Skills:

- ***verbal skills***
- oral skills
- language skills
- literacy
  
- **numeracy**
- number sense
- numerosity
- mathematical ability
  
- ***non-verbal skills***
- visual skills
- visuo-spatial skills
- early concepts
- school readiness
- general cognitive ability
  
- ***executive function***
- attention
- memory
- problem solving
- decision making
  
- **openness**
- creativity
- play
- divergent thinking
- openness to experience
- play style
- thinking style

## Appendix 3 Glossary of longitudinal datasets

### **UK**

Avon Longitudinal Study of Parents and Children (ALSPAC)

British Cohort Study (BCS), 1970 Cohort

Millennium Cohort Study (MCS)

MRC National Survey of Health and Development (NSHD), 1946 Cohort

National Child Development Study (NCDS), 1958 Cohort

Twins Early Development Study (TEDS)

### **US and CANADA**

Colorado Adoption Project (CAP)

Concordia Longitudinal Risk Project

Fragile Families and Child Wellbeing Project

Fullerton Longitudinal Study

Hawaii Personality and Health Cohort

Kauai Longitudinal Study

National Longitudinal Survey of Children and Youth (NLSCY)

Project Competence Longitudinal Study (PCLS)

The Early Childhood Longitudinal Study–Kindergarten Cohort (ECLS-K)

The Infant Health and Development Program (IHDP)

The Minnesota Study of Risk and Adaptation from Birth to Adulthood

The Montreal Longitudinal-Experimental Preschool Study (MLEPS)

The NICHD Study of Early Child Care and Youth Development (SECCYD)

## **NEW ZEALAND and AUSTRALIA**

Christchurch Health and Development Study

Dunedin Multidisciplinary Health and Development Study

Mater-University of Queensland Study of Pregnancy (MUSP)

1970 Youth Transition Study

The Longitudinal Study of Australian Children (LSAC)

## **EUROPE**

Cardiovascular Risk in Young Finns

Copenhagen Perinatal Cohort

Individual Development and Adaptation Study (IDA), Sweden

The Bielefeld Longitudinal Study of Adult Twins (BiLSAT), Germany

The Jyväskylä Longitudinal Study of Personality and Social Development (JYLS)

The Swiss Survey of Children and Youth, COCON (**C**ompetence and **C**ontext)

## Appendix 4 Measures used in the Analysis

We first describe the indicators of early childhood skills comprising indicators of self-regulation, emotional health, social relationships and cognitive skills. We then describe the adult outcomes, and last the control variables included in the model.

### A.4.1. Indicators of early socio-emotional skills

#### ***Self-Regulation***

##### *Non-hyperactivity*

We use the hyperactivity subscale of the mother-reported Rutter Behaviour Questionnaire (Rutter, 1970) to create a measure of non-hyperactivity. The hyperactivity subscale addresses impulsivity and a lack of self-control, with questions relating to restlessness, fidgeting, being irritable and unsettled. We code the items such that a higher score represents lower levels of hyperactivity. We create an aggregate score, before standardising<sup>8</sup>. A factor analysis of this measure indicates a unidimensional scale, and internal consistency is acceptable (Cronbach alpha = .66)

##### *Good conduct*

We use the conduct subscale of the mother-reported Rutter Behaviour Questionnaire to create a measure of good conduct. The conduct subscale also addresses impulsivity and a lack of self-control, with questions relating to destroying things, fighting, stealing, lying and being disobedient. We code the items such that a higher score represents fewer conduct problems. We create an aggregate score, before standardising. A factor analysis of this measure indicates a unidimensional scale, and internal consistency is ok (Cronbach alpha = .72).

#### ***Emotional health***

We use the emotional subscale of the mother-reported Rutter Behaviour Questionnaire to create a measure of emotional health. The emotional subscale includes questions relating to

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<sup>8</sup> Standardising is a simple statistical process where the individual's score is subtracted from the average for everyone in the cohort (the cohort mean), and then divided by the standard deviation. The standard deviation summarises the average level of variability in the sample. This results in a variable with mean = 0, and a standard deviation of 1, which allows us to compare the relative effects of different scales (e.g. for self-esteem and social skills) that are originally measured in different units. This means that the variables have been expressed in terms relative to the average degree of variability with which they are reported.

being worried, miserable, fearful and fussy. We code the items such that a higher score represents fewer emotional difficulties. We create an aggregate score, before standardising. A factor analysis of this measure indicates a unidimensional scale, yet the internal consistency is low (Cronbach alpha = .53).

### ***Social relationships (Peer relations)***

As an indicator of social skills we create a scale to indicate peer relations. We use selected items of the mother-reported Rutter Behaviour Questionnaire to create a measure of peer relations. This subscale includes questions relating to not being liked, being solitary and bullying others. It can be considered to be an indicator of social collaboration or peer relations. We code the items such that a higher score represents better peer relations. We create an aggregate score, before standardising. A factor analysis of this measure indicates a unidimensional scale, yet the internal consistency is very poor (Cronbach alpha = .31).

## **A.4.2. Cognitive Skills**

We utilize three measures of cognitive ability, based on assessments carried out as part of the age 5 sweep of the British Cohort Study.

### ***Verbal skills***

English language development at age 5 was assessed using the English Picture Vocabulary Test (EPVT), an adaptation of the American Peabody Picture Vocabulary Test. It consists of 56 sets of 4 different pictures with a particular word associated with each set of 4 pictures. The child is asked to indicate the one picture that corresponds to the given word, and the test proceeds with words of increasing difficulty, until the child made five mistakes in a run of eight consecutive items. The total score is standardised. The test has good internal consistency ( $\alpha = 0.96$ ).

### ***Non-verbal skills***














































We have two indicators of non-verbal skills: visual-motor ability and conceptual maturity.

#### ***Visual-motor ability***

The copy-a-design test assesses the cohort member's perceptual-motor ability, assuming that children must have reached a certain level of conceptual development in order to be able to recognise the principles governing different geometric forms and to reproduce them. The child copies pictures of 8 shapes and has 2 chances to do each. A score of one was given if at least one good copy was made of a given design, with the total score standardised. The test has a satisfactory reliability of .70 (Osborn et al., 1984).

Figure A 4.1. gives examples of the copy-a-design test completed by a 5 year old cohort member:

**Figure A 4.1: Examples of completed Copying Designs task**

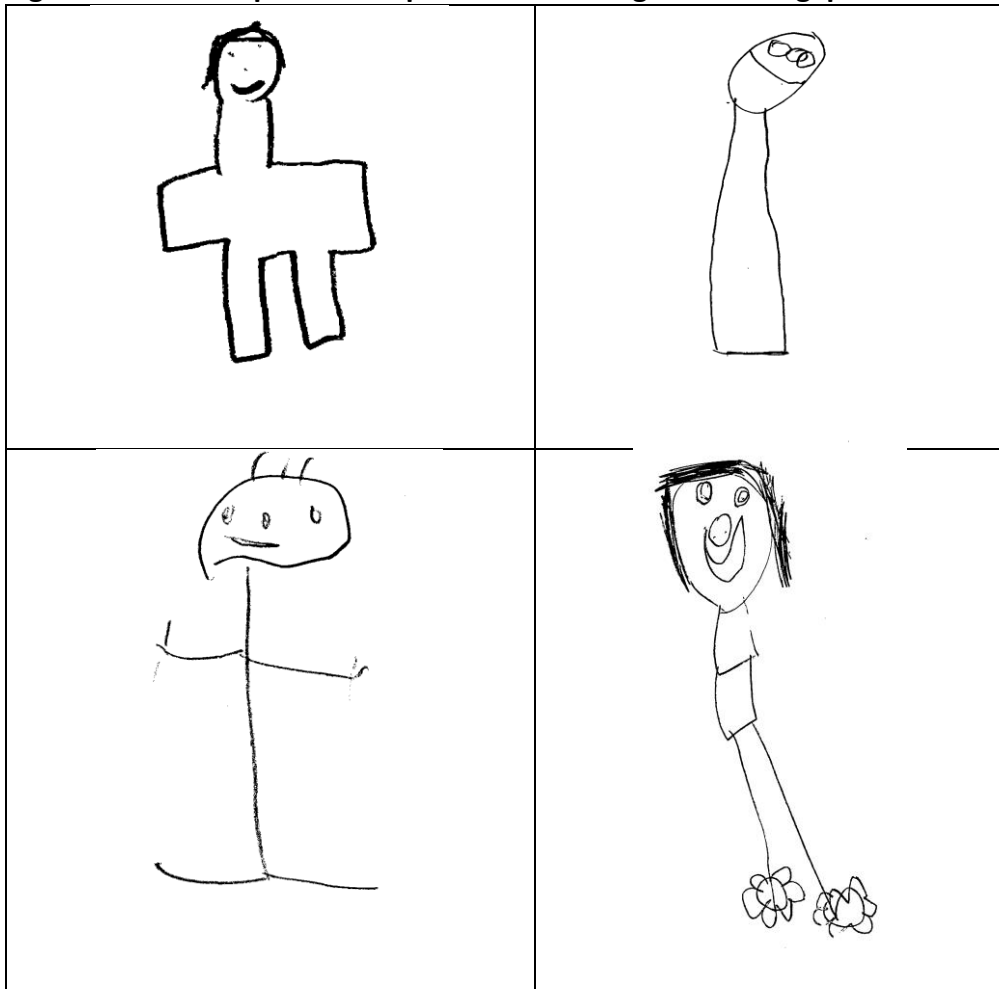
Example 1					
					
					
					
					
Example 2					
					
					
					
					

*Conceptual maturity*

The child is asked to draw a human figure and this picture is scored by trained coders according to set criteria, e.g. presence of a head, eyes, etc. The test is intended to reflect conceptual maturity (Goodenough 1926; Harris 1963). The test has a good reliability of .94 (Osborn et al., 1984) and correlates with conventional IQ tests such as Binet and Wechsler (Scott, 1981), with the correlation averaging between .4 and .5.

Figure A 4.2. gives examples of the draw-a-man (Human Figure Drawing) test completed by a 5 year old cohort member:

**Figure A.4.2: examples of completed 'Human Figure Drawing' pictures**



## Scoring Instructions for the Human Figure Drawing test

### The presence of any of the following features adds one point to the score.

- 1) Head: Any representation
- 2) Eyes: Any representation
- 3) Pupils: Distinct circles or dots within the outlines of the eyes
- 4) Eyebrows or eyelashes: Either brows or lashes or both
- 5) Nose: Any representation
- 6) Nostrils: Dots or nostrils shown in addition to nose
- 7) Mouth: Any representation
- 8) Two lips: Two lips outlined and separated from each other: two rows of teeth only are not scored
- 9) Ear: Any representation
- 10) Hair: Any representation, or hat or cap covering head and hiding hair
- 11) Neck: Definite 'stalk' separating head and body
- 12) Body: Any representation, clear outline necessary
- 13) Arms: Any representation
- 14) Arms in two dimensions: Both arms represented by more than a single line
- 15) Arms at an angle: One or both arms pointing downwards at an angle of 30° or more from horizontal position or arms raised appropriately for activity in which figure is engaged
- 16) Arms correctly attached at the shoulder: Arms firmly connected at the shoulder with shoulder clearly evident
- 17) Elbow: Distinct angle in arm; rounded curve in arm not scored
- 18) Hands: Differentiation from hands and figures necessary such as widening of arm or demarcation from arm by sleeve or bracelet
- 19) Fingers: Any representation distinct from hands or arms; any number of fingers acceptable
- 20) Correct number of fingers: Five fingers on each hand or arm
- 21) Legs: Any representation; in case of female figures in long skirts this item is scored if distance between waist and feet is long enough to allow legs to be present under the skirt
- 22) Legs in two dimensions: Both legs represented by more than a single line
- 23) Knee: Distinct angle in one or both legs (side view), or kneecap (front view); round curve in leg not scored
- 24) Feet: Any representation
- 25) Feet in two dimensions: Feet extending in one direction from heel (side view) and showing greater length than height, or feet drawn in perspective (front view)
- 26) Profile: Head drawn in profile even if rest of figure not entirely in profile
- 27) Clothing, one item or more: Items counted as clothing: trousers, shirt, skirt, blouse, dress, (Upper part of dress separated by belt scored as blouse), necklace, watch, ring, bracelet, pipe, cigarette, umbrella, cane, gun, rake, shoes, wallet, briefcase, hat, gloves
- 28) Clothing, two or more items: Two or more items of clothing represented
- 29) Clothing, four or more items: Four or more items of clothing represented
- 30) Good proportions: Figure looks right, even if not entirely anatomically correct



### **A4.3. Adult outcomes (age 42)**

Adult outcomes include indicators of mental health, socio-economic and labour market attainment, physical health, health behaviours, and other outcomes.

#### **A4.3.1. Socioeconomic Status and Labour Market**

##### ***Net Wealth (Savings – Debt)***

The BCS contains separate variables capturing the total amount of savings and debt held by the cohort member. A net wealth measure is constructed equal to total savings less total debt, and is logged.

##### ***Social Housing***

We combine information on housing ownership or rental, with information on from whom the home is rented, where applicable, to construct a binary indicator for social housing tenure, equal to '1' if the cohort member rents from either a housing association or local authority. In our estimation sample, approximately 12% are in social housing.

##### ***Net Family Income and Hourly Pay***

We combine information on earnings, other sources of income, benefits received and tax credits to construct a measure of log net family income. To create the earnings measure we combine both the cohort member's net pay from their main job, and their partner's, should they have one, as well as subsidiary net pay of the cohort member from other jobs. The net amount from other sources of income is provided in a single variable in the data, while the total amount received from benefits is aggregated over the 30 different types of benefits defined in the data, where the amount 0 is recorded if the benefit is not received. Similarly, to calculate the total tax credit amount granted we aggregate over the two types, working tax credits and child tax credits, where the amount 0 is recorded if the tax credit is not applicable. All components of the net family income measure are converted to weekly amounts, before being added together and then logged, meaning the final measure captures the log of weekly net family income. We create a cohort member hourly pay measure (net and gross) and retain partner pay (net and gross) for use as standalone dependent variables.

##### ***Top Job***

Our top job variable captures the ability of cohort members to access top managerial and professional jobs during adulthood. We create this measure using the National Statistics

Socioeconomic Classification (NS-SEC), which contains seven analytic classes and 14 operational categories, defining a high-status job as one which is classified in the top NS-SEC class. This definition of high-status occupation contains higher managerial, administrative and professional occupations. In our estimation sample, approximately 29% are in a top job.

### ***Employment***

We create an employment and unemployment indicator for the cohort member and partner, where applicable, derived from their respective economic activity status variable. In our estimation sample, approximately 85% are employed.

### ***Job Satisfaction***

Job satisfaction of the cohort member is measured using a single variable capturing the level satisfaction with their current job, based on a scale of 1 to 5, ranging from “very dissatisfied” to “very satisfied”, and is restricted to those cohort members in employment, and is standardised for the analysis.

## **A.4.3.2. Mental Health**

### ***Malaise***

Levels of psychological distress or depression of the cohort member are measured using the nine item self-reported Rutter malaise inventory, a shortened version of the 24 item malaise inventory provided in earlier sweeps of the BCS. Questions include “Do you feel tired most of the time?” and “Do you often feel miserable or depressed?”<sup>9</sup> The total malaise score is an aggregate of the scores given for the individual binary-response items and is increasing in malaise, and is standardised for the analysis.

### ***Wellbeing***

Wellbeing is captured using the Warwick-Edinburgh Mental Wellbeing scale (WEMWBS), which covers a wide range of aspects of positive thoughts and feelings including both hedonic and eudemonic perspectives.<sup>10</sup> WEMWBS contains 14 positively worded statements, and cohort members are asked to describe how well each statement describes their experience over the previous two weeks. Statements include “I’ve been feeling optimistic about the future” and

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<sup>9</sup> For complete list of questions in the nine-item malaise inventory see; [http://doc.ukdataservice.ac.uk/doc/7473/mrdoc/pdf/bcs70\\_2012\\_follow\\_up\\_guide\\_to\\_the\\_datasets.pdf](http://doc.ukdataservice.ac.uk/doc/7473/mrdoc/pdf/bcs70_2012_follow_up_guide_to_the_datasets.pdf)

<sup>10</sup> Tenner et al (2007).

“I’ve been feeling useful”<sup>11</sup>. Responses are in the form of a five-point rating scale, ranging from “None of the time” to “All of the time”, with total scores ranging from 14 to 70, and higher scores indicating higher levels of wellbeing, and are standardised for the analysis.

### ***Life Satisfaction***

Life-satisfaction of the cohort member is measured using a single variable capturing the level of “satisfaction with the way life has turned out so far”, on a scale of 0 to 10 where 0 is “completely dissatisfied” and 10 is “completely satisfied”, and is standardised for the analysis.

### **A4.3.3. Physical Health:**

#### ***General Health***

General health is captured using a single measure asking the cohort member their opinion of their general state of health. Cohort members respond on a five-point rating scale ranging from “excellent” to “poor”. We create a binary indicator for both ‘positive’ general health, equal to ‘1’ if the cohort member responds with “excellent” or “very good”, and another binary indicator for ‘negative’ general health, equal to ‘1’ if the cohort member responds “poor” or “fair”. In our estimation sample, approximately 15% have fair/poor self-rated health.

#### ***Body Mass Index (BMI)***

We utilise a derived BMI measure and based on the World Health Organisation (WHO) Classification<sup>12</sup> of adult weight, create separate binary indicators for obese, equal to ‘1’ if BMI exceeds 30.00 and underweight (mild, moderate or severe thinness), equal to ‘1’ if BMI is less than 18.50. In our estimation sample, approximately 22% are obese.

### **A.4.3.4. Health Behaviours:**

#### ***Smoking***

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<sup>11</sup> For complete list of questions in the WEMWBS statements see link in footnote 12, above.

<sup>12</sup> WHO. Physical status: the use and interpretation of anthropometry. Report of a WHO Expert Committee. WHO Technical Report Series 854. Geneva: World Health Organization, 1995; [WHO. Obesity: preventing and managing the global epidemic. Report of a WHO Consultation. WHO Technical Report Series 894. Geneva: World Health Organization, 2000.](#)

We construct a binary indicator for smoking, equal to '1' if the cohort member is a daily smoker. In our estimation sample, approximately 20% smoke daily.

### ***Alcohol***

We utilise the Alcohol Use Disorders Identification Test (AUDIT) containing 10 questions designed to identify persons with detrimental patterns of alcohol consumption, originally developed by the WHO. The questions are intended to capture hazardous alcohol use, dependence symptoms and harmful alcohol use. We create a binary indicator for strong likelihood of hazardous or harmful alcohol consumption, equal to '1' if the total score is greater than 8 for men and 7 for women.<sup>13</sup> In our estimation sample, approximately 17% drink to a harmful/hazardous level (21% of men and 14% of women).

### ***Exercise***

We utilise a measure of exercise capturing the number of days in a typical week that the cohort member does 30 minutes or more of exercise, which is standardised for the analysis.

### ***Body Mass Index (BMI)***

We utilise a derived BMI measure and based on the World Health Organisation (WHO) Classification<sup>14</sup> of adult weight, create separate binary indicators for obese, equal to '1' if BMI exceeds 30.00 and underweight (mild, moderate or severe thinness), equal to '1' if BMI is less than 18.50. In our estimation sample, approximately 22% are obese.

#### **A4.3.5. Other:**

### ***Political Engagement***

We capture political engagement by utilising a measure of the level of interest in politics, to which the cohort member responds on a four-point scale ranging from "very interested" to "not at all interested", which is standardised for the analysis.

### ***Partnerships and Children***

We construct binary indicators for whether the cohort member lives with either a spouse or partner and whether the cohort member has any children (by the age of 42). For those with any

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<sup>13</sup> [http://apps.who.int/iris/bitstream/10665/67205/1/WHO\\_MSD\\_MSB\\_01.6a.pdf](http://apps.who.int/iris/bitstream/10665/67205/1/WHO_MSD_MSB_01.6a.pdf)

<sup>14</sup> WHO, 1995, 2000 and 2004.

children, a further measure is constructed indicating the number of own children. In our estimation sample, approximately 76% have a cohabiting partner and 78% are parents.

#### **A4.4. Control Variables**

Our control variables include indicators of child and parental characteristics.

##### **A4.4.1. Child Characteristics**

**Birth weight:** A measure of the cohort member's birth weight, in grams (at birth).

**Gender:** A binary indicator, equal to '1' if the cohort member is male (at birth).

**Ethnicity:** An eight-category ethnicity measure, which includes separate indicators for English, Irish, Other European, West Indian, Indian, Pakistani, Bangladeshi and Other. Each ethnic group is included separately as a binary indicator in the analysis (at 10).

**Older siblings:** A binary indicator, equal to '1' if the cohort member has any older siblings (at 5).

**Education:** A categorical variable indicating the highest academic level achieved by the cohort member. The categories are included as factor dummies in the analysis, and indicate 8 levels, ranging from no formal academic level, to higher degree (at 30).

##### **A4.4.2. Parent Characteristics**

**Education:** Separate binary indicators for whether the cohort member's mother and father stayed on in school post-16 (at birth).

**Employment:** Separate binary indicators for whether the cohort member's mother and father are unemployed (at 10).

**Age:** A binary indicator for whether the cohort member's mother is young, defined as being 23 or younger when the cohort member was born (at birth).

**Mental health:** The total score based on the 24-item Malaise Inventory of the cohort member's mother (at 5).

**Family Income:** A banded measure of weekly gross family income, containing eight categories ranging from the lowest band, under £35 per week, to the highest band, above £250 per week. The bands are included as factor dummies in the analysis (at 10).

**Social housing:** A binary indicator, equal to '1' if the family is in social housing (at 10).

## Appendix 5: Methodology

We first consider the raw association between the full set of social and emotional ( $S_i^5$ ), and cognitive ( $C_i^5$ ) skills of cohort member  $i$ , at age 5 and adult outcomes at age 42 ( $Y_i^{42}$ ), by estimating equation (1) by OLS where the outcome is continuous and using a Probit model where the outcome is binary.<sup>15</sup> Equation (1) will be estimated separately for each outcome, with  $\beta_S$  capturing the overall relationship between the vector of social and emotional skills,  $S$ , and outcome,  $Y$ , and  $\varphi_C$  capturing the overall relationship between the vector of cognitive skills,  $C$ , and outcome,  $Y$ , regardless of the mechanisms mediating this association.

$$Y_i^{42} = g(\alpha + \beta_S S_i^5 + \varphi_C C_i^5 + \varepsilon_i) \quad (1)$$

We will then condition on a vector of child, parent and family covariates of cohort member  $i$ , measured between birth and age 10 ( $X_i^{B,5,10}$ ) as described in the data section.  $\beta_S$  and  $\varphi_C$  in equation (2) thus capture the association between the age 5 skills and the outcome, independent of observable differences across cohort members in childhood and their families. This is our preferred specification for understanding the effect of each skill at age 5 on a later outcome. It is important to note, however, that cohort members and their families are still likely to differ in ways that we do not observe and which might affect adult outcomes. Thus, estimates of  $\beta_S$  and  $\varphi_C$  cannot be considered causal.

$$Y_i^{42} = g(\alpha + \beta_S S_i^5 + \varphi_C C_i^5 + \gamma_X X_i^{B,5,10} + \varepsilon_i) \quad (2)$$

A further specification, given by equation (3), also conditions on the formal educational outcomes of the cohort member, exploring the extent to which any association between the childhood skills and the outcome is mediated through formal educational attainment.  $E^{30}$  captures the highest formal educational qualification obtained, and is recorded when the cohort member was 30 years of age.

$$Y_i^{42} = g(\alpha + \beta_S S_i^{10} + \varphi_C C_i^{10} + \gamma_X X_i^{10} + \tau E^{30} + \varepsilon_i) \quad (3)$$

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<sup>15</sup> The OLS model assumes an identity link function,  $g$ , while the Probit model assumes  $g$  is the cumulative normal distribution. Both models assume the errors,  $\varepsilon$ , are normally distributed.

### Box 3. Our statistical methods and how to read the charts

**Methods:** Our results are created by estimating a series of regression models, in which each of the outcomes is used as the dependent variable in turn. We always include as controls the full set of social and emotional, and cognitive skills at age 5 (defined in Section 4.2.1 and whose inter-correlation is described in Table 4.2).

**Understanding the charts below and the units in them:** We present our results as a series of charts – one for each outcome – in which we show effect sizes from three regression specifications (described further below). In each chart the vertical axis lays out the set of social and emotional, and cognitive skills we are examining. The horizontal axis gives the **estimated change in an outcome associated with a one standard deviation increase to one of the skills**. Note that a single standard deviation change in a skill would be considered a large change in that skill – since depending on how it is distributed, the whole of the population is likely to lie within three standard deviations above or below the average.

In the charts, the change in the outcome associated with a standard deviation increase in a skill is given in different units depending on the outcome itself. Outcomes that take a yes/no form (e.g. obtaining a degree) or continuous variables (e.g. wages or family income) are given as a percentage point change (either in the probability of an event occurring, or in the amount of the outcome); for other variables expressed as numeric scores, such as life satisfaction or minutes of exercise, where the proportional rate of change is not appropriate, the raw data have been ‘standardised’, in the same way as the childhood skills, and the effects on them, are expressed as standard deviations.

With the simultaneous inclusion of a number of social and emotional, and cognitive skills in each regression and the years between the skills and the outcomes, any statistically significant effects of the skills can be considered striking, even if the effect sizes appear individually modest.

**Confidence intervals:** Each marked point estimate is surrounded by a bar representing the margin of error around its estimate. This is the range in which there is the conventional 95% chance that the true estimate lays, given that these data are drawn from a sample and how well the data fit. Estimates whose margin spans zero are said not to be significantly different from zero. Their possible range could include either positive or negative, and are referred to as ‘not significant’. Estimates that do not include zero in their range are thus those that are ‘significant’. For these the value on the x-axis becomes of interest.



**Regression specifications:** For each outcome we estimate three different regression specifications, in which an increasing number of additional explanatory variables are included.

The three models are as follows:

1. The 'Raw' specification (given by a circular marker on the bar in the charts), which has no other additional explanatory variables beyond the full set of skills. This shows uncontrolled statistical associations of the outcome with the set of skills taken together.

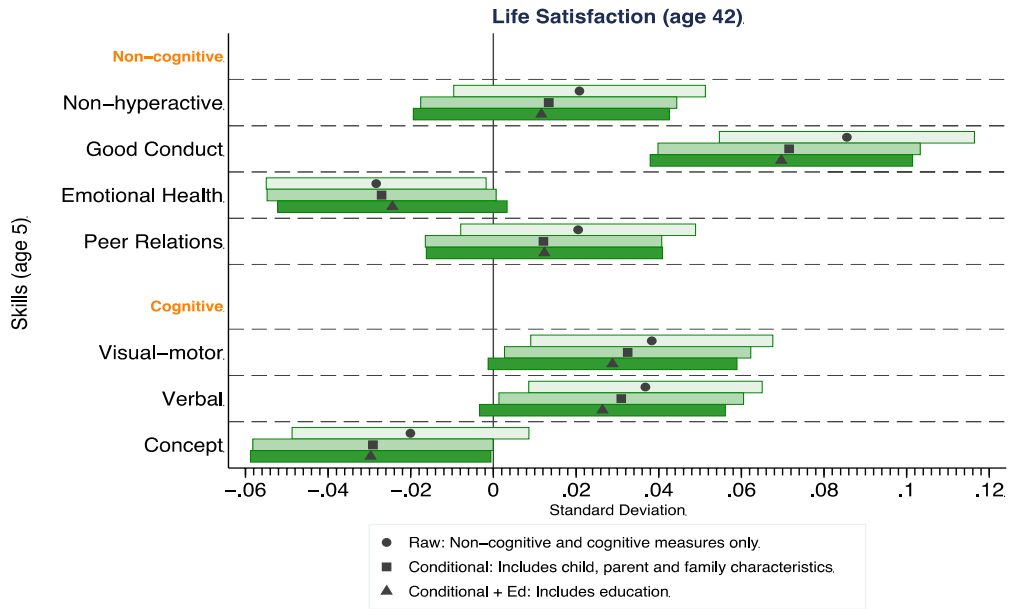
2. The 'Conditional' specification (given by a square marker on the bar in the charts), which includes additional childhood controls (described in Appendix 5). **This is our preferred specification for understanding the effect of a skill at age 5 on a later outcome, and form the basis of the summary results tables 4.1 and 4.5** (since possible confounders which may account for some, if not all, of the associations detected in the first specification are controlled for). In general, the allowance for these controls reduces the estimated effect of the skills.

3. The third 'Conditional + Education' specification (given by a triangular marker on the bar in the charts) includes educational attainment alongside the skills and controls in the second model. This specification is designed to show **whether education is a strong mediator, or pathway** between each skill, and the later outcome. If so, the estimated effects are further reduced when educational attainment is controlled for. The reduction of the estimated effect in this case would suggest that the effect of a given skill is mediated by educational attainment.

Much of our discussion of results focuses on the middle specification (the square markers) which forms the basis of the summary of results presented in tables 4.1 and 4.5, but the others are included for wider context and information.

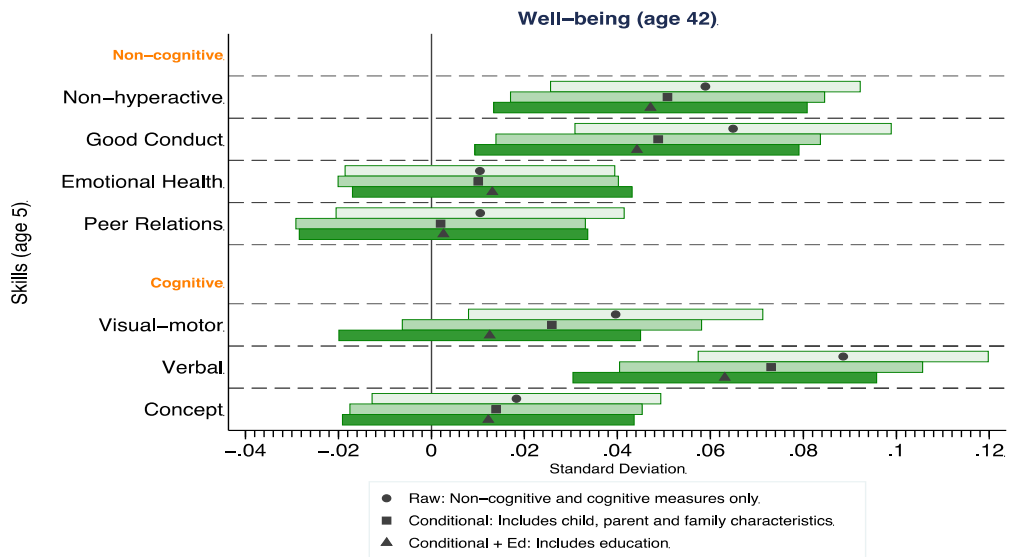
## Appendix 6 Results for each outcome

**Figure A6.1**



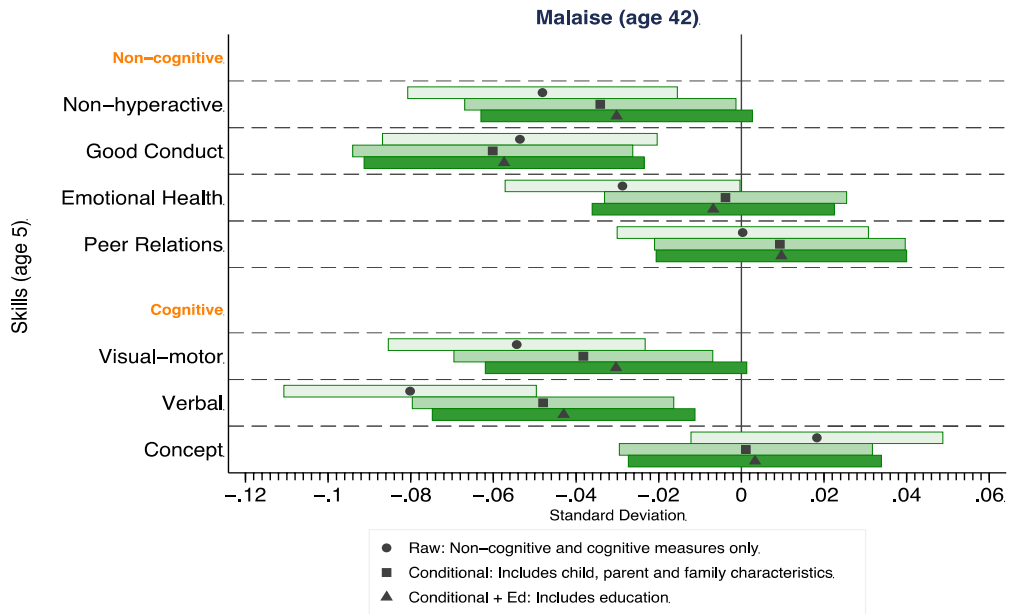
Notes:  
 1. Symbols represent coefficient estimates.  
 2. Shaded boxes represent 95% confidence intervals.

**Figure A6.2**

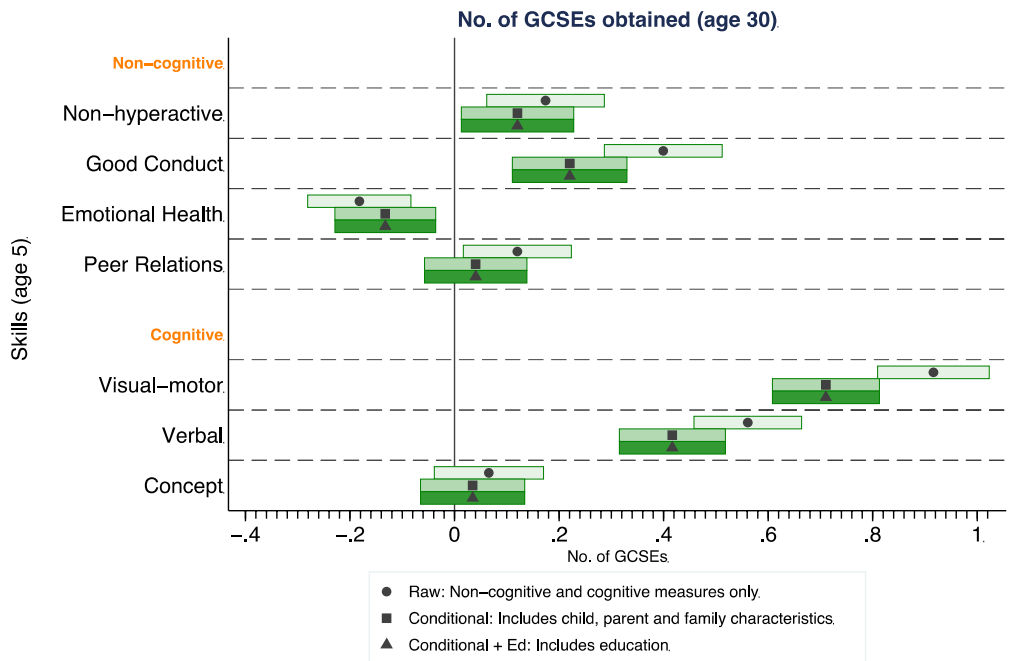


Notes:  
 1. Symbols represent coefficient estimates.  
 2. Shaded boxes represent 95% confidence intervals.

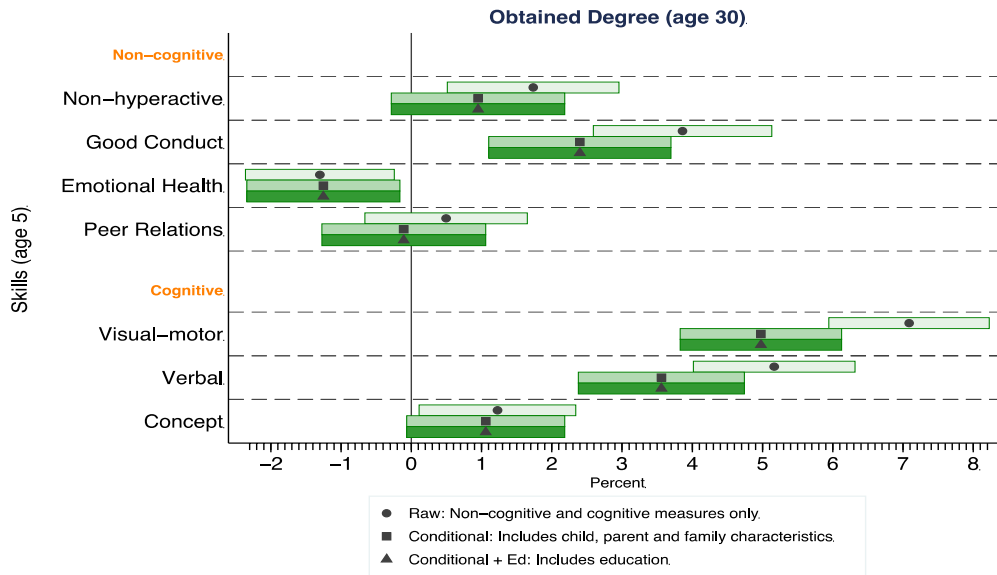
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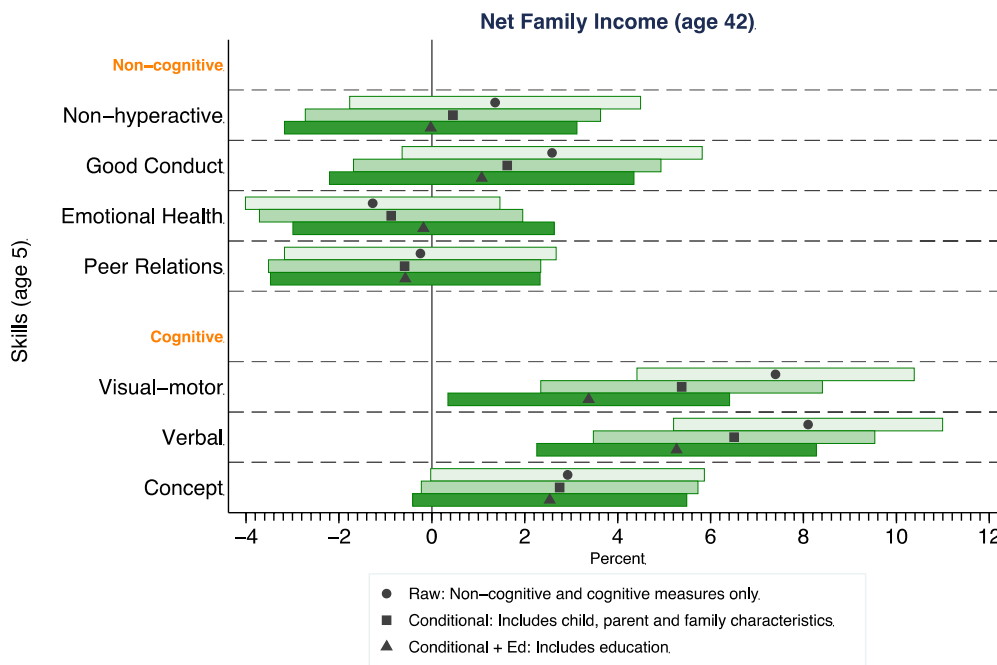
**Figure A6.4**



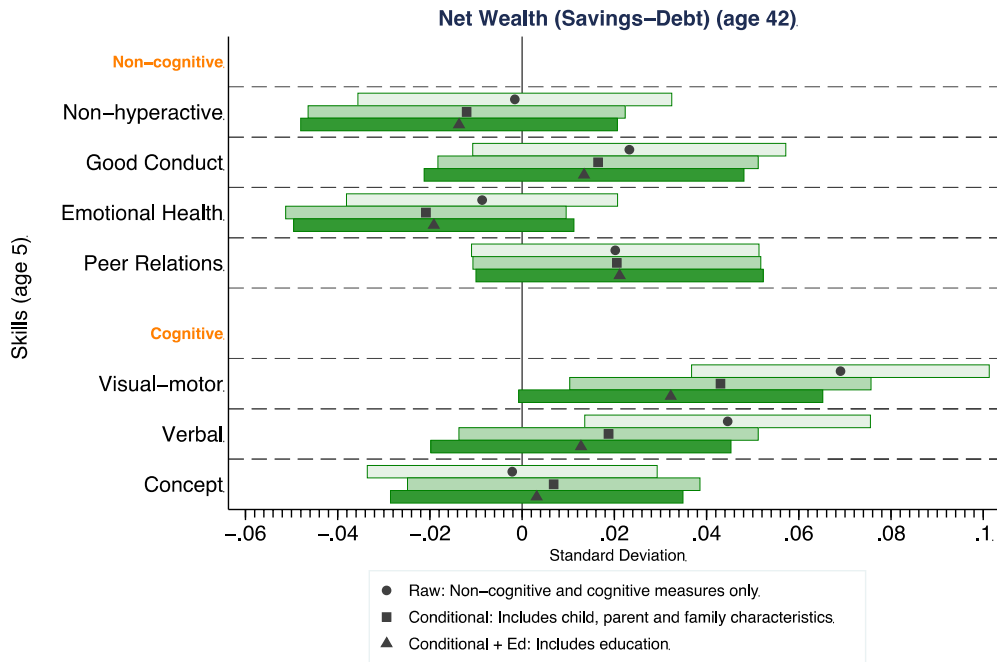
**Figure A6.5**



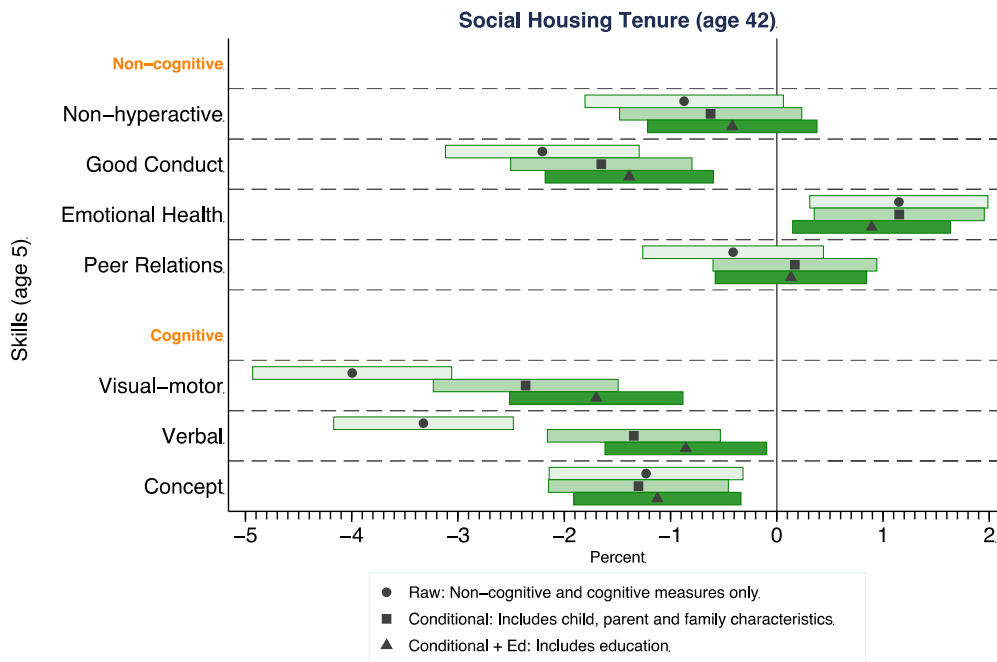
**Figure A6.6**



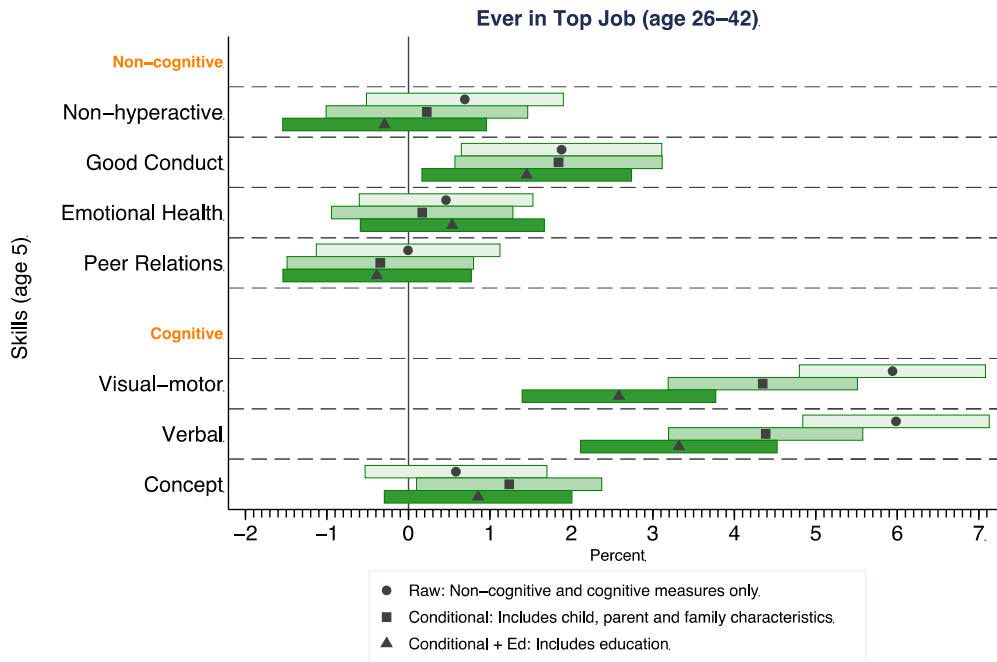
**Figure A6.7**



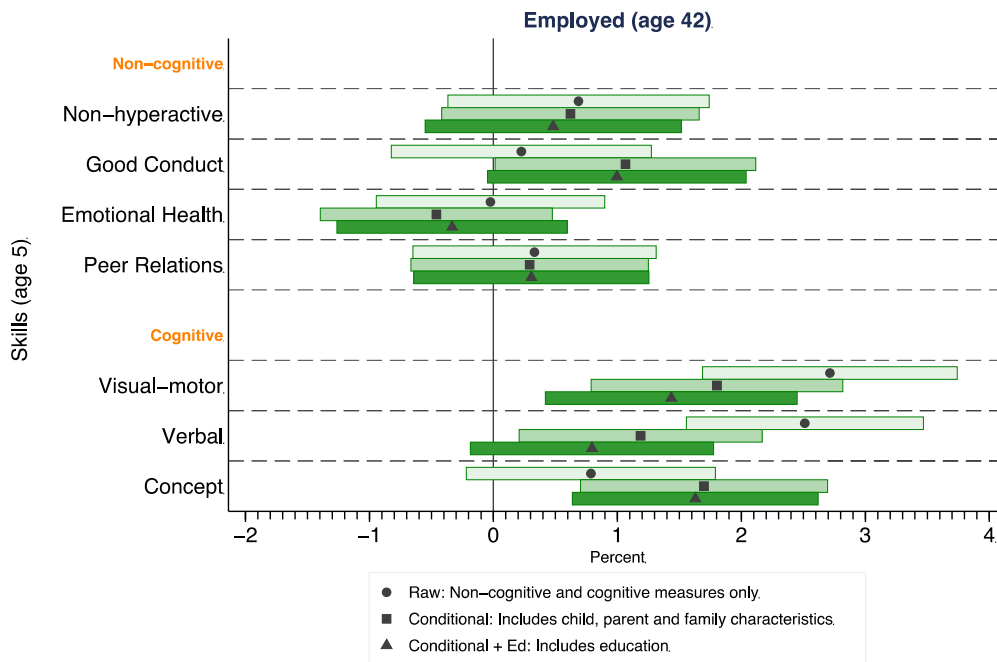
**Figure A6.8**



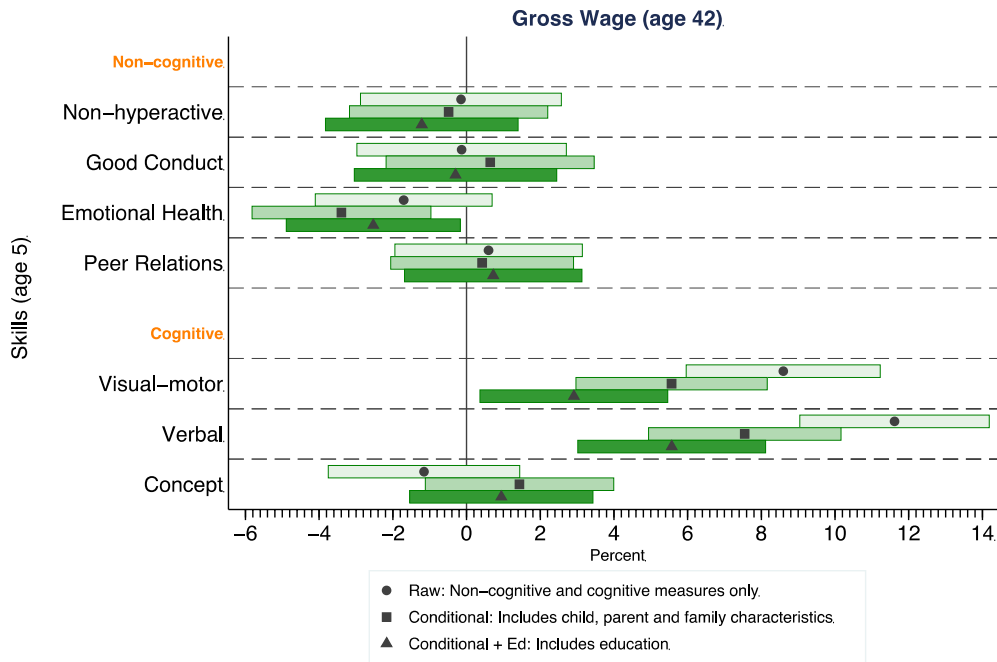
**Figure A6.9**



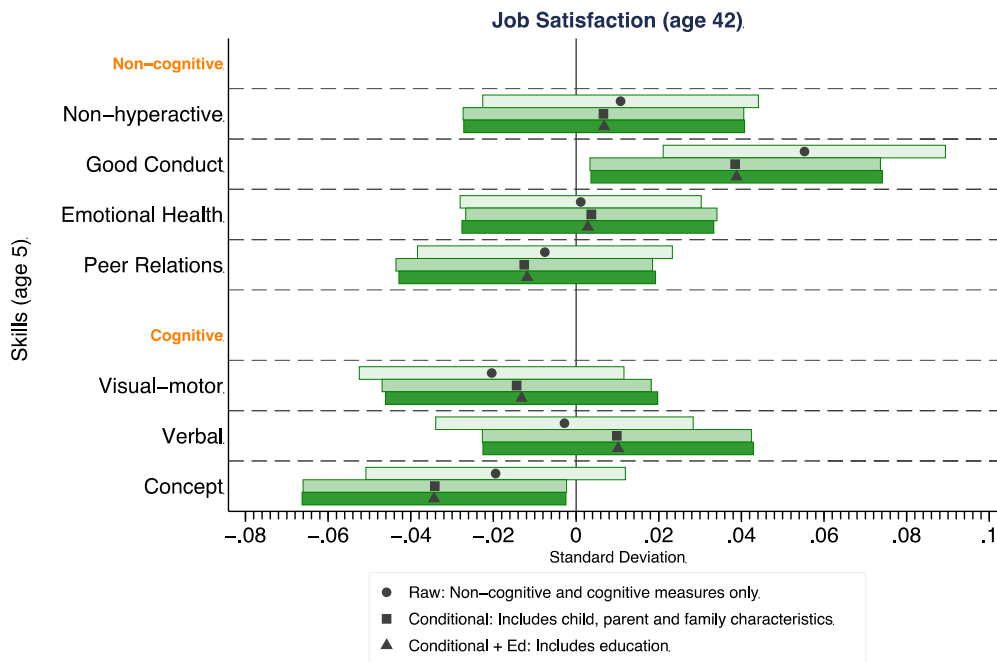
**Figure A6.10**



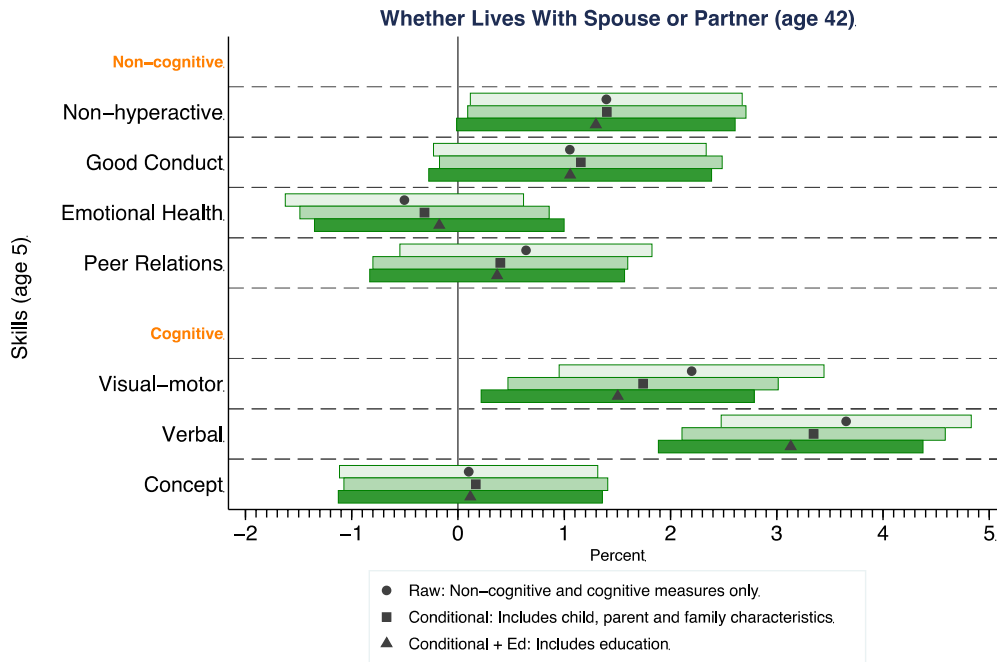
**Figure A6.11**



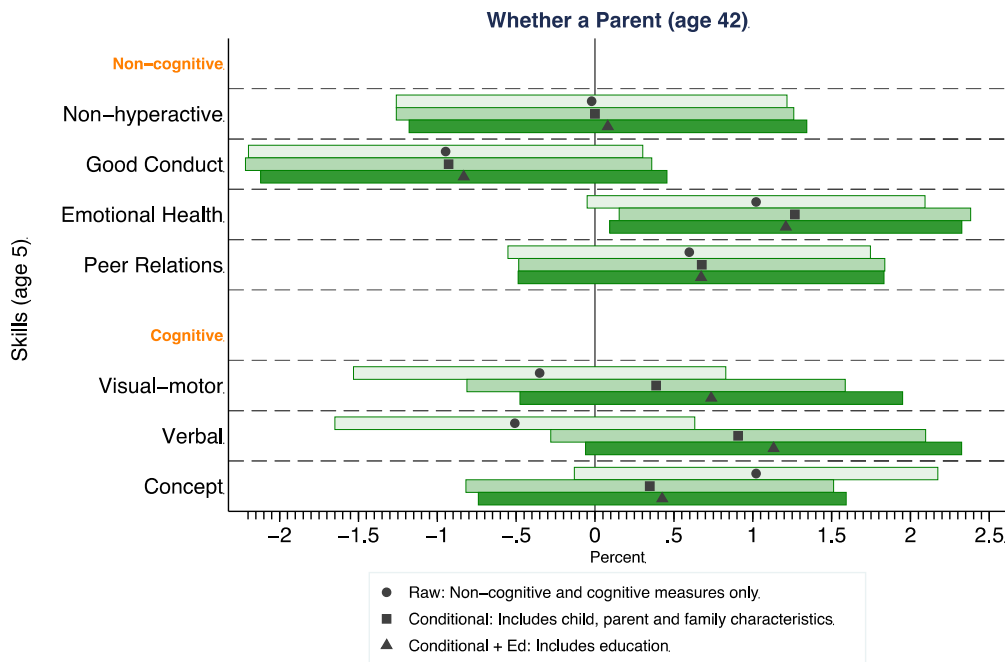
**Figure A6.12**



**Figure A6.13**

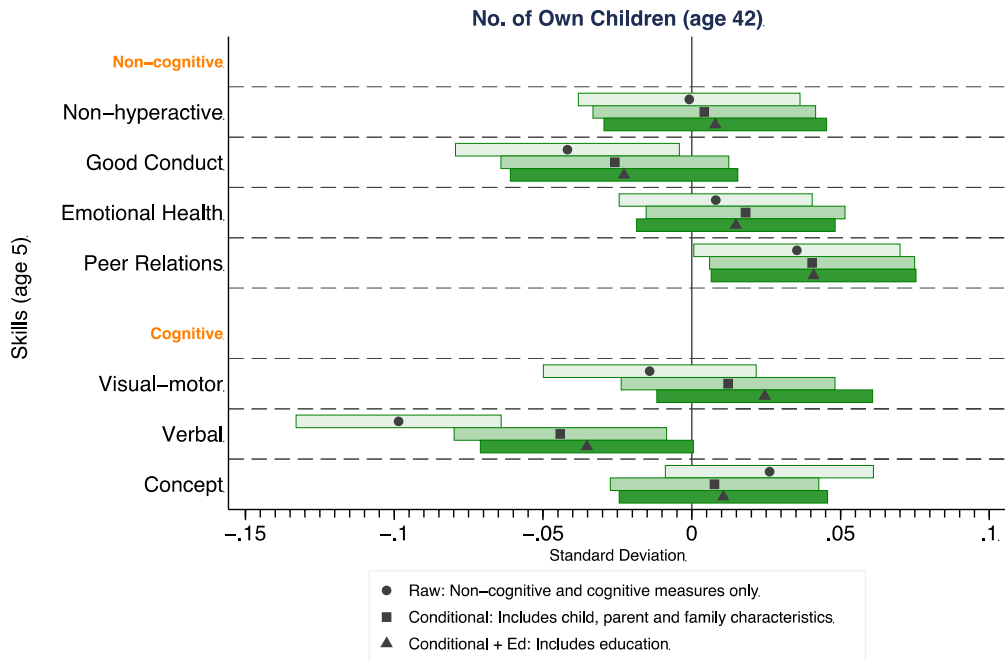


**Figure A6.14**



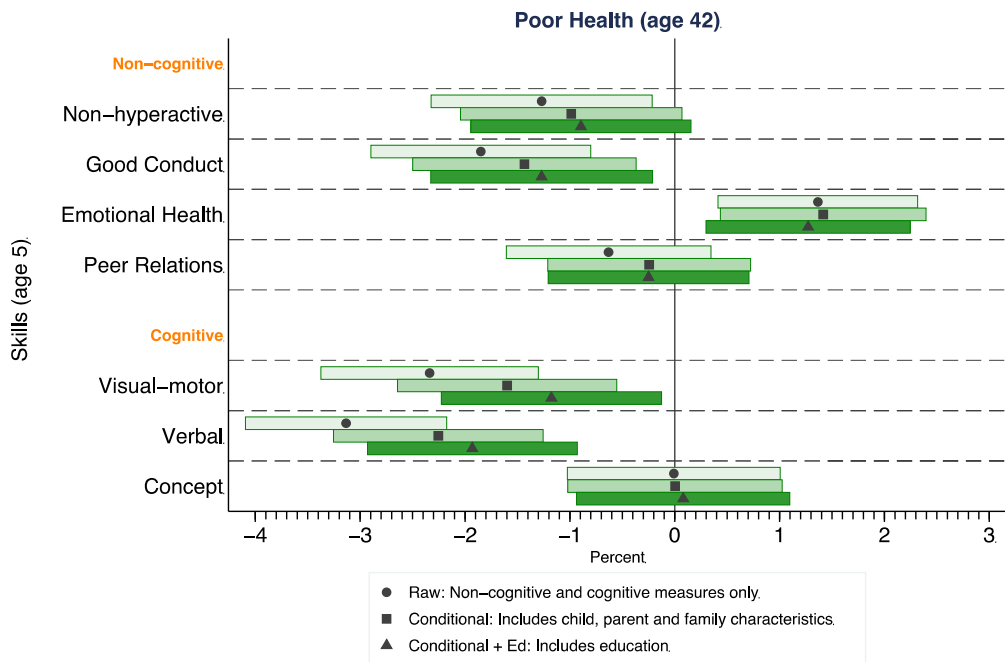


**Figure A6.15**



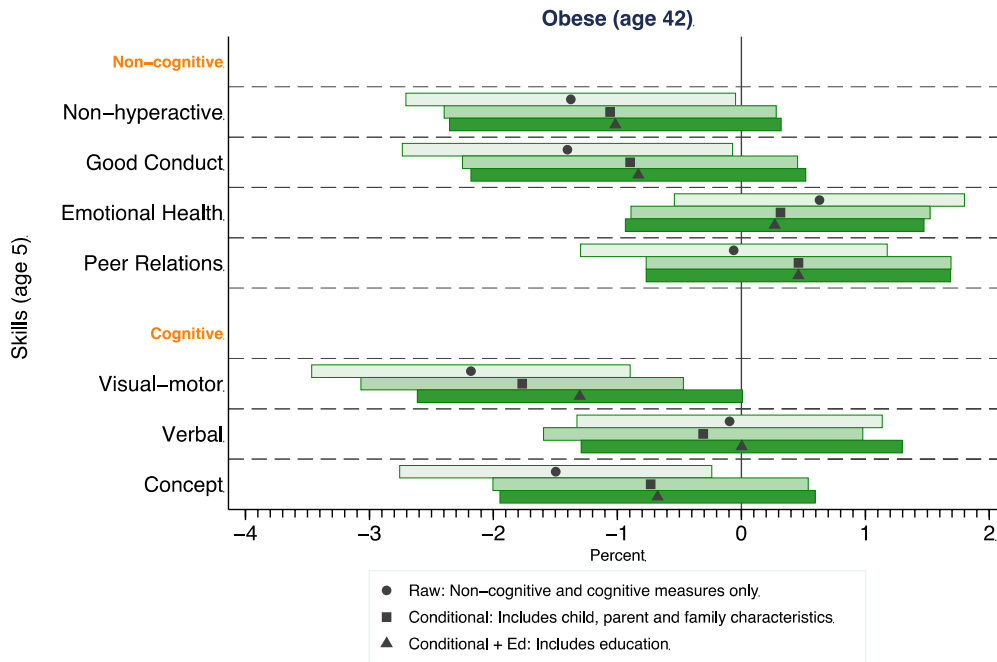
Notes:  
 1. Symbols represent coefficient estimates.  
 2. Shaded boxes represent 95% confidence intervals.

**Figure A6.16**

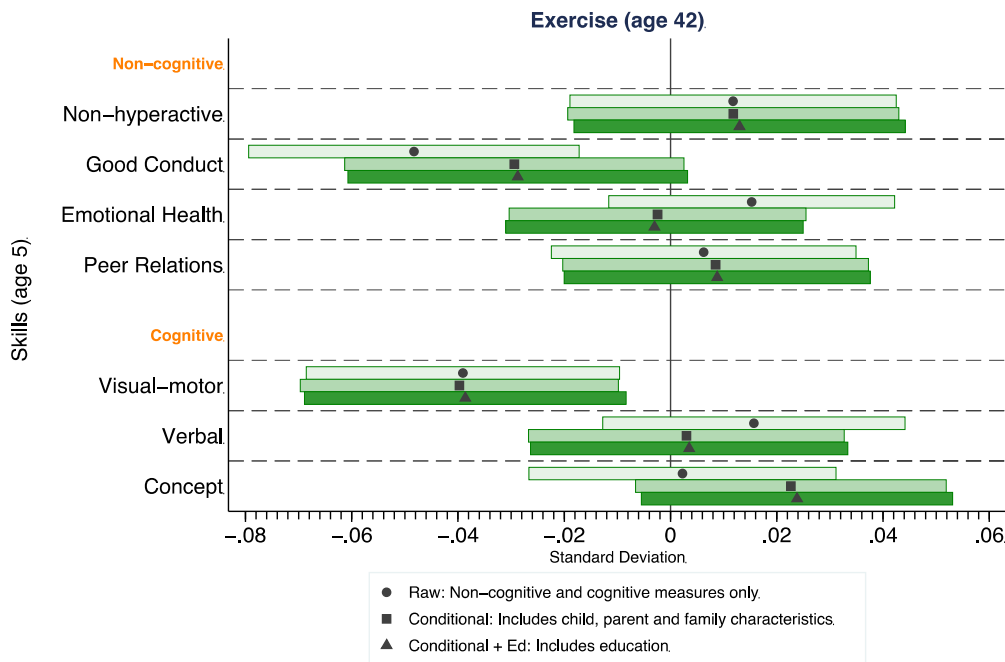


Notes:  
 1. Symbols represent coefficient estimates.  
 2. Shaded boxes represent 95% confidence intervals.

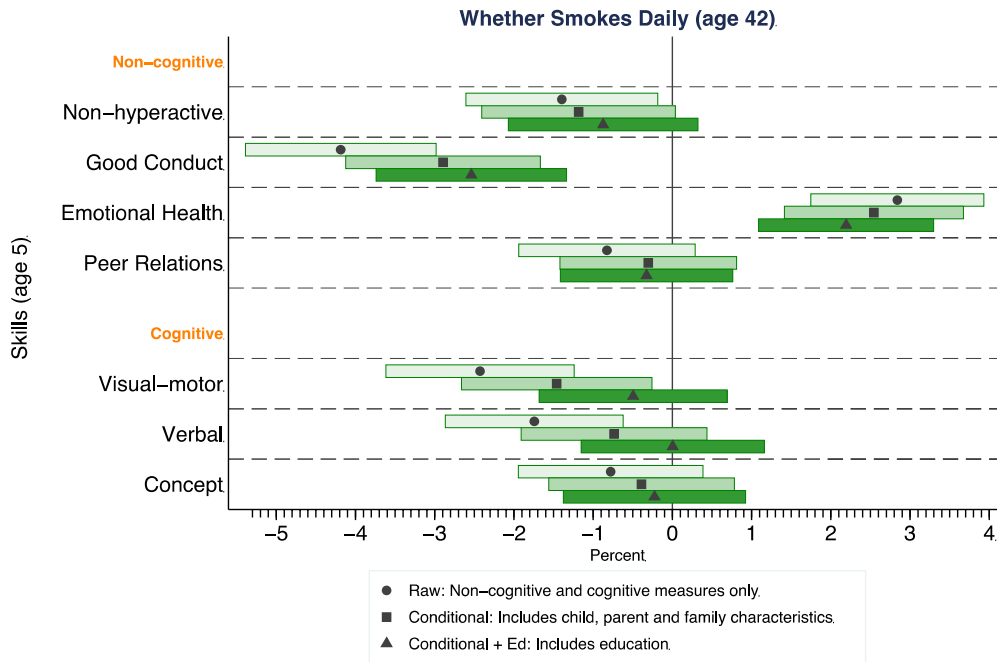
**Figure A6.17**



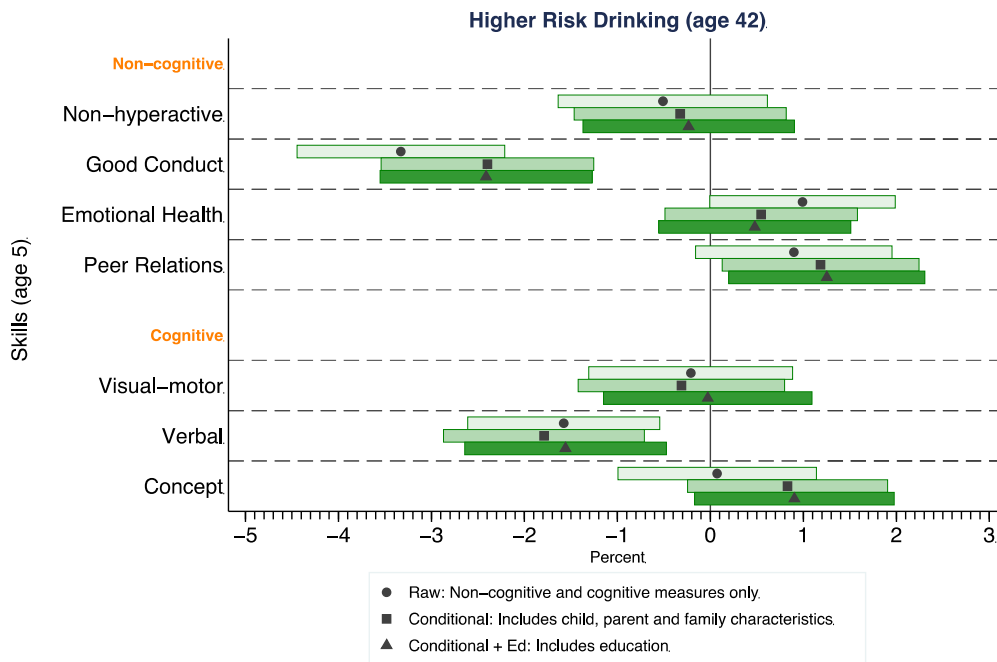
**Figure A6.18**



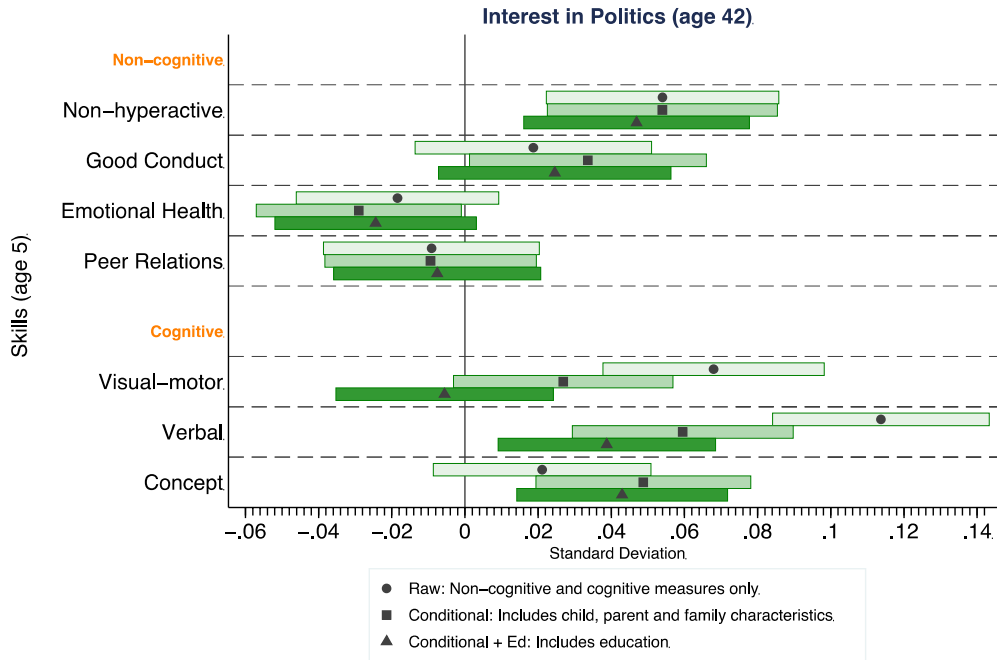
**Figure A6.19**



**Figure A6.20**



**Figure A6.21**



Notes:  
 1. Symbols represent coefficient estimates.  
 2. Shaded boxes represent 95% confidence intervals.